UNIVERSITEIT VAN PRETORIA
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# CONCEPTUALISING A TEACHER GUIDANCE INTERVENTION IN SUPPORT OF LEARNERS WITH COLOUR VISION DEFICIENCY

by

**HELOÏSE GEVERS**

Submitted in fulfilment in accordance with the requirements for the degree

**PHILOSOPHIAE DOCTOR**
(Educational Psychology)

in the

Faculty of Education
Department of Educational Psychology
University of Pretoria

Supervisor
**Prof. Ronél Ferreira**

AUGUST 2024

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*I dedicate this work to my loving husband, Derrick and my beautiful daughter, Avah.*

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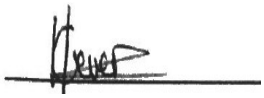
# DECLARATION OF ORIGINALITY

I, Heloïse Gevers (student number 10611658) hereby declare that all of the resources consulted are included in the reference list and that the present study titled **CONCEPTUALISING A TEACHER GUIDANCE INTERVENTION IN SUPPORT OF LEARNERS WITH COLOUR VISION DEFICIENCY** is my original work. This thesis submitted to meet the requirements for the degree Philosophiae Doctor (Educational Psychology) was not previously submitted by me for any other degree at another university.



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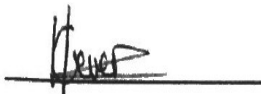
The author, whose name appears on the title page of this thesis, has obtained for the research described in this work, the applicable research approval. The author declares that she has observed the ethical requirements in terms of the University of Pretoria's *Code of ethics for researchers and the Policy guidelines for responsible research.*



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| **INVESTIGATOR** | Mrs Heloïse Gevers |
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| **APPROVAL TO COMMENCE STUDY** | 26 February 2021 |
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# ACKNOWLEDGEMENTS

First and foremost, I would like to thank my Heavenly Father for the grace, mercy, strength and wisdom throughout this journey.

I would like to express my sincerest gratitude and appreciation to the following significant individuals who formed part of the process of completing my thesis:

- My supervisor, Prof. Ronél Ferreira, for challenging me to grow, and sharing your wisdom and your attention to detail. You have instilled in me research skills that will be useful throughout my life. Thank you for your support, patience and commitment to my success on this journey.
- The Department of Statistics at the University of Pretoria, with specific reference to Dr Tanita Botha and Ms Gopika Ramkilawon for assisting me with the analysis of my data.
- My husband, Derrick: Thank you for being there and believing in me. You have stood by my side through this challenging journey and I could not have done this without your love and support. Thank you for bearing with me and being patient with me.
- My mother, for showing me how to keep on going when things were hard, for teaching me endurance, and supporting and believing in me.
- All the participating schools and teachers, for your time and sharing your personal views and experiences.
- Prof. Tinus Kühn for the language editing.
- Ms Mardeleen Müller for the technical editing.



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# ABSTRACT

There is a scarcity of research in South Africa on how to support learners with colour vision deficiency (CVD). Inspired by inclusive approaches to education, the purpose of my study was to explore and describe teachers' current disposition to CVD and the extent to which CVD is taken into consideration during teaching and classroom instruction, with the aim of conceptualising a teacher guidance intervention in support of learners with CVD. My study forms part of a broader research project undertaken by the Centre for Visual Impairment Studies, University of Pretoria.

In compiling a conceptual framework, I integrated aspects of Vygotsky's theory of dysontogenesis (Vygotsky et al., 1993) and the socio-constructivist theory of Vygotsky (1987). Methodologically, I implemented an explanatory sequential mixed methods design, with pragmatism as epistemology. Data was collected/generated in two phases. During the quantitative phase, I relied on a combination of convenient and purposive sampling to select 92 teachers from public schools in the Ekurhuleni district, Gauteng, who completed a structured questionnaire. During the qualitative phase, data was generated through seven semi-structured interviews involving nine participants who were conveniently selected. For data documentation, I relied on field notes and a research journal. I utilised descriptive and inferential statistics to analyse the quantitative data and completed inductive thematic analysis of the qualitative data. Following my analysis of the data, I integrated the results of the two phases.

The findings of my study indicate that colour is widely used within the school context, not only during teaching and classroom instruction and in educational media but also during extra-curricular activities, such as sport and cultural activities. The findings furthermore highlight that the use of colour may negatively affect learners with CVD, not only impacting their scholastic performance but also their participation in extra-curricular activities. In addition, CVD-related challenges can negatively affect the psycho-social functioning of learners with the condition. My study presents some guidelines for teachers working with learners with CVD in support of their optimal functioning. Based on the findings I obtained, I conceptualised a teacher guidance intervention in support of learners with CVD that can be developed and implemented in a follow-up study.



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# KEY CONCEPTS

- Barriers to learning
- Classroom instruction
- Colour use in schools
- Colour Vision Deficiency (CVD)
- Inclusive education
- Learner with colour vision deficiency
- Special needs
- Teacher guidance intervention
- Teaching and learning
- Teaching resources



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# CHAPTER 1 - GENERAL ORIENTATION AND INTRODUCTION

## 1.1 INTRODUCTION AND RATIONALE FOR UNDERTAKING THE STUDY

This study aimed to explore and describe teachers' perceptions and understanding of colour vision deficiency (CVD) and the extent to which the condition is taken into account during lesson planning, teaching and classroom instruction. The ultimate purpose was to conceptualise a teacher guidance intervention that may be developed and implemented as part of a follow-up study. The current study forms part of a broader research initiative undertaken by the Centre for Visual Impairment Studies (CVIS) at the University of Pretoria, focusing on holistic support provision to children with CVD.

My motivation for focusing on this field of research is based on a personal interest as well as the apparent need for ongoing research in the field of CVD. In terms of my personal interest, my mother grew up in a home where both her parents were deaf, yet were able to work, raise a family and contribute to the broader society. This led me to appreciate and value inclusion in all spheres of life. Building on this, as a former teacher and current educational psychologist, my interest in inclusive education has continually been confirmed and strengthened. My specific interest in the field of CVD relates to one of my close friends being colour vision deficient, with him often asking me for advice in terms of colour – for example, whether or not his clothes match. This friend has raised my awareness of the specific challenges that people with CVD may face, the possible impact of CVD on individuals as well as society's general reaction (if any) based on people's understanding, or rather limited understanding of the condition.

In addition to my personal interest in the topic, limited research has been conducted in the field of CVD, specifically in South Africa. This field of interest therefore requires ongoing research, as highlighted by Chan et al. (2014), Mashige and Van Staden (2019) as well as Kvitle (2018). Ongoing research can, amongst other topics, focus on addressing the impact of CVD on individuals' daily lives, including ways to address the challenges often faced within the school and workplace environment (Klooster, 2016). Chan et al. (2014) and Kvitle (2018) underscores the importance of research on advancements in diagnosis, intervention and assistive technologies in support of people with CVD.

Research related to CVD and the challenges associated with the condition along with possible ways to address such challenges is not only relevant to those affected by CVD but



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also holds significance for education and healthcare settings (Collins, 2015; Lausegger et al., 2017; Prieto et al., 2021). To be more specific, research related to the challenges associated with CVD and interventions that may address these challenges can lead to improved accessibility and educational media that are mindful of CVD as well as more inclusive schools and work environments (Geddes et al., 2022; Hui, 2021; Lin et al., 2019). Additionally, Johnson and Davis (2020) highlight the need for research on the psycho-social and societal implications of CVD in support of those living with this visual condition as well as others who interact with them. Therefore, ongoing research in this field seems important to address the multifaceted challenges associated with CVD and may pave the way for more inclusive and accommodating environments.

CVD compromises a person's ability to effectively perform visualisation and colour-related tasks (Machado et al., 2009). It follows that people with CVD experience problems with colour perception in their daily lives and when executing tasks where colour is important (Machado et al., 2009). Various types of CVD are distinguished that may vary in severity and can influence daily living in different ways, ranging from minor challenges to experiencing high levels of frustration on a daily basis (Bailey, 2013). The different types of CVD and their potential impact are discussed in more detail in Chapter 2.

Whichever the type, CVD can affect people across their lifespan in various ways. In early childhood, colour is often used as an important learning instrument due to children (learners[1]) generally learning through visual stimulation involving imagery and colours (Bailey, 2013). As learners with CVD are often challenged in the learning and school environment, they can be regarded as being at an educational disadvantage (Chan et al., 2014; Cumberland et al., 2004). Within the school setting, learners with CVD may, for example, experience challenges to describe objects around them accurately, follow instructions that include colour, read coloured printed material or interpret coloured pictures (Collins, 2015; Lin et al., 2019). This may lead to them experiencing difficulty to complete tasks in workbooks that involve colour, or read text in books and on a writing board that is written in colour (Chan et al., 2014; Lin et al., 2019). In this regard, a study by Torrents et al. (2011) highlights the fact that educational media are seldom developed in a way that considers or accommodates learners with CVD. In addition to these basic challenges, the increased use of colour due to recent technological advances (CUDO, 2006) may pose further challenges to learners with CVD. Such learners may also experience negative

[1] Throughout this thesis, *learner* is used when referring to a child in the school context and *child* is used when referring to a child outside the school context, such as the home or family context.



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psychological effects due to feeling, for example, embarrassed, ashamed or anxious due to the challenges they face as a result of CVD and them not being able to perform as well as their peers (Klooster, 2016; Hui, 2021).

Hence, in addition to school-related challenges, CVD implies possible psychological effects (Bailey, 2013; Barry et al., 2017; Nagy et al., 2014). Feelings of embarrassment, anxiety and fear may, in turn, lead to withdrawal or even school refusal when a learner is not able to perform well or when feeling inferior in comparison with their peers (Bailey, 2013; Klooster, 2016). Ongoing research in the field of CVD may not only result in a better understanding of the challenges associated with the condition; it can also foreground possible support that can be provided to learners with CVD, not only within the school context but also beyond. In this way, the current study may add to the existing body of knowledge on possible ways of addressing educational challenges related to CVD.

The fact that colour is widely used in school resources during teaching and also for after school activities, for example in textbooks, posters, blocks and other concrete manipulatives (Klooster, 2016) highlights the importance of supporting learners who are challenged by CVD. In terms of the move towards inclusive education policy implementation, an increased focus has been placed on identifying and addressing extrinsic barriers to learning – barriers in the learners' environment – to be able to support all learners to perform to the best of their ability. Despite the fact that a limited number of recommendations for possible adjustments to the educational environment and teaching practice to support learners with CVD have been put forward in existing literature (Collins, 2015; Frane, 2015; Berisso, 2018; Bigman, 2015; Prieto et al., 2021), ongoing research in this field is necessary. As background, Collins (2015) argues that to make such proposed adjustments, a thorough understanding is required of how colour is used in the environment and within the school context, of the possible challenges that learners with CVD may experience and how these can be identified, as well as of the ways in which learners can be supported in this regard.

The challenges related to CVD are, however, not limited to the school context. To be more specific, people with CVD may find it difficult to play games where colour is used, for example in differentiating between teams (Chan et al., 2014). CVD can also result in people experiencing difficulty when having to choose and match clothes to buy and wear. Additional challenges include the possibility of people with CVD losing their way more often than those with normal vision (Chan et al., 2014) and being fussy eaters due to the unappetising appearance of food as perceived by them (Bailey, 2013). Despite these challenges being



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known, a paucity of literature remains prevalent concerning specific ways of addressing the challenges that these people may experience, not only in the school context but also in terms of their holistic functioning (Chan et al., 2014).

Although the focus of the current study falls on learners with CVD, the challenges related to CVD extend into adulthood. In terms of daily living, challenges may, for example, be experienced when reading charts, cooking food (Tagarelli et al., 2004), perceiving the colour of LED lights on electronic devices (Gómez-Robledo et al., 2018), driving, drinking coloured medication or experiencing work-related restrictions and limitations (Barry et al., 2017). Furthermore, people with CVD have limited career choices, with certain careers requiring the ability to differentiate between colours (Barry et al., 2017; Tanuwidjaja et al., 2014). Despite the prevalence of CVD being fairly high, namely 8% for males and 1% for females (Simunovic, 2010), Lin et al. (2019, p. 1) argue that, "compared to the human population, people with colour vision deficiency are still a minority, and they are sometimes ignored and restricted by our society". The resulting lack of sufficient awareness amongst the general population of CVD and what the condition implies (Chan et al., 2014) furthermore emphasises the need for research into the various challenges associated with CVD and possible support that can be provided.

## 1.2 PURPOSE OF THE STUDY

Against the background discussed in the previous section, the purpose of the current study was to explore, describe and explain teachers' current understanding of CVD and the extent to which the condition is taken into account during lesson planning, teaching and classroom instruction, with the aim of conceptualising a teacher guidance intervention that may result in more effective support provision to learners with CVD. In pursuing this purpose, I explored teachers' understanding of CVD and also how colour is generally used within the school context by teachers during teaching and classroom instruction as well as how it is used within school books and educational media. In addition, I explored how learners with CVD are accommodated (or not) within classrooms in South Africa, aiming to gain insight into the potential barriers to learning that such learners may experience within the school context. By identifying possible barriers to learning with the purpose of identifying potential alternative ways of teaching and classroom instruction, and resources for learners with CVD, possible content for a teacher guidance intervention could be formulated that may be implemented in future support of the accommodation of learners with CVD in schools.



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As such, my aim was firstly to understand how colour is currently used in the classroom during lesson planning, teaching and classroom instruction; and secondly, to conceptualise a teacher guidance intervention in support of learners with CVD. In undertaking the study, I aimed to contribute to existing literature on CVD and support for people with CVD, specifically for learners within the school context. I envision that an understanding of the current use of colour in the classroom and how teachers experience the teaching of learners with CVD may provide insight into ways of supporting learners with CVD in school. The conceptualisation of a teacher guidance intervention may furthermore inform future research, contribute to the existing body of research on CVD and potentially guide teachers on how to support learners with CVD in the school context.

In terms of the specific objectives of my study, I strove to explore, describe and explain the following:

- Teachers' understanding of CVD and what the condition implies for learners.
- The use of colour in the school context, resources and teaching practice.
- Possible ways in which teachers can accommodate and support learners with CVD in the school context.
- Teachers' need for guidance on possible supportive strategies for learners with CVD.

## 1.3 RESEARCH QUESTIONS

The following primary research question guided me in undertaking this study: *How can insight into teachers' understanding of CVD in the classroom inform a teacher guidance intervention in support of learners with CVD?*

To address the primary research question, I formulated the following secondary research questions:

- What is teachers' understanding of CVD and what this condition implies for learners?
- How is colour used in the school context, in teaching resources as well as in teaching practice?
- How can teachers accommodate and support learners with CVD in the school context?
- What are the needs of teachers for guidance on possible supportive strategies for learners with CVD?



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## 1.4 HYPOTHESES

Creswell and Poth (2017) recommend three steps when formulating hypotheses for a study implementing an explanatory sequential design. I accordingly firstly formulated a quantitative hypothesis based on my primary research question. To this end, I predicted a possible relation between teachers' experiences of teaching learners with CVD (independent variable) and their support provision to such learners (dependant variable), as reflected in the following statement:

*Teachers' experiences of teaching learners with CVD will have a positive effect on the support provided to learners with CVD in the classroom.*

Next, I considered the qualitative phase of my study by looking at the possible way in which the qualitative results could inform my understanding of the quantitative results (Creswell & Poth, 2017). As a result, I formulated the following hypotheses:

- $H_0$: There is no significant relationship between teachers' experiences of teaching learners with CVD and the support they offer to such learners.
- $H_1$: There is a positive significant relationship between teachers' experiences of teaching learners with CVD and the support they offer to such learners.

The null hypothesis ($H_0$) suggests no significant relationship, while the alternative hypothesis ($H_1$) indicates a significant positive relationship.

## 1.5 WORKING ASSUMPTIONS

In undertaking my research, I upheld the following working assumptions:

- Colour is often used in the school context, with teachers using colour during teaching and classroom instruction on a regular basis.
- Teachers are not adequately aware or informed of CVD and how this condition may impact learners' functioning.
- Teachers may, as a result, not sufficiently attend to the specific needs of learners with CVD.
- Insight into teachers' understanding of CVD and the extent to which the condition is considered during lesson planning, teaching and classroom instruction will provide sufficient background to conceptualise a teacher guidance intervention in support of learners with CVD.



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- A teacher guidance intervention may equip teachers to better support learners with CVD within the school context.

## 1.6 CONCEPT CLARIFICATION

In this section, I clarify the key concepts that underpin the current study.

### 1.6.1 Colour vision deficiency

Colour vision deficiency (CVD), often referred to as colour blindness by the general public and also known as Daltonism (Maule & Featonby, 2016), refers to the inability, or decreased ability, to distinguish between certain colours (Collins, 2015; Woldeamanuel & Geta, 2018). CVD does not mean that a person is not able to see colour at all or can only see black and white (Bailey, 2013), but rather that a person has a narrower colour spectrum than others that affects the person's perception of colour.

CVD can be congenital (inherited) or acquired (Berisso, 2018), with acquired CVD being less common than the congenital form (Fentahun, 2014; Mitiku et al., 2020). Acquired CVD mostly occurs as a secondary condition to, for example, ocular or general pathology (Chan et al., 2014) whereas congenital CVD entails an untreatable disorder caused by genetic mutations (Simunovic, 2010). Congenital CVD is one of the most common vision disorders amongst human beings and affects approximately 8% of males and 0,5% of females (Simunovic, 2010; Berisso, 2018).

Different types of CVD can be distinguished, with these varying in severity. This results in some people with CVD experiencing minor challenges with tasks that require colour discrimination, while others may face pronounced challenges in daily living (Birch, 2001). The different types of CVD are categorised according to the ways and extent in which the cones responsible for colour perception are affected (Berisso, 2018). The three primary categories of CVD that are distinguished in terms of severity are trichromacy, dichromacy and monochromacy (Simunovic, 2010). The types of CVD are further differentiated in terms of the type of cone affected, according to the categories of protanopia (red-green deficiency), deuteranopia (red-green deficiency), and tritanopia (blue-yellow deficiency) (Birch, 2012).

CVD thus implies a condition that causes difficulty to see colour, distinguish between shades of similar colours, or see the brightness of colours (Randolph, 2013). The condition will have an effect on the lifestyle and general functioning of the person with CVD. Depending on the severity and type of CVD, the effect of the condition on the individual may range from slight



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daily frustrations to being exposed to dangerous situations in extreme examples (Bailey, 2013). In the current study, CVD refers to any type of CVD, regardless of the cause or severity of the condition.

### 1.6.2 Accommodation of learners with CVD

Inclusive education policy propagates the accommodation of all learners in school, irrespective of any intellectual, linguistic, physical, social and emotional differences and challenges that they may experience (Landsberg et al., 2016). As such, inclusive education aims to meet the diverse needs of all learners in the educational setting by providing them with appropriate and individualised support where required (Watson, 2011). According to Du Plessis (2013), this implies that learners will be supported in terms of their holistic development by addressing their diverse needs through the adaptation of the learning environment within any school setting.

Learners with CVD often experience challenges within the school context due to the regular use of colour during teaching and classroom instruction. As learners with CVD are not able to see or differentiate between all colours correctly, they may experience challenges to access work and follow instructions when colour is used (Collins, 2015; Lin et al., 2019; Klooster, 2016). From an inclusive educational perspective, such experienced challenges and the needs of learners with CVD should be acknowledged and met through appropriate support and accommodation in class (Landsberg et al., 2016; Forlin, 2010b), despite this often not being the case.

As part of the current study, I conceptualise a teacher guidance intervention in Chapter 6, with the aim of supporting possible better inclusion of learners with CVD in the school context. Within the context of my study, inclusion and inclusive education is taken as the provision of support and accommodation practices by teachers in the everyday classroom (Forlin, 2010a) to address the specific needs of learners with CVD, based on the challenges they experience with colour perception and tasks where colour differentiation is important.

### 1.6.3 Teacher guidance intervention

Intervention refers to the act of intervening. As such, when executing an intervention, one is required to interfere in, prevent or modify events (Ebersöhn, 2015). Within the context of the current study, I set out to conceptualise a teacher guidance intervention that may guide teachers on how to support learners with CVD within the school context.



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The aim of the teacher guidance intervention I conceptualise (consult Chapter 6), as in the case of all teacher professional development initiatives, is to assist teachers in future to gain knowledge and skills on a specific topic (González & Skultety, 2018). In this regard, several studies indicate that teacher training and learning can play an important role in improving the academic results of learners and the quality of education provided by teachers (OCDE, 2019; Comisión Europa, 2012). This trend is based on teacher training activities positively influencing the quality of teaching offered to learners (Guerrero-Romera & Perez-Ortiz, 2022). In the case of the current study, the goal of my conceptualisation of a teacher guidance intervention was to promote teachers' understanding of CVD and to gain the necessary skills to support learners with CVD in the general classroom.

## 1.7 CONCEPTUAL FRAMEWORK OF THE STUDY

I compiled a conceptual framework by integrating concepts from Vygotsky's theory of dysontogenesis (Vygotsky, 1983) and the socio-constructivist theory of Vygotsky (1987)[2]. Vygotsky's theories emphasise elements that may play a role in learning, in the case of learners with different abilities (Tashakkori, 2005). Vygotsky's theory of dysontogenesis specifically stresses the uniqueness of child development and acknowledges a broad spectrum of children's abilities and/or disabilities. Vygotsky's theory of dysontogenesis furthermore forms the theoretical and methodological basis of the theory on contemporary inclusive education (Rodina, 2007). In this section, I briefly introduce the theories I relied on in compiling a conceptual framework. More detailed discussions follow in Chapter 2.

### 1.7.1 Vygotsky's theory of dysontogenesis

According to Vygotsky, insight into the primary challenge of a disability does not focus on the physical impairment itself, but rather on its social implications and how it may influence social interaction. By incorporating Vygotsky's theory of dysontogenesis into the conceptual framework of my study I was thus able to view CVD according to the following guidelines:

> *Any physical handicap ... not only alters the child's relationship with the world, but above all affects his interaction with people. Any organic defect is revealed as a social abnormality in behaviour. It goes without saying that blindness and deafness per se are biological factors; however, teachers must deal not so much with these biological factors by themselves, but rather with their social consequences* (Vygotsky et al., 1993, p. 102).

[2] I acknowledge the fact that I relied on several dated sources in this section. I consulted authors who initially conceptualised the theories underlying my conceptual framework.



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Although CVD is not considered to be a disability, this condition may still have a negative effect on the learning of learners with CVD, resulting in them being differently abled than their peers. Vygotsky differentiates between the concepts *primary disability* and *secondary disability*, with a primary disability referring to a physical impairment (or for the purpose of this study, the primary challenge associated with colour differentiation) and secondary disability to distortions caused by social factors (for the purpose of this study, the use of colour by teachers in the classroom). A physical impairment can prevent a child from acquiring the social and/or cultural means and knowledge as can be expected, in a socially acceptable manner.

In the case of a learner with CVD, the condition can thus be regarded as the primary disability; however, due to social interactions such as teaching and classroom instruction in schools and the way in which school-based activities typically rely on colour, CVD may also present as a secondary disability. It follows that underachievement and possible adverse psychological effects, such as a poor self-esteem, may form a secondary disability caused by the primary disability of CVD. In this regard, Vygotsky et al. (1993) proposes that one should focus on the strengths of a child with a disability, of which I regard CVD to be an example, namely aspects such as a child's independence and the support required rather than focusing on the disability or the challenge that is experienced as a result of a condition such as CVD.

As a condition such as CVD may hamper learners' ability to acquire certain skills, some accommodations may be required in the same way that other learners with disabilities may require alternative ways of teaching to be accommodated in terms of their unique needs. Accordingly, teachers can be expected to teach the same content in an alternative way that will allow learners with a disability to perform according to their potential. Consequently, within the context of the current study, it may be assumed that teachers have to reconsider the way in which they use colour during teaching practice and in educational media to support learners with CVD in the classroom.

By integrating the underlying principles of the socio-constructivist theory of Vygotsky and his theory of dysontogenesis, the conceptual framework I compiled enabled me to understand how social interactions in schools and more specifically the use of colour within the school context has the potential to hamper the learning outcome and performance of learners with CVD; however, alternative ways of teaching and the practice of using colour within the school context may reduce the educational challenges and negative psychological impact,



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the so-called secondary disabilities that these learners may experience. In undertaking my research, I was thus guided by the principles of these two theories, allowing me to look beyond the condition of CVD at social factors such as teaching and classroom instruction, the use of better suitable resources in the classroom that may affect learning and performance, and alternative ways of teaching that may support learners with CVD to perform optimally.

### 1.7.2 Socio-constructivist theory of Vygotsky

From a socio-constructivist perspective, children are viewed as active participants in their own learning who construct knowledge and understanding. This is typically achieved with the support of adults who enable children to take charge of their own thinking through interaction and collaboration (Excell et al., 2015; Vygotsky, 1978). As children are supported by adults in accomplishing culturally meaningful activities, such communication becomes part of the child's thinking processes (Mensah & Badu-Shayar, 2016). Accordingly, through the internalisation of discourses, children can start using internal language to guide their thoughts and actions and to this end, gain new skills (Berk 2013; Vygotsky, 1987).

Vygotsky (1978) stresses the importance of developing appropriate instructions to assist learners in their learning efforts. He defines the zone of proximal development (ZPD) as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance" (Vygotsky, 1978, p. 86). Such assistance that is typically provided by adults or more capable peers is known as *scaffolding*. During learning, scaffolding is thus provided to learners until a concept or skill is mastered and learners are able to complete the task by themselves. However, any teacher needs to be aware of a learner's ZPD when wanting to provide instruction that is developmentally appropriate.

Within the context of the current study, this implies that adults (in this case teacher-participants) may fulfil an important role in the learning of learners with CVD. The theory further stresses how teachers can facilitate learning through interaction and collaboration with learners with CVD, thereby foregrounding the important role of teachers' communication with learners. In the current study, the focus falls on the teaching practices of teachers that may assist learners with CVD in their learning efforts when considering the use of colour during teaching and instruction. In the same way, however, the lack of consideration of this factor may have a negative effect on the performance of learners with CVD.



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## 1.8 PARADIGMATIC PERSPECTIVES

In this section, I introduce the paradigms that guided me in undertaking my study. More detailed discussions follow in Chapter 3.

### 1.8.1 Epistemological paradigm

Due to the nature and focus of my study, I relied on pragmatism as epistemological paradigm. From a pragmatic perspective, a researcher will collect data based on "what works" to find solutions and answer formulated research questions (Creswell, 2007, p. 24). According to Johnson et al. (2016), pragmatism can in this manner be viewed as a philosophy of freedom that provides researchers with the opportunity to focus on what works.

Significance and a practical orientation have become the foundation of educational research with the aim of generating relevant knowledge that can inform activities, actions and decision making. Research embedded in pragmatism is thus focused on problem-solving *via* research as well as practice (Creswell, 2009). As such, when adopting a pragmatic perspective, the focus falls on the consequences of research. In the current study, I aimed to conceptualise a teacher guidance intervention that has the potential to facilitate better support to learners with CVD. In this way, the information stemming from my research may inform future practice.

As pragmatism is pluralistic and typically concerned with practicality (Creswell, 2007), it involves a process of adapting logical thinking to the practical constraints of real-life situations (Creswell, 2009). Based on the focus on practical theory, pragmatism merits the use of both quantitative and qualitative methods when undertaking a study (Johnson et al., 2016). In this regard, Creswell (2009) argues that a pragmatic paradigm will therefore allow researchers with the necessary freedom of choice to utilise methods that can address the purpose of a study. By employing a pragmatic lens in the current study, the focus therefore shifted from antecedent conditions to situations, actions and consequences (Creswell, 2009), providing me with the opportunity to use different methodological strategies to be able to answer the formulated research questions (Creswell, 2009; Creswell & Plano Clark, 2018).

In summary, pragmatism is regarded as a good fit for mixed methods research for several reasons (Creswell, 2009). Firstly, researchers can choose procedures, techniques and methods to achieve a specific goal when adopting a pragmatic epistemology. Secondly,



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multiple approaches to data collection/generation and analysis align with the pragmatic view, according to which the world is not seen as an absolute unity. Next, the combined use of quantitative and qualitative data may enable the researcher to gain an in-depth understanding of the research phenomenon in question. Finally, the reason for mixing methods aligns with a pragmatic perspective as the focus will fall on the *what* and *how* of a specific research problem.

### 1.8.2 Methodological approach

I followed a mixed methods methodological approach (Creswell & Creswell, 2022). Mixed methods methodology is generally referred to as the third methodological movement (Teddlie & Tashakkori, 2009; Johnson & Onwuegbuzie, 2004), following on and combining quantitative and qualitative approaches (Creswell & Creswell, 2022). A mixed methods approach is often followed when conducting social and human science research, such as the research embedded in the field of education (Creswell & Plano Clark, 2018). In following a mixed methods approach I could thus integrate concepts from and rely on the strengths of both the quantitative and qualitative approaches to explore, describe and explain teachers' understanding of CVD, and the extent to which the condition is considered by teachers during lesson planning, teaching practice or when selecting learning material.

According to Johnson et al. (2007, p. 123), mixed methods research "combines elements of quantitative and qualitative research approaches for the broad purposes of breadth and depth understanding and corroboration". In support of this definition, Teddlie and Tashakkori (2012, p. 776) refer to mixed methods research as "methodological eclecticism" as it entails the integration of quantitative and qualitative methods and data in such a way that the best possible techniques can be used to answer the research question.

By being able to utilise a combination of quantitative and qualitative data collection/generation methods, a mixed methods approach allows researchers to draw on the strengths of both quantitative and qualitative methodology, whilst limiting the weaknesses associated with each individual approach, with the aim of obtaining an integrated comprehensive understanding of the phenomenon that is researched (Scammon et al., 2013; Wisdom et al., 2012; Andrew & Halcomb, 2009). Mixed methods methodology thus implies a multiple level approach. For the purpose of the current study, I followed a systematic and planned approach (Creswell, 2009; Flick, 2011) where I first implemented quantitative data collection methods, followed by qualitative data generation methods. In this way, by *mixing* quantitative and qualitative elements in my study I was able to obtain a fuller



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account of the research problem than what would probably have been the case if I had relied on only a quantitative or qualitative approach (Glogowska et al., 2011; Zhang & Creswell, 2013). As a result, I was able to understand the topic in greater depth than what could have been expected had I merely relied on either one of the approaches (Hoover & Krishnamurti, 2010).

When following a mixed methods approach triangulation is possible, whereby multiple findings about a single phenomenon can be presented when using elements of both the quantitative and qualitative approaches as was done in the current study. To be more specific, in my study, the quantitative data I collected provided general patterns and width while the qualitative data enabled me to gain insight into the experiences and depth of the teacher-participants' perceptions (Newby, 2014). By integrating the data that was collected/generated during the quantitative and qualitative phases of the study I was thus able to triangulate the results I had obtained.

## 1.9 OVERVIEW OF THE RESEARCH PROCESS AND METHODOLOGICAL STRATEGIES

In this section, I introduce the methodological choices I made. More detailed discussions of these aspects follow in Chapter 3.

### 1.9.1 Research design

I implemented an explanatory sequential mixed methods design (Creswell & Creswell, 2022). In accordance with this selected design, a combination of both quantitative and qualitative data enabled me to gain rich information and an in-depth understanding of the phenomenon I set out to explore (Creswell & Creswell, 2022). This understanding of the research problem, in turn, enabled me to subsequently address the research questions that guided the study.

The explanatory sequential mixed methods design provided me with a framework to collect quantitative data in a structured manner whilst providing the opportunity for breadth and in-depth qualitative data generation in support of answering the research questions (Creswell & Creswell, 2022). The use of this design furthermore allows for an increased understanding of the topic under research due to the complementary quantitative and qualitative approaches building on each other in terms of the strengths associated with these approaches to research (Morgan, 2007). By specifically implementing an explanatory sequential mixed methods design (Creswell & Creswell, 2022), I was thus able to rely on



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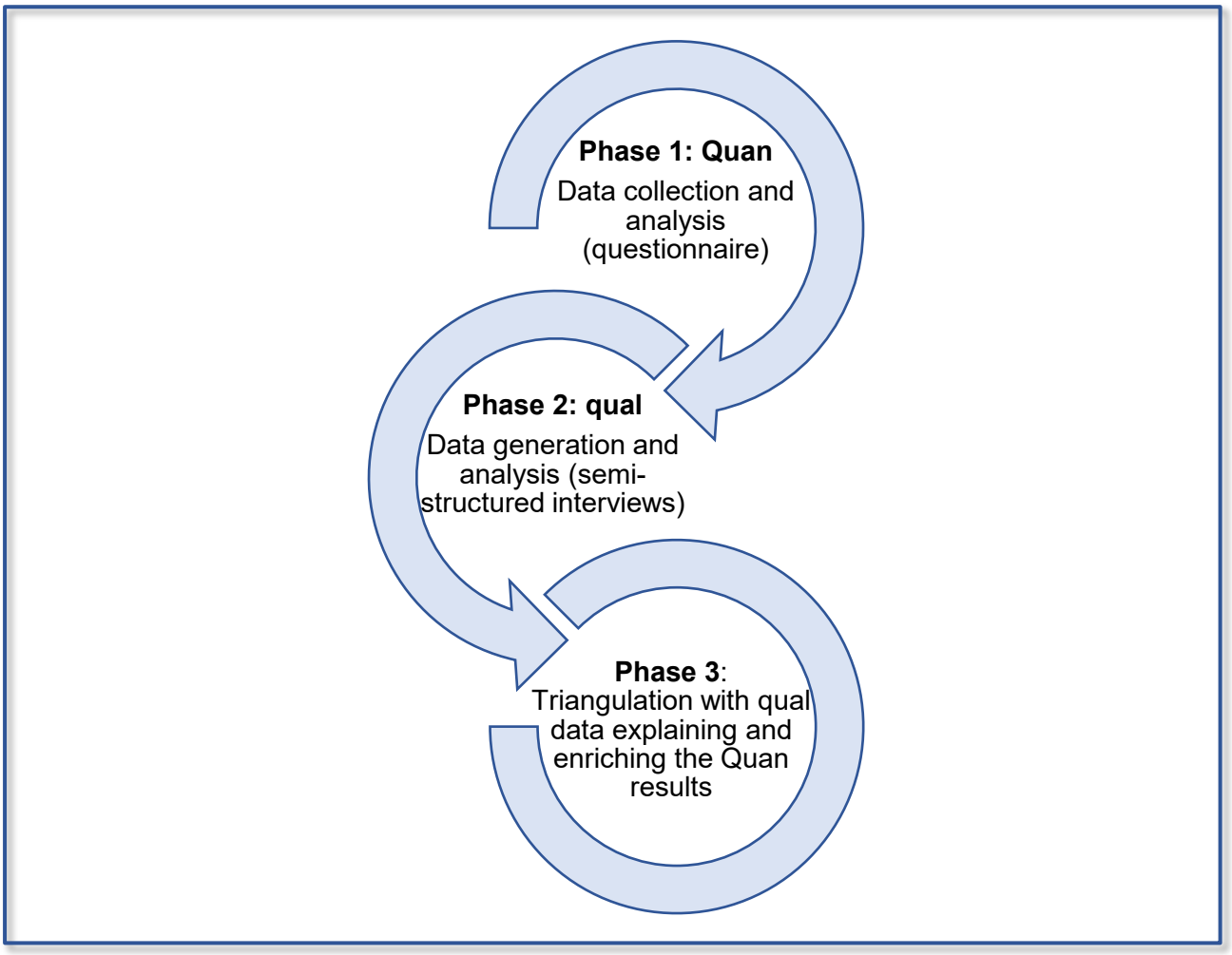
sequential data collection/generation in completing a three-phase project. Figure 1.1 provides an overview of the explanatory sequential Quan-qual[3] mixed methods design I implemented.

**Figure 1.1:**

*Explanatory sequential design*




***Note:*** Adapted from Creswell and Creswell (2022)

The first phase of the study (Quan) involved the completion of a questionnaire by teacher-respondents[4], with the purpose of obtaining baseline data on teachers' knowledge and understanding of CVD, how they use colour in the classroom and how they have been supporting learners with CVD, where applicable. During the second phase of the study (qual), data was generated through semi-structured interviews with selected teacher-participants who had participated in the first phase of the study. The second phase of the

[3] Reference to the *Quan-qual* design indicates the phases and the extent of the data as well as the way in which the qualitative data explained the quantitative results that had been obtained.
[4] When referring to the quantitative part of the study, the term respondent is used. For the qualitative part, the term participant is used.



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study provided me with the opportunity to obtain rich data on teachers' understanding of CVD and their personal experiences in teaching learners with CVD.

During the initial Quan phase of my study, I was thus able to quantify relationships, and associations in a structured manner that allows for a broad understanding of the phenomenon under study. Thereafter, the qual methods I employed during Phase 2 of my study allowed for rich explanations, context, and deeper insight into the Quan results obtained during Phase 1 (Creswell & Creswell, 2022). The qual data that was generated during the second phase involved direct engagement with some of the teacher-participants who participated in the first phase of the study and provided them with the opportunity to share their perspectives and lived experiences in more detail. Sharing their experiences provided the teacher-participants with a voice and ensured that the findings of this study are grounded in the real-world contexts of teachers (Creswell & Plano Clark, 2018; Onwuegbuzie & Johnson, 2006).

### 1.9.2 Sampling and selection procedures

In the current study the target population was teachers in the Ekurhuleni area in Gauteng, South Africa. My reason for this demographic area was one of convenience as I stay in Ekurhuleni and know several teachers who teach at schools in the area. In selecting research sites, I combined convenience and purposive sampling to select teachers at public schools that were easily available and accessible, in line with the description of this method as entailing the selection of respondents or a case that is "easily and conveniently available" (Maree & Pietersen, 2016, p. 197).

Even though I initially employ purposeful sampling by selecting a number of urban and rural schools, COVID-19 related restrictions prevented me from visiting and recruiting a range of schools. Despite contacting over 30 schools telephonically or *via* email, I experienced a very low response rate from schools that were willing to participate in the study at the time, with no rural schools being willing to participate. For this reason, I decided to add convenience sampling and involve schools that were available and where I had access to potential respondents. For the quantitative phase of the study, I sampled 92 respondents from seven schools. The number of schools involved in the study was influenced by the availability of contact information for schools and schools located in the region I had permission to conduct research in.



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For the qualitative phase of my study, I selected participants who had indicated their willingness to participate in a follow-up phase during their participation in the quantitative phase. I therefore relied on convenience sampling to select nine participants to participate in the second phase of the study (Maree & Pietersen, 2016).

### 1.9.3 Quantitative phase of the study

For Phase 1 of my study, I conducted a survey (Maree & Pietersen, 2016). I developed a structured questionnaire to explore the constructs I had identified during my literature review, based on the information obtained from an EXPO project of Gerthyo Ferreira in 2019 that served as a small-scale pilot study for my research. I adapted the questions that were asked to teachers during the EXPO project, being guided by existing literature and the purpose of my study.

I used the Qualtrix online survey platform (Mondal et al., 2018) for implementation of the questionnaire. Although there has been an increase in the use of technology, it should be noted that online surveys often result in a poor response rate (Sinclair et al., 2012). I aimed to address the potential low response rate associated with online surveys by drawing on my personal network of teachers and sampled as many teacher-respondents as possible in the selected region. Despite my efforts, the online response rate remained low, resulting in me also distributing hard copies of the questionnaire to two of the secondary schools and two of the primary schools involved.

According to Creswell (2009), a survey can result in a quantitative or numeric description of trends, attitudes or opinions of a population by studying the sample population. For this reason, I used the data I collected during the first phase of my study by means of a survey to understand the current use of colour in the school context and teachers' understanding of CVD and what it implies. The use of a survey during this phase gave me access to a large number of potential responses within a relatively short period of time (Neuman, 2014), providing me with the opportunity to obtain a fairly representative view of the sample population (Creswell & Poth, 2017).

### 1.9.4 Qualitative phase of the study

Nine teacher-participants participated in semi-structured interviews (Smith et al., 2009) during the second phase of my study. To be specific, I conducted two dyadic and five individual interviews, with two participants from primary schools and seven from secondary schools. All nine participants also completed the questionnaire during Phase 1 of the study.



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I conducted both telephonic and face-to-face semi-structured interviews (Maree & Pietersen, 2016), enabling me to obtain rich and more detailed data on teachers' experiences with regard to teaching learners with CVD and the use of colour in school. The decision to include nine participants was based on data saturation.

During the interviews, I was guided by an interview guide that consisted of pre-formulated open-ended questions (consult Appendix B2). All interviews were recorded and transcribed verbatim for data analysis purposes. Field notes (Creswell & Poth, 2017; Denzin & Lincoln, 2018) supported the data generation by means of interviews (Saldaña, 2016). In addition, I relied on a research journal (Saldaña, 2016) to document my reflections and emerging insights as the research process progressed.

My "general observations, non-verbal information and descriptions of the existing asset and knowledge base, as experienced and observed by me" were thus captured in a research journal and also in the form of field notes (Ferreira, 2006, p. 29). To be more specific, I used a research journal to document my thoughts and feelings, along with my reflections on, amongst other things, the possible effect I may have had on the research process and how the research may have influenced me (Mouton, 2001; Mukherji & Albon, 2010). I recorded the sequence of events during the data generation by means of interviews through the use of field notes (Mouton, 2001). I made use of both reflective and descriptive field notes (Denzin & Lincoln, 2018).

### 1.9.5 Data analysis

A statistician from the University of Pretoria assisted me with an in-depth analysis of the quantitative data, using both descriptive and inferential statistics (Ali & Bhaskar, 2016). Descriptive statistics were used to summarise the trends or tendencies in the data and provide an understanding of the score variations (Creswell, 2009). Accordingly, I relied on measures of central tendency, the spread of the scores and the relative ranking of the scores to describe trends in the data. In addition, inferential statistics were used to study the sample and draw inferences (Creswell, 2009).

For the qualitative part of my study, I conducted inductive thematic analysis (Neuman, 2014). Inductive thematic analysis implies the identification and examination of themes and patterns within the data (Braun & Clarke, 2021b). When following this approach, "categories and patterns emerge from the data rather than being imposed on data before data collection" (McMillan & Schumacher, 2006, p. 462). I followed a bottom-up approach as I categorised



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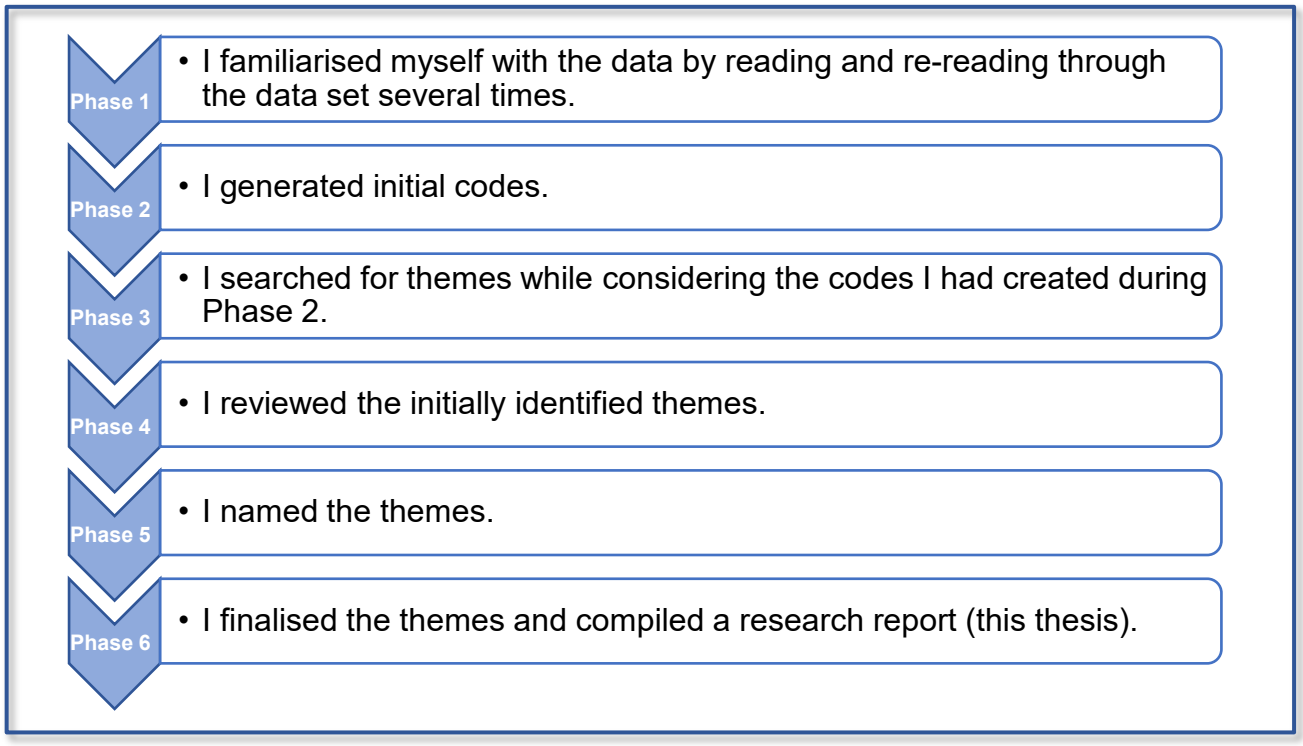
the data without having predetermined themes (Braun & Clarke, 2006). Through reading and re-reading of the data (Rice & Ezzy, 1999), themes that were central to the phenomenon I investigated could be identified (Maree & Pietersen, 2016).

For the thematic inductive analysis, I firstly familiarised myself with the data by reading and re-reading the data set. Data was then clustered into units of meaning by interpreting, coding, and categorising the data into possible themes and subthemes (Cohen et al., 2004). Next, I started looking for patterns of meaning, and then focused on the meaning of the themes and patterns that I had identified (Braun & Clarke, 2021b). The data analysis that I completed was not a linear process but rather entailed a process of continuously moving back and forth in the data (Braun & Clarke, 2021a). The six phases that I followed as suggested by Braun and Clarke (2021b) are summarised in Figure 1.2.

**Figure 1.2:**

*Implementation of the six phases of inductive thematic analysis*




Lastly, I combined the data from the quantitative and qualitative phases of my study by reporting on points of convergence and divergence (Creswell & Plano Clark, 2018). I made use of a table to combine the two data sets and considered how the qualitative data could contribute to a more in-depth understanding of the quantitative data (Creswell & Poth, 2017).



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## 1.10 VALIDITY, RELIABILITY AND TRUSTWORTHINESS OF THE STUDY

Based on the mixed methods approach I followed, I considered validity and reliability together with trustworthiness. Validity in quantitative research indicates that an instrument measures what it is supposed to measure, whereas reliability indicates whether or not the results of a study are credible (Welman et al., 2005; Gravetter et al., 2009) and whether the results of a study can be repeated with consistent scores (Hayes, 2000; Foxcroft & Roodt, 2013). During the quantitative phase of my study, I aimed to ensure the validity of the questionnaire by making sure that it would measure what was intended to be measured (Hayes, 2000).

I made use of different types of validity, namely surface validity, content validity and construct validity. To ensure surface validity, I used a surface examination of the items included in the questionnaire to determine whether the test would measure what it was supposed to measure (Wilson & MacLean, 2011). Next, I aimed to ensure content validity by reviewing the instrument to confirm that it would measure the specific content area that it was developed for (Gay et al., 2011). I furthermore attempted to ensure construct validity by checking that the questionnaire reflected the theoretical constructs for which purpose it was developed (Gay et al., 2011; Hayes, 2000). Finally, I made use of an internal validity metric, to determine the internal consistency of the questionnaire.

Next, in quantitative research, reliability refers to the dependability of an instrument (Foxcroft & Roodt, 2013; Gravetter et al., 2009), which implies that the same results will be obtained when repeating a study using the same instrument. Reliability therefore refers to the consistency of a quantitative instrument (Cohen et al., 2004). In the current study, I aimed to ensure reliability by including accurate descriptions of the data with the assistance of an expert statistician from the University of Pretoria in addition to the guidance of my supervisor.

Guba and Lincoln (1981) argue that *trustworthiness* in qualitative research can be compared with reliability and validity in quantitative studies. In an attempt to ensure rigorous findings, I aimed to meet Lincoln and Guba's (1986) criteria of transferability, credibility, confirmability, authenticity and dependability. Transferability can be compared to external validity and relates to the relevance of a study's findings to other contexts (Babbie & Mouton. 2006; Lincoln & Guba, 1986). In support of transferability of the qualitative findings, I relied on strategies such as providing rich, thick descriptions of the research context and participants and engaging in member checking that involves the seeking of feedback from participants to confirm the accuracy and relevance of the findings, thereby allowing readers to assess



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the applicability of the findings for other studies (Creswell & Poth, 2017). Next, credibility is associated with consistency and drawing accurate conclusions when conducting qualitative research (Patton, 2002). To this end, I documented the analysis process in detail and used rich descriptions while continuously reflecting throughout the course of the study and while writing up this thesis. Through the use of multiple data sources, both quantitative and qualitative, as well as my detailed reporting on the research process, I hoped to promote a greater understanding of the study, thereby enhancing credibility (Patton, 2002).

In qualitative research, confirmability replaces objectivity, indicating whether or not the findings of a study can be confirmed by someone else (Lincoln & Guba, 1986). Hence, in a qualitative study, confirmability refers to whether or not the views, perceptions and experiences of the participants confirm the general findings of the study (Babbie & Mouton, 2006). Seale (2000) claims that an audit trail of the data, decisions and methods used during a study can support confirmability. In support of confirmability, I thus include a detailed audit trail in this thesis (Babbie & Mouton, 2006), thereby allowing the reader to determine the extent to which my interpretations, conclusions and recommendations had been drawn from the raw data.

According to Streubert and Carpenter (1999), authenticity can be achieved through an accurate representation of the participants' reality and experiences. I aimed to achieve authenticity by asking participants to comment on and check the preliminary results of the study by involving them in a member checking session. Finally, dependability is related to reliability in quantitative research (Lincoln & Guba, 1986). According to Merriam (1998), dependability in qualitative research can be claimed when consistency exists between the results that are reported and the raw data that was obtained. This can be enhanced by means of an audit trail that can include the documentation of decisions, methods and the data of a study (Seale, 2000). For this purpose, I report on the data collection/generation and analysis process of my study in detail in this thesis for other researchers to be able to repeat the study in similar research contexts in future (Babbie & Mouton, 2006).

Throughout, I relied on reflexivity in support of trustworthiness, thereby reflecting on my potential influence on the research process in terms of my own background and ideas (Dowling, 2008). I documented my experiences and possible influences on the study to remain cautious of the possible subjective nature of the research (Shaw, 2010). Through reflexivity, I thus acknowledged the potential effect that I, as a researcher, could have had on the data collection/generation, analysis as well as interpretation of the results. To this



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end, I used a research journal to maintain reflexivity and engaged in regular debriefing discussions with my supervisor (Sullivan, 2010).

## 1.11 ETHICAL CONSIDERATIONS

Throughout my study I was guided by the ethical principles of voluntary participation, informed consent, privacy and protection from harm in undertaking research with human participants (Babbie & Mouton, 2006; McMillan & Schumacher, 2014). In addition, I respected the ethical principles of confidentiality, anonymity and trust (Creswell & Poth, 2017; Liamputtong, 2009).

I obtained permission from the University of Pretoria's Research Ethics Committee, the Gauteng Department of Education as well as the principals and related School Governing Bodies of the participating schools prior to commencing with my research. In addition, I obtained informed consent from all the respondents/participants after explaining to them what was expected of them and which possible risks and benefits they could face if they consented to participate. The following information was thus included in the consent form (Babbie & Mouton, 2006; McMillan & Schumacher, 2014):

- A brief description of the nature and purpose of the study.
- A brief explanation of the respondents'/participants' role in terms of the survey and possible participation in individual interviews.
- An explanation that participation was voluntary and that the respondents/participants could withdraw from the study at any time, without giving an explanation or facing any consequences.
- The level of confidentiality and anonymity that would be practised.

I aimed to maintain respectful and trusting relationships with the participants before commencing with qualitative data generation (Babbie & Mouton, 2006; McMillan & Schumacher, 2014), inviting them to ask questions during the interviews whenever needed. By involving teacher-participants (i.e. research with humans) I was further guided by the ethical principles of autonomy, non-maleficence, beneficence and justice (O'Reilly et al., 2013). Throughout, I respected the participating teachers' right to take part willingly and withdraw from the research whenever they wished to do so. In addition, I guarded against coercion of the teachers both explicitly and implicitly into their agreement to participate (O'Reilly et al., 2013).



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In terms of protection of the data, confidentiality and anonymity, my supervisor and I were the only people with access to the identifying information of the participants. I safeguarded all digital recordings, field notes and reflective notes by relying on suitable strategies (Babbie & Mouton, 2006), such as assigning codes to the respondents/participants for the analysis and reporting process, and using passwords for electronic files containing data and identifying information. During the qualitative phase of the study, I requested the participants to check the transcripts for accuracy and identify any data they wished to be deleted, if appropriate.

## 1.12 STRUCTURE OF THE THESIS

This thesis consists of six chapters, each with a specific purpose. A brief overview of the content of each chapter is provided below.

***CHAPTER 1: GENERAL ORIENTATION AND INTRODUCTION***

In Chapter 1, I provide an introduction and general orientation to the study. I discuss the necessary background and explain my rationale for undertaking the study. I formulate research questions and hypotheses, state my assumptions and clarify the key concepts underlying the study. I introduce the conceptual framework that guided me in conducting my research and then provide a brief overview of the research design and methodology I relied on. I also introduce the way in which I strove to ensure validity, reliability and trustworthiness, and refer to the ethical guidelines I considered.

***CHAPTER 2: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK***

In Chapter 2, I discuss existing literature on CVD, the use of colour in the classroom and how CVD affects people across their life span. I specifically focus on the effect of CVD on learners and how teachers can support these learners within the school context. As part of this discussion, I foreground the value of school-based support for learners with CVD and refer to policies that support inclusive education. In the final part of the chapter, I explain the conceptual framework of my study in more detail, highlighting the way in which I integrated the socio-constructivist theory of Vygotsky (1978) and Vygotsky's theory of dysontogenesis (1983).



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***CHAPTER 3: RESEARCH DESIGN AND METHODOLOGICAL STRATEGIES***

Chapter 3 focuses on the research process and methodological choices I made. In my discussion, I elaborate on the selected epistemological paradigm and methodological approach I followed, the selected research design, the sampling procedures and selection of respondents/participants, as well as the data collection/generation, capturing/ documentation and analysis strategies I employed for Phases 1 and 2 of the study. I also explain the measures I took to ensure validity, reliability and trustworthiness, and elaborate on the ethical guidelines I considered.

***CHAPTER 4: RESULTS OF THE STUDY***

In Chapter 4, I present the results I obtained from both phases of my study. In my presentation of the quantitative results, I include diagrams and tables in support of my discussion. For the qualitative results, I discuss the themes and subthemes that I identified, substantiating these with direct quotations and excerpts from the data. Finally, I integrate the results from the two phases of my study.

***CHAPTER 5: FINDINGS OF THE STUDY***

In Chapter 5, I present the findings of the study, relating the results I obtained to the existing literature presented in Chapter 2. I interpret the findings through the lenses of the theories I integrated into the conceptual framework that had been presented in Chapter 2. Throughout my discussion, I indicate correlations, contradictions, silences in the data as well as new insight stemming from the study.

***CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS***

In the final chapter of this thesis, I draw conclusions when addressing the research questions. I contemplate the potential theoretical and practice-related contributions of the study and reflect on the limitations I identified. Finally, I formulate recommendations for training, practice and future research based on the findings and conclusions of the study.

## 1.13 CONCLUSION

In this chapter, I introduced my selected research topic and provided a brief overview of the study. After outlining the rationale and purpose, I formulated research questions that guided this study and stated the formulated hypotheses. I introduced the paradigmatic perspectives I relied on as well as the research design, sampling and selection procedures, and methodological strategies I employed. I also briefly referred to the quality criteria and ethical considerations I aimed to adhere to in undertaking my research.



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In the next chapter, I discuss existing literature that is pertinent to this study and the topic under investigation. I first explain the use of colour in the classroom and the prevalence and types of CVD. Next, I explore common challenges that people with CVD may face across their lifespan, paying specific attention to school-related challenges. I contemplate the value of school-based support for learners with CVD and explore inclusive policies. I conclude Chapter 2 by outlining and explaining my conceptual framework.

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# CHAPTER 2 - LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

## 2.1 INTRODUCTION

In the preceding chapter, I introduced my research, stated the purpose of the study and formulated the research questions that guided me. I introduced the epistemological and methodological paradigms I adopted, as well as the guiding conceptual framework. I provided a broad overview of the research process and referred to the strategies I relied on to ensure ethical research and rigour. Hence, Chapter 1 provided the necessary background to all other chapters.

In this chapter, I discuss existing literature on the use of colour and the potential impact of CVD on children through the different stages of their lives as well as possible ways of addressing such challenges. In my discussion, I describe the general use of colour and how colour may limit or restrict people with CVD. Next, I provide the necessary background for the conceptualisation of an intervention for teachers in support of learners with CVD. In the final part of the chapter, I present and explain the conceptual framework that guided me in undertaking the study, explaining how I integrated concepts of Vygotsky's theory of dysontogenesis (Vygotsky, 1983) with the socio-constructivist theory of Vygotsky (1987)[5].

## 2.2 UNDERSTANDING THE PHENOMENON OF COLOUR VISION DEFICIENCY

CVD is defined as the inability or decreased ability to distinguish between certain colours (Collins, 2015). As such, CVD implies that a person will have a narrower colour spectrum than people with normal colour vision, with this affecting their perception of colour. CVD is the most common known vision disorder (Woldeamanuel & Geta, 2018). CVD does not refer to visual acuity, in other words how clearly a person can see objects, as people with CVD generally have normal eyesight and are able to see small objects clearly (Fentahun, 2014). Typically speaking, in the case of CVD, certain combinations of colours may look different in comparison to what people with normal vision see, as captured in Figure 2.1 (CUDO, 2006).

[5] I acknowledge that these are seminal sources; however, I relied on the original author who conceptualised the theories.



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**Figure 2.1:**

*An example of colour perception by people without and with CVD*

| Normal colour vision | Images seen by a person with CVD (deuteranopia) |
|---|---|
| | |



***Note:*** Adapted from CUDO (2006, p. 5)

In order to understand CVD and how it may affect a person's ability to perceive colour, it is important to understand the physical attributes of colour and the visual system that enables people to appreciate the visual world (Fentahun, 2014). In this regard, Machado et al. (2009) note the following:

> *CVD compromises people's ability to effectively perform colour and visualization-related tasks, impacting their private and professional lives. Understanding how such individuals perceive colours has a significant practical importance for using visualizations effectively* (p. 1292).

The colour of an object, as perceived by people, depends on the wavelength of the light it reflects as objects that appear a certain colour will absorb all other colours (Fentahun, 2014). For example, a blue object absorbs all other colours except blue, with the blue wavelength being reflected into a person's eye (Fentahun, 2014). To be more specific, light consists of wavelengths within the visual spectrum that are observed as rods and cones within the retina (Klooster, 2016) and carried to the brain where it is converted into *messages* that enable people to see colour (Fentahun, 2014).

For normal colour vision, the two different photoreceptor cells, cones and rods need to function correctly (Klooster, 2016). Rods provide important visual information in dimly lit conditions, while the cone photoreceptors of the retina are responsible for the perception of colour (Wu et al., 2019). Defects in these cones can lead to difficulty in perceiving a range of colours or distinguishing between different colours (Maule & Featonby, 2016). People with



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normal colour vision, also known as trichromats, have three types of cones that perceive red, green and blue colours and enable them to perceive the full spectrum of colour (Simunovic, 2010). To be more specific, colour cones observe long wavelengths (L), medium wavelengths (M), and short wavelengths (S) (Gómez-Robledo et al., 2018). L-type cones are red-sensitive and detect low frequency waves, M-type cones are green-sensitive and detect middle frequency waves and S-type cones are blue-sensitive and detect high frequency waves (Fentahun, 2014). Through the combination of information that the brain receives from the three types of cone, humans are able to detect over a million colours (Gómez-Robledo et al., 2018).

In comparison to normal colour vision, CVD is caused by abnormal or absent cones that lead to a person perceiving colours differently than others. CVD can take the form of a total deficiency or can be focused in a specific area, resulting in partial deficiency (Maule & Featonby, 2016). CVD will thus occur if one or more of the three types of colour cones' spectral sensitivity is altered or when a person has only two of the three types of cones that match colour (Fentahun, 2014). When the cones within the eye do not work as they should, the signals from the eye to the brain are different, causing people with this condition to perceive colour differently than others (Gómez-Robledo et al., 2018).

According to Serrantino et al. (2015), CVD is not viewed as a disability, even though people with CVD may be at a disadvantage, requiring certain accommodations to be made for them. Tofts (2007, p.63) contends that CVD can be viewed as a "hidden disability" in the same way as conditions such as dyslexia. In support of this view, Kvitle (2018) argues that "recognizing CVD as a learning challenge that requires special education is a first step towards an accessible learning situation for these children" (p. 837). This view is confirmed by Bailey (2013) who notes, "Ironically, though this disability deals with a person's vision, it is not a visible disability" (p. 6). In support, Meeks et al. (2016) argue that CVD can be disabling within certain contexts, for example, within the health science context. People with CVD can furthermore be at a disadvantage in occupations such as diamond grading, geology, art, interior design and teaching (Mashige & Van Staden, 2019).

The World Health Organisation (WHO) defines the concept *disability* as the umbrella term for activity limitations, participation restrictions and covering impairments. Accordingly, disability is viewed as a complex phenomenon rather than a mere health problem due to the way in which it may influence the interaction between a person's body and the external environment (WHO, 2017). As CVD generally implies a negative impact on daily living



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(Bailey, 2013), limitations with certain activities, especially ones relating to colour (Chan et al., 2014; Kvitle, 2018) and restrictions when it comes to careers and activities such as driving (Lin et al., 2019), the argument can be put forward that CVD may cause challenges similar to those described by the WHO (2017) as challenges associated with a disability.

### 2.2.1 Causes of CVD

CVD can be either congenital (inherited) or acquired (Berisso, 2018), with the latter being less common than the former (Fentahun, 2014; Mitiku et al., 2020). Congenital CVD is the result of genetic mutations and is an untreatable disorder that remains constant throughout life (Simunovic, 2010). Congenital CVD is one of the most common vision disorders and affects 8% of males and 0,5% of females worldwide, as stated earlier (Simunovic, 2010; Berisso, 2018). The difference in prevalence among males and females is due to the most common form of CVD being inherited through a gender-linked recessive trait (Simunovic, 2010; Frane, 2015; Mitiku et al., 2020). To be more specific, the X chromosome contains the genes that yield photopigments. Therefore, if the genes that yield photopigments are damaged or absent, CVD will occur (Wu et al., 2019). It follows that the presence of the genetic mutation for CVD on the X chromosome will result in the manifestation of the condition. Due to females having two X chromosomes, CVD will only occur if the mutation is present on both X chromosomes. However, as males have only one X chromosome, the probability of CVD is higher amongst this gender group (Wu et al., 2019). In addition, females may also carry the genetic mutation for CVD on one of their X chromosomes without presenting with CVD (Mitiku et al., 2020), resulting in the general prevalence of the condition being higher amongst males than females.

Acquired CVD is secondary to ocular or general pathology, and is often caused by neurological diseases, certain metabolic disorders and extended exposure to particular solvents and medications (Chan et al., 2014). Instances where young children can acquire CVD apart from hereditary causes include shaken baby syndrome, trauma and ultraviolet damage (Bailey, 2013). Dyschromatopsia can furthermore be caused by brain fever, cerebral infraction and cortical trauma (Fentahun, 2014), whereas fundus detachment, glaucoma, nervous system diseases, optic atrophy and macular degeneration may cause other types of CVD. Finally, according to Heydarian et al. (2017), continuous exposure to welding light may also cause CVD, with the duration of the exposure playing a determining role.



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### 2.2.2 Types of CVD

Different types of CVD are distinguished that may vary in terms of severity and prevalence (Maule & Featonby, 2016). To be more specific, CVD is classified as anomalous trichromacy, dichromacy, and monochromacy (classification according to severity), with a further differentiation in terms of the type of cone being affected (Simunovic, 2010). CVD can affect a person's shade matching ability, with certain types of CVD affecting this skill more significantly than others (Pohlen et al., 2019).

Red-green CVD is the most common type of CVD (National Institutes of Health, 2015; Mitiku et al., 2020), and are often used as an umbrella term for protanomaly, deuteranomaly, protanopia and deuteranopia (Simunovic, 2010; Mitiku et al., 2020). Deuteranopia and protanopia are the more serious types of red-green CVD when compared to the other two types (Fentahun, 2014).

#### *2.2.2.1 Anomalous trichromacy*

People with anomalous trichromacy, the mildest form of CVD, possess all three types of cones required for the interpretation of the three primary colours that will enable a person to see the range of existing colours (Simunovic, 2010). In the case of anomalous trichromacy, the way in which the primary colours are perceived is, however, deviant, due to one of the three types of colour cones' spectral sensitivity being altered (Fentahun, 2014).

Different types of anomalous trichromacy can be distinguished, based on the cones that are affected, namely protanomaly, deuteranomaly and tritanomaly (Simunovic, 2010). Protanomaly and deuteranomaly are most common and represent the milder forms of so-called red-green CVD, with the M- or L-cones being altered, causing the M-cones to develop in a similar way as L-cones or *vice-versa* (Fentahun, 2014). The three types of anomalous trichromacy are compared in Table 2.1, with the last column depicting images of how a person with the specific type of CVD will see the image captured in Figure 2.2.



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**Figure 2.2:**

*Image that people with normal vision see*

**Table 2.1:**

*Types of anomalous trichromacy*

| TYPE OF ANOMALOUS TRICHROMACY | CONES AFFECTED | EFFECT OF THE CVD | WHAT PEOPLE WITH THIS TYPE OF CVD SEE |
|---|---|---|---|
| Protanomaly | L-cones, also known as the red cones. | Reduced sensitivity to the colour red. | |



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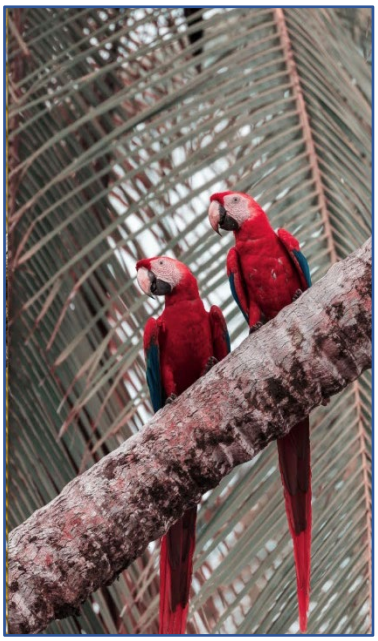
| TYPE OF ANOMALOUS TRICHROMACY | CONES AFFECTED | EFFECT OF THE CVD | WHAT PEOPLE WITH THIS TYPE OF CVD SEE |
|---|---|---|---|
| Deuteranomaly | M-cones, also known as the green cones. | Reduced sensitivity to the colour green, the most common type of congenital CVD. | |
| Tritanomaly | S-cones, also known as the blue cones. | Less common, affects a person's ability to perceive the colour blue. |  |

***Note:*** Adapted from Simunovic (2010) and Fentahun (2014)

### *2.2.2.2 Dichromacy*

Dichromacy is a form of CVD where people experience a reduced dimension of colour vision due to possessing only two types of cones that match colour (Simunovic, 2010). This means that a person with dichromacy is able to distinguish between two or three different hues only, while a person with normal colour vision is typically able to distinguish between seven different hues. Hence, dichromacy results in the confusion of colours associated with the absent type of cone (Moreira et al., 2017). Three types of dichromacy can be distinguished,



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as summarised in Table 2.2. In the far-right column, an indication is provided of how a person with CVD sees the image included in Figure 2.2.

**Table 2.2:**

*Types of dichromacy*

| TYPE OF DICHROMACY | CONES AFFECTED | EFFECT OF THE CVD | WHAT PEOPLE WITH THIS TYPE OF CVD SEE |
|---|---|---|---|
| Deuteranopia | Medium wavelength sensitive cones (M-cones), also known as green cones, are missing. | Green sensitive cones are not absent but deficient in some way, or the point of sensitivity is shifted towards red sensitive cones. The person is usually able to distinguish between yellows and blues. | |
| Protanopia | Deficiency of red cones (L-cones) in the retina, often confused with deuteranopia. | The person is likely to confuse black with shades of red; purples with blue and dark pinks; dark orange, dark red, dark brown with dark green; greens with some oranges, and certain blues with certain reds. | |



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| TYPE OF DICHROMACY | CONES AFFECTED | EFFECT OF THE CVD | WHAT PEOPLE WITH THIS TYPE OF CVD SEE |
|---|---|---|---|
| Tritanopia | S-cones are absent in the retina; in other words, blue sensitive cones are lacking. | A much rarer type of CVD that affects males and females equally due to not being located on an autosome. Common colour confusions include dark purples with black, oranges with reds, light blues with greys, and mid-greens with blues. | |

***Note:*** Adapted from Maule and Featonby (2016) and Fentahun (2014)

### *2.2.2.3 Monochromacy*

Monochromacy, which is the most severe form of congenital CVD, is characterised by the inability to discriminate colour (Simunovic, 2010). Some monochromats, known as *incomplete achromats* display residual colour discrimination (Simunovic, 2010). Another form, that of dyschromatopsia, refers to total CVD, where a person sees the world in black and white (Fentahun, 2014; National Institutes of Health, 2015). In Table 2.3, I compare the perception of people with normal colour vision with that of people with monochromacy.

**Table 2.3:**

*Monochromacy*

| NORMAL COLOUR | MONOCHROMACY |
|---|---|
| | |



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## 2.3 PREVALENCE OF CVD

Approximately 200 million people worldwide are affected by CVD (Machado et al., 2009). Even though the prevalence of CVD varies across geographical regions, gender and among race due to it being a genetic disorder (Hasrod & Rubin, 2016; Mitiku et al., 2020), the prevalence is likely to rise worldwide due to the growing population (Mashige & Van Staden, 2019). As indicated and explained earlier, CVD affects more males than females (Gupta et al., 2017), with only a small proportion of females having CVD. Gupta et al. (2017) estimate the percentage of CVD amongst females to be approximately 1%.

Red-green CVD is the most common type of CVD, affecting 8% of European males, and 4% of European females, around 6,5% of Chinese and Japanese males and 1,7% of Chinese and Japanese females, and between 6% and 7% of African males, according to Birch (2012). Even though a fairly larger prevalence among people of European descent is indicated for especially males (8%), in comparison to males of African origin (3% to 4%) (Hasrod & Rubin, 2016), limitations in terms of research conducted in Africa may account for this difference, in addition to the possibility of some people with CVD not being aware of the condition and not being accounted for in available statistics.

In Durban, one of a few South African studies that were conducted with 1 305 black school learners found that 2,2% of the participants presented with red-green CVD (Mashige & Van Staden, 2019), which is comparable to the results of 1% obtained in Nepal (Shrestha et al., 2010), 2,6% in Nigeria (Tabansi et al., 2008) and 1% in Bangladesh (Yasmin et al., 2009). On the contrary, however, other studies indicate a higher prevalence of CVD, of nearly 5,28% in India among Manipuri Muslims (Ahsana et al., 2013), 4,2% in Thailand (Napaporn Tananuvat et al., 2004) and 4,1% in Ethiopia (Woldeamanuel & Geta, 2018). Therefore, as CVD seemingly continues to occur at a relatively high rate across various populations, the varying statistics merit the need for ongoing research in this field.

It is specifically important to consider the prevalence of CVD within the classroom, as colour is often used to convey meaning and code information during teaching in schools (Olurinola & Tayo, 2015; Collins, 2015). Given the abovementioned prevalence of the condition, it is statistically likely that there will be one or two learners with CVD in every classroom (Collins, 2015; Albany-Ward, 2011), implying the possibility of school-going children experiencing difficulty to perform optimally as a result of this condition. In this regard, Collins (2015) argues that although this may not seem to be a significant percentage, the number of



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learners with CVD will exceed many other types of identified disability (Pastor & Reuben, 2008).

In addition to existing research being fairly scarce, a number of people with CVD remain undiagnosed (Mashige & Van Staden, 2019). This unawareness of a diagnosis has a distinct effect on the statistics that are available, resulting in the probability of skewed numbers. Ongoing research in this emerging field may provide better insight in terms of the current status and prevalence of CVD in society.

## 2.4 IDENTIFICATION, SCREENING AND DIAGNOSIS OF CVD

Although there are a number of screening tests available for CVD, many people do not know their colour vision status (Kvitle, 2018; Prieto et al., 2021), which could have a negative impact on their school and work performance (Cole, 2007), limit career choices and possibly lead to challenges in other areas of life (Chan et al., 2014). Furthermore, even though CVD can have a negative effect on early learning, it is often detected only later in the developmental phase (Suero et al., 2005). According to The National Institute of Health (National Institutes of Health, 2015) milder forms of CVD may go unnoticed and may therefore not be diagnosed, as confirmed by Kvitle (2018), with all these factors having an effect on the available statistics of people with CVD. Fentahun (2014) argues that although the majority of diagnoses of visual impairments are done among the elderly, early detection of a visual problem can have educational and behavioural benefits for children.

Commercially available assessment instruments for CVD include the Ishihara Test, the Colour Vision Testing Made East (CVTME) instrument and the Farnsworth-Munsell 100 Hue Test (Klooster, 2016; De Fez et al., 2018). These assessments all require people to identify a shape on a coloured background or foreground and can also be used with young children that are not yet fully literate (Klooster, 2016). Some of the assessment instruments can be accurately used with children as young as four years of age (Xie et al., 2014).

The Ishihara Colour Test (Ishihara, 1917) consists of 24 coloured plates with numbers and letters on them, with their visibility being dependent upon the viewer's colour vision (Barry et al., 2017). Ishihara plates are commonly used to screen for CVD and can enable clinicians to quickly identify people with red-green CVD (De Fez et al., 2018). Next, the Colour Vision Testing Made East (CVTME) instrument (Cotter et al., 1999) is a pseudoisochromatic colour plate test that is used to identify red-green colour deficiencies for all ages, including pre-school children. Another instrument, the Farnsworth-Munsell 100 Hue Test (FM 100H)



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(Farnsworth, 2011), is mostly used in clinical practice as it provides a more comprehensive result than in the case of the Ishihara Colour Test, allowing for the diagnosis of both red-green and blue-yellow CVD (De Fez et al., 2018). In recent years, Optopad, a fast and easy-to-perform colour vision test on the iPad has also shown promising results, similar to those of the Ishihara or FM 100H tests. However, more research on larger sample sizes is required before coming to conclusions on the usability of this option (De Fez et al., 2018).

Even though many countries followed Japan in using the Ishihara test to assess the colour vision of children (Kvitle, 2018), this practice gradually phased out in many countries, with learners with CVD often remaining undiagnosed (Kvitle, 2018). Despite colour being increasingly used in teaching contexts (Chen et al., 2014), colour vision testing has thus been neglected and largely phased out in schools in contemporary times (Maule & Featonby, 2016). This has led to many learners not being aware that they have CVD during their years of schooling (Collins, 2015) and the condition being under-diagnosed due to limited structured screening procedures being undertaken.

Although CVD is often congenital, and a child may have had the condition since birth, symptoms of CVD are often not evident until the early learning phase commences (Bailey, 2013). People with CVD may also not be aware of their CVD due to them not having experienced the full spectrum of colour and therefore not knowing that they have a dificiency (Chia et al., 2008). As indicated in a study conducted in Karachi-Pakistan, many drivers with CVD are, for example, unaware of their condition (Faiz et al., 2019). In support of this finding, a study by Cole (2007) indicates that 30% of dichromats and 60% of anomalous trichromats involved in the study were not aware of their condition during their school-going years. In this regard, Woldeamanuel and Geta (2018) recommend screening procedures for CVD of all children in support of early detection and a reduced risk of school and lifestyle difficulties.

General vision screening can result in the identification of possible visual diseases or defects through the use of, for example, rapid tests or procedures (Metsing et al., 2018). As screening methods may not be diagnostic in nature, a person with positive tests results is usually referred to professionals, such as an ophthalmologist or optometrist, for a confirmed diagnosis. Metsing et al. (2018) reviewed several visual screening methods often used for children and found that most of these aim to identify children with vision problems that may interfere with their scholastic performance, focusing on conditions such as amblyopia, strabismus and refractive errors. Hence, screening for CVD often does not form part of common practice in visual screening procedures (Metsing et al., 2018). Even though some



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online tests may provide an indication that someone is experiencing challenges related to colour vision, these methods are mere screening methods requiring an ophthalmologist or optometrist to confirm a formal diagnosis based on an assessment using suitable testing material.

According to Chan et al. (2014), the timely identification of CVD is important to provide educational and career advice, as well as individualised support for learners with CVD. To be more specific, the early identification of a learner with CVD may allow teachers to make the necessary adjustments within the classroom in support of the learner (Chan et al., 2014). According to Kvitle (2018), a diagnosis of CVD can increase the understanding of the condition by important role-players such as teachers and parents, whereas undiagnosed CVD may pose a risk for educational success in addition to being a potential source of perceived *failures* by a learner that may in turn be confused with other special educational needs. This view is supported by Woldeamanuel and Geta (2018), who posit that undiagnosed CVD may impair the performance of learners, potentially resulting in them not understanding why they are experiencing challenges and are made fun of by others such as their peers (Bailey, 2013). In line with this argument, Mashige and Van Staten (2019) contend that people with CVD should be aware of their condition from an early age to receive advice regarding, for example, appropriate career paths. In general, learners who are aware of their CVD will possibly be able to adapt more effectively and make more informed career choices than those not being aware of their condition (Woldeamanuel & Geta, 2018; Klooster, 2016).

Despite the importance of learners with CVD knowing about their diagnosis, some negative effects can be associated with the screening of CVD in terms of learners with CVD being labelled, or schools not being sufficiently equipped to provide useful information and support to learners and their parents in such cases (Klooster, 2016). Ramachandran et al. (2014) analysed the existing literature on screening procedures for congenital CVD and found that the majority of research is in favour of not adopting routine screening for CVD unless a learner expresses interest in occupations where normal colour vision is a requirement. Hence, Cole (2007) favours optometrists rather than schools to screen for CVD, with CVD screening taking place only during specific times, such as school entry and/or when choosing a career. The seemingly opposing views on this topic merit ongoing research in the field.



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## 2.5 THE EFFECT OF CVD ON PEOPLE'S LIVES

Colour is used for various purposes, such as aesthetic, denotative and connotative purposes (Cole, 2007). The connotative purpose of colour is associated with the message conveyed through the use of colour; for example, in the case of traffic lights, informing drivers when to stop or go, or the colour of fruit indicating when fruits are ripe. The denotative use of colour relates to the ability to differentiate between things based on colour; for example, when team players wear coloured shirts to indicate that they belong to the same team. The aesthetic use of colour is associated with how objects look, determining, for example, where flowers are placed in a garden (Cole, 2007). It follows that colour can convey important information and is often used as a method of communication (Wu et al., 2019), with colour screens occurring increasingly more frequently; for example, in the case of mobile phones, photocopiers and automatic teller machines (ATMs) (CUDO, 2006).

Most people with CVD experience challenges in situations where information is coded through the use of colour, whether it is used for man-made codes as in the case of traffic lights or for natural codes such as the colour of food signalling its ripeness or freshness (Collins, 2015). Colour coding is widely used in public places such as museums, or at exhibition sites where areas or rooms are separated according to theme colours, potentially creating challenges for people with CVD. Public transport is also often colour-coded to indicate direction, times and route maps (Cole, 2007), with colourful information displays regularly being used to convey important information (Wu et al., 2019).

### 2.5.1 The effect of CVD across the lifespan

As effectively stated by Fentahun (2014, p. 1), "Vision is the primary means of integration between individuals and the external environment". As the type and severity of CVD can influence daily living differently, people with CVD may experience a range of challenges, from experiencing minor frustration on a daily basis to experiencing frequent challenges for the majority of time (Bailey, 2013). Even though CVD will thus affect different people across their lifespan in various ways, the effects of CVD are lifelong, and challenges typically extend across various fields, including those of sport, education, social and emotional functioning, career choice and daily living tasks, such as driving.

Children with CVD may experience several challenges associated with CVD within the school environment (consult Section 2.4.3). However, these challenges extend beyond the school context. During early childhood children with CVD typically face challenges due to



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colour playing an important role in educational and recreational activities (Woldeamanuel & Geta, 2018). To be more specific, in this developmental stage, objects are often colour-coded to assist in identifying objects, explaining concepts and sorting items (Woldeamanuel & Geta, 2018). Children with CVD may, therefore, experience difficulty in distinguishing between colours during educational tasks and recreational activities that rely on colour recognition (Birch, 2001; Kvitle, 2018). As early childhood is a critical period for foundational learning and colour-related activities are frequently used in early education, these may have a negative impact on a child's ability to engage fully in and comprehend certain aspects of their early learning experiences (Hui, 2021).

When progressing to primary school, the challenges associated with CVD continue for this group of children. Educational media, such as maps, charts and diagrams often use colour-coded information to convey a message or foreground information (Collins, 2015). Learners with CVD may struggle to interpret these media, potentially leading to misunderstandings and academic setbacks (Gordon, 2014). Furthermore, certain activities such as art classes and science experiments that involve colour may pose challenges for learners with CVD (Suero et al., 2005).

In secondary school, the challenges for learners with CVD extend to more complex subjects and activities (Prieto et al., 2021). Certain subjects, such as Chemistry and Geography, often rely on colour-coded information to convey important concepts, making it challenging for learners with CVD to grasp the content fully (Rabin, 2016). Furthermore, standardised testing, which is prevalent in secondary education, may pose additional difficulties for these learners when colour-based information is used (Simunovic, 2010).

Challenges associated with CVD will continue into adulthood, and many who have not yet received a diagnosis may face even more challenges when entering this life phase (Barry et al., 2017). Challenges that are prominent during adulthood relate to driving, drinking coloured medication correctly, or experiencing restrictions at work (Barry et al., 2017). One may argue that people with CVD are potentially discriminated against, as can be seen in certain places where people with CVD may have limited career choices based on their ability to perceive colour (Lin et al., 2019).

### 2.5.2 Challenges with daily living

Research indicates that between 66% and 90% of the people living with CVD experience challenges with daily living. In this regard, several studies (Chan et al., 2014; Tanuwidjaja



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et al., 2014; Tagarelli et al., 2004; Gómez-Robledo et al., 2018) underscore the fact that people with CVD may experience challenges in their daily lives when playing games where colour is important, such as games played on smart phones, computer games, console video games, board games and card games. As a result, people with CVD may find less joy in such games when compared to peers with normal vision. In addition, activities such as building puzzles will require more effort from people with CVD when compared to others with normal colour vision, potentially resulting in the former not enjoying this activity.

Next, people with CVD may be challenged when choosing clothing to buy and wear, due to the inability to match colours and choose suitable outfits for certain occasions. This inability can result in criticism and even scrutiny directed at them (Chan et al., 2014). People with CVD may furthermore encounter challenges when reading charts, diagrams and safety signs, as many visual representations in educational media, workplace environments and public spaces rely on colour to convey information. Safety signs, for example, often contain colour-coded information to communicate warnings or instructions that people with CVD may struggle to access, posing potential safety risks (Regan et al., 2003). Similarly, colour-coded information is often used for navigation and wayfinding, with those with CVD experiencing challenges to distinguish between coloured signage, maps or information displays in places such as airports or public spaces. According to Chan et al. (2014), children with CVD may, as a result, lose their way more often if directions include coloured objects and/or signs.

In the same way, people with CVD may experience challenges with LED lights as LED light sources often emit a limited spectrum of colours, due to commonly using narrow wavelength bands (Viénot et al., 1999). Challenges with LEDs can affect various aspects of daily life for people with CVD, from discerning colour-coded indicators on electronic devices to accurately identifying objects under LED lighting. Thus, the reduced ability to differentiate between colours in LED-lit environments may impact tasks that require colour discrimination, for example, reading colour-coded information on screens (Viénot et al., 1999).

People with CVD often experience challenges with driving, due to their inability to distinguish between signal lights, which may lead to an increased risk of collisions (Simunovic, 2010). Additionally, painted street curbs can pose a problem, for example, when a person is not able to identify no-parking zones that are indicated through colour only. A study conducted on male drivers in Karachi, Pakistan found that drivers with CVD prefer driving during the day and that they typically experience challenges with recognising vehicles and traffic lights



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(Faiz et al., 2019). It was further noted that drivers with CVD may be a risk to themselves and others on the road (Faiz et al., 2019). Recommendations to assist such drivers include practical changes such as shaped coding for signals and other related modifications.

At home, people with CVD may encounter a range of challenges with food-related tasks. When cooking, they may, for example, struggle to discern the colour changes that indicate when foods, such as meat or baked goods are ready to eat (Birch, 2012). The use of colour cues to select ripe fruits and vegetables may furthermore be challenging, potentially impacting the quality of the ingredients chosen for meals. Additionally, when buying packaged or processed foods, people with CVD may experience challenges to interpret colour-coded labels that convey information about nutritional content, ingredients or expiration dates (Regan et al., 2003). Subsequently, people with CVD have been identified as fussy eaters in research studies, as a result of the unappetising appearance of food, for example, of vegetables (Bailey, 2013).

People with CVD may also face challenges in the medical context where colour-coded information is often crucial. In emergency situations, such as during first aid operations, quick and accurate identification of colour-coded items, such as medication labels or medical supplies may be required; yet people with CVD may experience difficulty with this action (Regan et al., 2003). Therefore, people with CVD may struggle to distinguish between different types of medication or colour-coded bands on medical equipment, with this potentially impacting the timely and accurate administration of care. Further health-related challenges include identifying colour-related bodily changes such as identifying blood in stools. Additionally, medical charts, diagrams and displays often rely on colour to convey information about vital signs, pathology and treatment plans.

For those with CVD pursuing art, challenges may arise in expressing and interpreting colour artworks. People with CVD tend to struggle to convey or perceive certain hues accurately, impacting the intended emotional or symbolic meaning of art. Furthermore, the mixing and blending of colours on a palette can be challenging for people with CVD, which will, in turn, affect the variety of tones and shades they use. Artists with CVD may, as a result, need to explore alternative techniques or rely on feedback from others to ensure the fidelity of their artistic expressions (Cole, 2007). In addition, certain hobbies, such as jigsaw puzzles or crafting, reliant on colour-coded elements, may pose challenges for people with CVD and may impede their progress and enjoyment when engaging in such activities. In activities like gardening, identifying different flower varieties based on colour becomes a more intricate



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task, with such challenges potentially limiting the range of activities and hobbies that people with CVD engage in.

Finally, people with CVD may experience challenges when engaging in sport, whether casually or competitively. Team sport, like soccer or basketball, often relies on coloured uniforms to distinguish between players that may pose difficulties in tracking the game (Simunovic, 2010). Similarly, sport equipment, such as balls or goalposts, may be colour-coded, thereby potentially impacting a player with CVD's performance and overall enjoyment of the game. Furthermore, many board games and card games incorporate colour-coded elements that may lead to confusion and require additional effort to participate in for people with CVD. This challenge can affect the enjoyment and inclusivity of social gaming experiences, both at home and in public spaces (Chan et al., 2014).

In a study that assessed the quality of life of people with CVD in comparison to a normally sighted control group of participants by Barry et al. (2017), people with CVD scored significantly lower on the emotional, health and lifestyle and work subscales. The low scores for people with CVD in specifically the health and lifestyle subtests can be linked to the challenges often experienced by these people in terms of daily living. Significantly lower scores on the work scale furthermore correlates with related research indicating that people with CVD may experiences limitations with regard to their choice of career and can experience challenges relating to the use of colour at work (Simunovic, 2010).

### 2.5.3 School-related challenges associated with CVD

Colour is widely used within the school context to provide information, demonstrate what is taught or communicate a message (Collins, 2015). It should be noted that "colour is both an educational resource of normal use in various activities and a part of the learning content itself" (Suero et al., 2005, p. 90). Collins (2015) states that despite the extent to which colour is used within schools, CVD is often overlooked in educational settings, resulting in learners with CVD experiencing unique challenges within the school environment and not being able to perform optimally.

To be more specific, learners with CVD may be at a disadvantage when it comes to performing visual tasks (Simunovic, 2010), describe objects around them, follow instructions involving colour or reading coloured print or print on a coloured background (Collins, 2015). A study by Helvacıog and Olguntürk (2011) found that colour plays an important role in learners' pointing task performances and way finding within the school environment. This



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may lead to additional challenges experienced by these learners within the school environment, such as difficulty to complete tasks that involve colour, or reading text in books and on a chalkboard that is written in colour (Chan et al., 2014). Consequently, the educational journey of learners with CVD may be challenging in several areas as discussed in this section (Torrents et al., 2011; Maule & Featonby, 2016; Albany-Ward, 2011).

It is, however, important to keep in mind that, during the perception of colour, not only a person's eyes and brain play a role but also the object and light (Helvacıog & Olguntürk, 2011). Thus, the quality of an object's surface will, for example, play an important role in the appearance of the colour in the sense that a smooth or glossy surface may reflect hues differently than a rough surface (Helvacıog & Olguntürk, 2011). Furthermore, colour and light are intertwined as colour needs light to exist (Helvacıog & Olguntürk, 2011). As such, low light conditions may increase the challenges that learners with CVD experience when the colour of an object is an attributive factor or when colour is used to organise a visual display (Cole, 2004; Torrents et al., 2011).

Consequently, classroom lighting may pose a compound challenge to learners with CVD (Klooster, 2016). In this regard, Nagy et al. (2014) note that stimulus brightness will have a significant effect on the ability to discriminate colour and even name colours in some cases. As a result, learners' colour identification ability may increase, depending on the brightness of a stimulus (Nagy et al., 2014), with people with CVD tending to rely on the luminance of a stimulus when experiencing challenges with colour naming (Sato & Inoue, 2016).

#### *2.5.3.1 The use of colour during the early learning phase*

During the early learning phase visual stimuli are often used in teaching activities (Collins, 2015; Hui, 2021). To be specific, colour is widely used as a form of communication during early education phases; for example, during tasks that include colour coding (Collins, 2015). At a young age, learners are typically expected to master basic colour differentiation skills and learners who experience challenges with colour differentiation may mistakenly be identified as having a learning disability, being inattentive or being lazy (Torrents et al., 2011). Yet, a learner with deuteranomaly (reduced sensitivity to green light) will be able to name only four colours in a box of 24 coloured pencils correctly (Chan et al., 2014). As learning builds on experience during early development, the degree to which colour is used during this stage may have a negative knock-on effect later in life in the case of learners with CVD (Collins, 2015). Figure 2.3 provides an example of how coloured pencils may look to a learner with CVD.



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**Figure 2.3:**

*Example of how a learner with CVD may see coloured pencils*

***Note:*** Retrieved from Colour Blind Awareness (2022)

As learners are typically able to discern colours before they are able to read words, the challenges implied by using colour to assimilate new information for a wide range of tasks seem prominent when they cannot differentiate between different colours (Suero et al., 2005). Primary school teachers, especially during Foundation Phase teaching, tend to use colour more intensely and frequently than during the later phases of schooling. When entering school, learners are thus expected to have knowledge of the basic colours (Klooster, 2016), with colour being used for a number of different types of tasks, including the completion of classroom activities and assessment tasks. As a result, accurate colour perception is important for learners to complete several activities during this phase (Klooster, 2016; Hui, 2021), with learners with CVD often not able to perform as expected (Sullivan, 2011). Figure 2.4 provides an example of an activity that a learner with CVD may struggle with when asked to identify all the red objects. The image on the left (a) provides the original image, with the image on the right (b) depicting what a learner with CVD may see.



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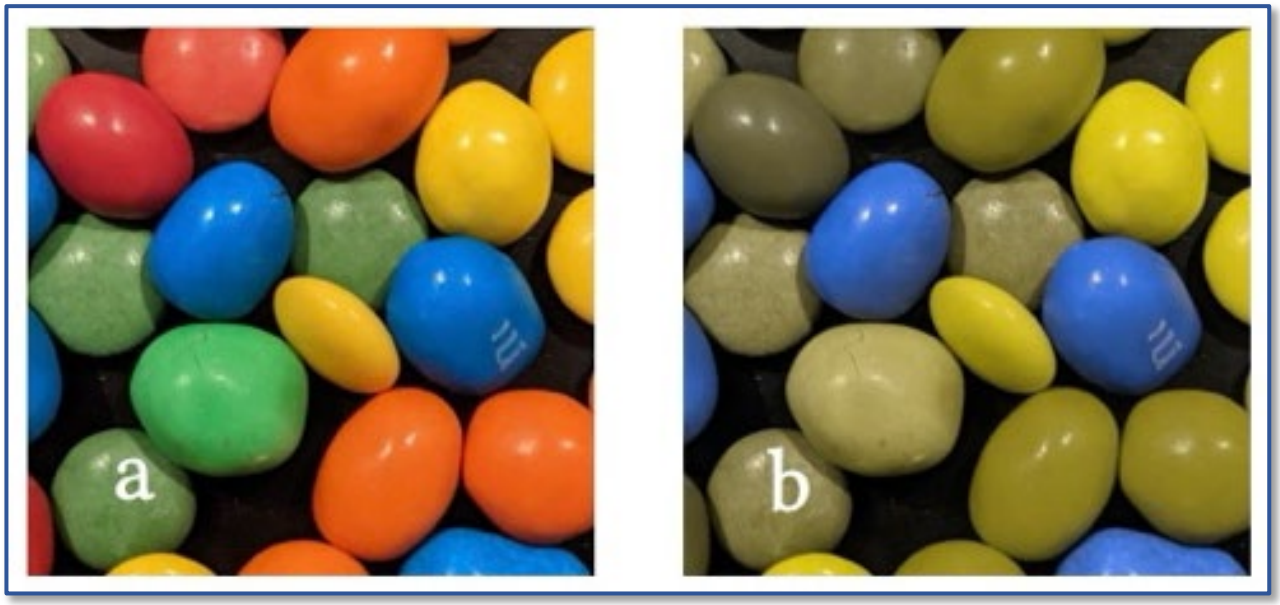
**Figure 2.4:**

*Example of challenges that learners with CVD may experience in the Foundation Phase*




***Note:*** Retrieved from Geddes et al. (2022)

In South Africa the Foundation Phase spans from Grade R to Grade 3. As already stated, during the Foundation Phase colour is often used to shape the learning environment and facilitate early childhood development, with colour having a significant impact on learners' mood, attention span and cognitive abilities (Terry, 2017). To this end, teachers often leverage colourful educational media, and visual media and charts to engage and stimulate learners (Klooster, 2016). Furthermore, colour is generally used in the Foundation Phase to support the development of foundational skills such as literacy and numeracy. Educational media are often colour-coded to help learners differentiate between subjects, concepts and tasks. For instance, colour-coded reading media may assist learners to associate specific colours with different phonetic sounds or word groups, enhancing early literacy skills (Al-Ayash et al., 2016). Similarly, Mathematics activities may rely on colours to represent different numerical operations or categories, providing a visual medium to reinforce basic mathematical concepts. According to Suero et al. (2005), applications of colour include the use of colour as visual support, with abacus analogues and coloured objects being frequently used in early Mathematics.

### *2.5.3.2 The use of colour during teaching and classroom instruction*

Continuing on Foundation Phase teaching, colour is widely used as a tool for teaching (Torrents et al., 2011), with teachers often making use of colour to assist learners in recognising and remembering learning material in the primary and secondary school years



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(Gegenfurtner & Rieger, 2000). Prieto et al. (2021) note that although a black and white colour scheme may be the best way to avoid confusion and increase access to learning content for learners with CVD, this may be considered less “attention-grabbing” (Prieto et al., 2021, p.92) by teachers and may not align with the preferences of other learners in class. In general, however, teachers seldom consider the needs of learners with CVD during lesson planning and instruction (Tofts, 2007).

In primary education, colour is often used to assist learners in identifying new objects and for the assimilation of new concepts (Klooster, 2016). Colour is used in multiple ways within the classroom; for example, when learners are requested to use only blue or black ink to write, and red ink is used by teachers for corrections. According to Kvitle (2018), colour is used as an important tool in schools to highlight, identify, explain and even warn learners. Furthermore, colour can be used to emphasise meaning and reinforce important concepts during teaching (Klooster, 2016).

In this regard, challenges associated with CVD may be caused by different concepts being marked as prominent in both textbooks and workbooks through the use of colour and highlighters (Olurinola & Tayo, 2015). As learners with CVD may struggle to accurately perceive and differentiate certain colours, there is the potential for misinterpreting the information presented in colour-coded media. This challenge is particularly significant in media where colour is used to convey specific meanings or relationships, such as in graphs, charts or diagrams. For example, a learner with CVD may have difficulty to distinguish between the colours used to represent data points on a diagram, with this, in turn, impacting their understanding of the content when the teacher is explaining the content and uses colour to refer to the data.

All learners with CVD are at a disadvantage when it comes to tasks that involve the exact matching of or discriminating between colours (Collins, 2015). In addition to learners with CVD not being able to see the difference between coloured labels or coloured pens used on the chalkboard, they may experience challenges when colour is used to label objects and organise visual displays (Collins, 2015) or to identify different objects (Cole, 2004). The participation of learners with CVD in classroom activities that rely on colour-based learning may, as a result, be limited. Colour-coded visual learning exercises, such as colour-coded group activities or interactive displays can accordingly hinder learners with CVD from fully participating and benefitting from educational experiences. In addition to being used as a didactic tool, colour is often used to support problem solving, with learners with CVD



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misinterpreting or even being unable to solve such tasks (Kvitle, 2018). Consequently, learners with CVD are likely to fall behind with schoolwork where colour plays an important role in learning (Barry et al., 2017).

#### *2.5.3.3 The role of colour for memory (coding)*

Colour vision is essential for a person's understanding of the visual world (Woldeamanuel & Geta, 2018). To this end, existing studies suggest a correlation between learning and colour vision (Pan, 2010; Reppa et al., 2020; Dzulkifli & Mustafar, 2013). Consequently, for learners with CVD, the value of colour as a learning and attentional cue is reduced (Collins, 2015).

Visual encoding entails a process where data input, sorting and retrieving are done visually. To this end, colour may offer a coding advantage, as it can facilitate visual memory by assisting people to memorise and identify objects at a faster pace (Klooster, 2016; Reppa et al., 2020). According to Dzulkifli and Mustafar (2013), "Colour has the potential to increase chances of environmental stimuli to be encoded, stored and retrieved successfully" (p. 8). Therefore, even though colour coding can be an effective tool to organise information in such a way that it can assist learners to make sense of information (Reppa et al., 2020), colour coding may imply limited benefits for learners with CVD (Collins, 2015). As a result, learners with CVD may experience challenges due to them not being able to decode given information and feeling lost when colour is the only element available to decode the information (Kvitle, 2018). As stated by Kvitle (2018), "For a colour vision deficient student, the colours used to code the information may be a source of confusion instead of a tool to decode" (p. 837).

Additionally, colour may increase a person's level of attention that can support the memorisation of certain information (Dzulkifli & Mustafar, 2013). According to Olurinola and Tayo (2015), colour can be a powerful tool for human cognition as it has been found to enhance memory. In support of this finding, a study by Reppa et al. (2020) indicates that when information is coloured, the colour will influence object recognition by assisting in the encoding of a visual object in memory as well as during the retrieval thereof. This contribution correlates with a study by Olurinola and Tayo (2015), indicating that congruent and achromatic colours may increase retention rates. In further support, a study by Pan (2010) relied on visual geometrical shapes of different colours to indicate that colour may enhance memory performance and increase attention. Therefore, colour can facilitate learning and memory by drawing on its cognitive and symbolic qualities, in addition to supporting concept identification (Olurinola & Tayo, 2015; Reppa et al., 2020). Yet, for



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learners with CVD, colour can be a source of confusion and misunderstanding that may reduce the cognitive advantages associated with memory.

Although these studies suggest that colour positively correlates with memory, some studies indicate contradicting findings. A study by Finn et al. (2011), for example, found that colour will not influence short- or long-term retention of knowledge, while Hall and Hanna (2004) found that greater contrast colours will increase readability, yet that colour combinations will not affect retention. Based on these contradictory findings it seems difficult to draw a conclusion on how the use of colour may influence memory and the attention of learners with CVD, thereby foregrounding the need for ongoing research in this emerging field of study.

Broadly speaking, however, it seems clear that colour-dependent strategies may negatively affect learners with CVD and may potentially lead to confusion rather than assisting them with learning and memory. According to Terry (2017), colour can play a significant role in memory enhancement; however, learners with CVD, relying on colour-coded information, may experience difficulties in accurately recalling and associating information. The limited ability to distinguish between colours may thus negatively impact the formation of strong memory associations, potentially influencing the retrieval of information presented in colour-dependent formats.

#### *2.5.3.4 The use of colour in textbooks and teaching resources*

Teaching resources seemingly seldom consider the needs and challenges potentially experienced by learners with CVD (Torrents et al., 2011). To be more specific, even though there is a significant number of people living with CVD, colour is widely used to transmit important information in the 21st century, especially in schools (CUDO, 2006). Previously, black and white printing was typically used for textbooks; yet in modern textbooks and related teaching resources, recent enhancements in colour printing technology have led to the increased use of colour (CUDO, 2006). Frane (2015) contends that the use of coloured graphics and information being presented in colour is increasing due to this being more affordable and accessible in contemporary times, and publications shifting from printed media to online resources. However, most coloured graphics are designed without taking into consideration the possible challenges that people with CVD may encounter when viewing such sources (Frane, 2015).



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As indicated in a study by Torrents et al. (2011) who analysed school textbooks to determine their suitability for learners with CVD, 10% of the tasks in Mathematics textbooks, for example, may be challenging and even impossible to do for learners with CVD (Torrents et al., 2011). Even though this seems to be a fairly low percentage, it highlights the fact that school-based resources may be a cause of placing learners with CVD at a disadvantage in comparison to other learners. Based on their research, Torrents et al. (2011) recommend that school textbooks be redesigned, while taking the needs of learners with CVD into consideration, focusing on the use of alternative colours and textures that these learners will be able to distinguish. As a result, Spanish editorial boards have started to consider people with CVD and effected some associated changes to this end (Torrents et al., 2011). Despite resources being available to assist in conscientious colour selection, such as the website http://colorbrewer.org that provides CVD-friendly colour palettes (Frane, 2015), CVD is seldom taken into consideration in various countries when writing textbooks (Torrents et al., 2011), as was also found by Maule and Featonby (2016) who conducted research in this field in the United Kingdom.

Learners with CVD may not only struggle to read coloured print on a coloured background but may also experience difficulty to interpret pictures, figures and maps that include colour. Colour maps often rely on various colours to represent data, which may cause challenges and possible misinterpretation by people with CVD, such as learners in the geography class (Nuñez et al., 2018). This finding correlates with research conducted by Jenny and Kelso (2007) who similarly found that people with CVD may experience challenges in reading colour-coded maps and weather maps. In the same way, coloured figures used for various school subjects may pose challenges for learners with CVD. Frane (2015) specifically examined the use of coloured figures in journals, finding that such figures may cause needless difficulties for people with CVD despite the fact that this could easily have been avoided through some simple adjustments.

A wide variety of resources other than textbooks that may contain colour, such as posters, blocks, cubes and other manipulatives are often used within the school environment (Klooster, 2016). In lower grades colourful blocks are, for example, often used as manipulatives in Mathematics education, whereas in higher grades, colour is often used in written material to reinforce understanding and/or emphasise important concepts (Klooster, 2016). While writing boards were typically black or green in the past, using white coloured chalk, an increase in whiteboards in classrooms has resulted in more colours being used,



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with the possibility of learners with CVD not being able to differentiate between clusters of information presented through the use of different colours (Olurinola & Tayo, 2015).

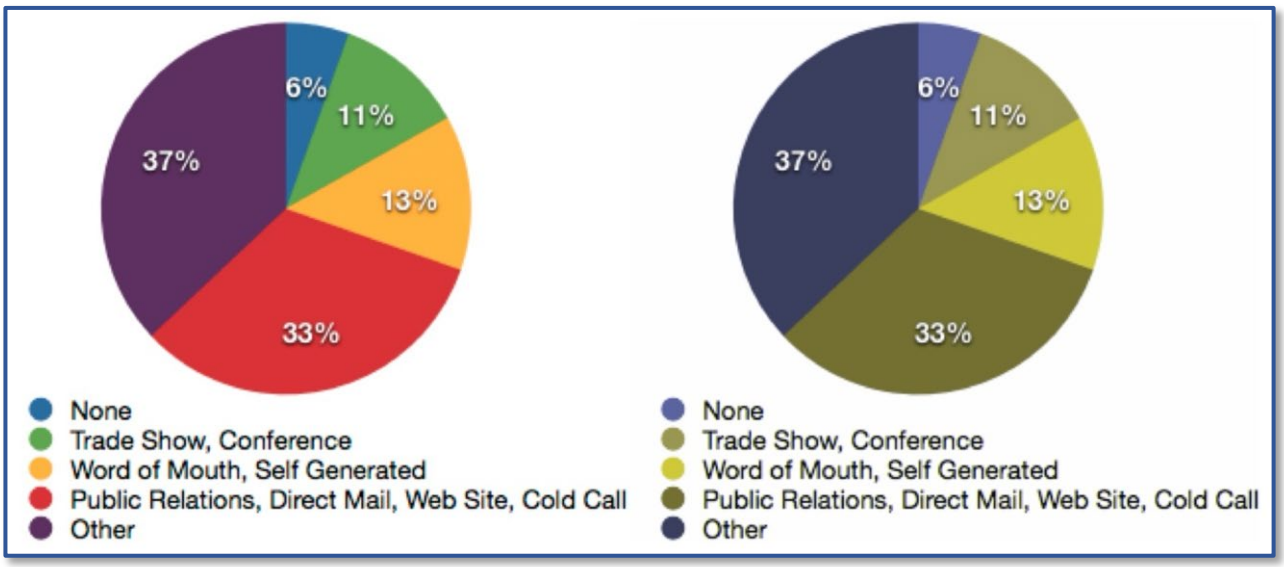
#### *2.5.3.5 Challenges experienced in various school subjects*

Learners with CVD may experience challenges in a number of school subjects. According to Sullivan (2011), learners with CVD may lag behind in school subjects such as Science, Geography and Mathematics specifically, where colour is often used as a teaching tool. For example, in the Science class, learners may be required to determine the outcome of a scientific litmus test, with litmus results often being displayed in shades of greens and purples that must be compared to a coloured reference chart (Bailey, 2013).

In Mathematics, colour is often used to differentiate between elements on graphs and charts, and in equations. Learners with CVD may struggle to accurately interpret these colour-coded elements that may impact their understanding of mathematical concepts and relationships (Kvitle, 2018). In general, scientific materials, including charts and diagrams, often rely on colour to convey information. Figure 2.5 captures how a person with normal vision may see a diagram (left diagram) in comparison to a person with CVD (right diagram), demonstrating how a person with CVD may experience challenges to distinguish between the different slices of the chart, when these are referred to by colour.

**Figure 2.5:**

*Example of a challenge experienced in Mathematics*




***Note:*** Retrieved from Geddes et al. (2022)



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In Physics and Chemistry, learners with CVD may experience difficulty with describing the colours of different chemical solutions in a quantitative analysis. Furthermore, these learners may find it challenging to identify metals from the colour of flame they produce when burnt and experience difficulty with prisms and coloured wiring. Figure 2.6 provides an example of how learners with CVD may struggle with a Science experiment due to the challenge of differentiating between colours.

**Figure 2.6:**

*Example of challenges experienced in Science*

***Note:*** Retrieved from Colour Blind Awareness (2022)

Closely related, learners with CVD may experience challenges with reading stained slides under microscopes in Biology or with identifying species of plants, accurately carrying out dissections and understanding coloured diagrams (Kvitle, 2018). Geography similarly involves the interpretation of maps and charts, with colour often representing various geographical features. Learners with CVD may experience challenges with reading and decoding such maps, in addition to reproducing these maps (Al-Ayash et al., 2016). For example, Figure 2.7 depicts how a map may look for a learner with normal vison in comparison to a learner with CVD.



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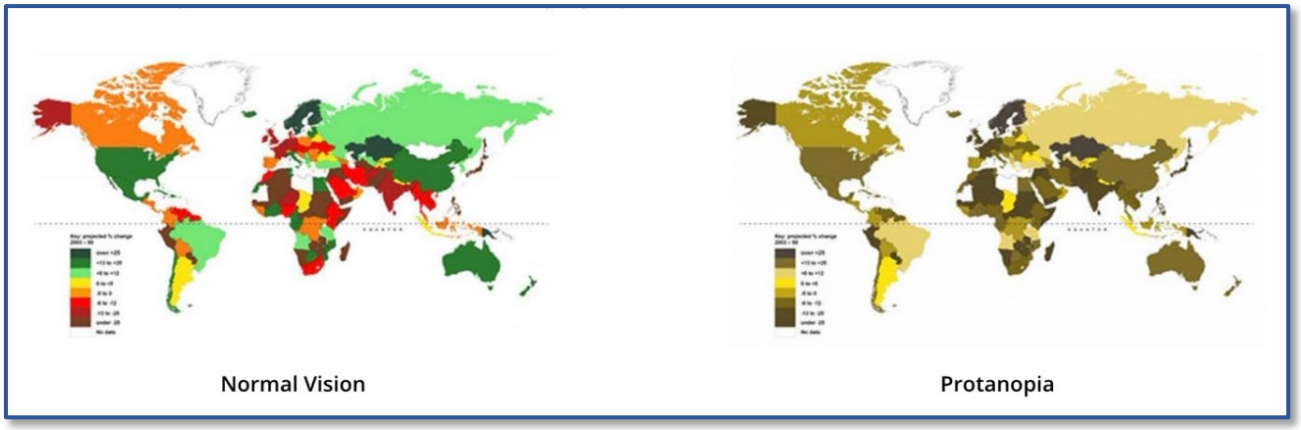
**Figure 2.7:**

*Example of challenges experienced in Geography*




***Note:*** Retrieved from Colour Blind Awareness (2022)

For Social Studies, materials may use colour to represent different concepts, regions or historical periods that learners with CVD may once again experience as hard to interpret (Al-Ayash et al., 2016). While colour is not central to language study, some language learning materials may include colour to highlight grammatical structures, with this negatively impacting the understanding of language nuances by learners with CVD. Furthermore, colour may be used in second language learning materials to highlight vocabulary or grammatical structures (Chan et al., 2014).

Next, Art and Design classes may pose distinct challenges, where colour is fundamental to artistic expression. Learners with CVD will typically struggle to accurately perceive and reproduce specific colour combinations, impacting their creative expression (Hui, 2021). They may struggle to appreciate the use of colour and even use the wrong colours when painting. Furthermore, learners with CVD may prefer to use black and white rather than colour for artistic expression.

In Computer Science and Programming, colour is often used to differentiate syntax elements. Learners with CVD may, as a result, encounter challenges to accurately distinguish between these colour-coded elements (Al-Ayash et al., 2016). In subjects such as Home Economics, colour coding may be used to represent different materials, ingredients or steps in a process, resulting in learners with CVD once again facing challenges to interpret these colour-coded cues accurately (Chan et al., 2014). Finally, in Physical Education learners with CVD may experience challenges with recognising targets and distinguishing teammates from opponents (Chan et al., 2014). Figure 2.8 provides an example of the challenges that learners with CVD may experience when participating in team sport where



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they have to identify their teammates. It thus seems clear that learners with CVD will probably experience challenges in the majority of the academic subjects offered at school.

**Figure 2.8:**

*Example of challenges experienced when participating in sport*

***Note:*** Retrieved from Colour Blind Awareness (2022)

*2.5.3.6 Pros and cons of using technology in the classroom*

The increased use of computers, electronic devices and colour vision displays along with more affordable colour printing options may have resulted in additional challenges with colour differentiation for people with CVD (Cole, 2004). This idea is voiced in the following way by CUDO (2006): “In our current society, life is ironically becoming even harder for the colour-blind” (p. 6). To be more specific, an increase in the use of colour vision displays, computers and other technological devices may lead to an increase in colour stimuli that may, in turn, confuse learners with CVD (Cole, 2004). Kvitle (2018) confirms this reality by stating that the challenges experienced by learners with CVD have increased due to the expanding use of colour in computer and other technological displays, more coloured printed materials, and the use of smartboards in classrooms. According to Kvitle (2018):

> *… advances in technology may ironically enough make daily life of CVD observers harder than ever before as the advent of inexpensive colour printing and the universal adoption of colour computer monitors enable colour to be more widely used for coding information and organizing complex visual displays* (p. 834).

However, technology may also offer advantages to learners with CVD that may enhance their educational experiences. To provide some examples, digital platforms and software can be tailored to accommodate CVD by allowing users to adjust the colours and choose high-contrast themes (Al-Ayash et al., 2016). Furthermore, technological readers providing auditory feedback can provide learners with CVD with an alternative method of accessing written content. Additionally, educational software has recently become more inclusive by



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incorporating alternatives to colour visuals such as patterns, symbols or texture differentiations when representing information. Due to technology implying both advantages and disadvantages for learners with CVD, the need for ongoing comprehensive investigations in terms of the impact of technology on learners with CVD seems clear (Birch, 2012). It is important to specifically explore the possible implementation of supportive technology in the school context for these learners who may not be benefitting from such available resources.

### 2.5.4 Psycho-social challenges associated with CVD

CVD may affect an individual's general quality of life and even have negative psychological consequences, resulting in feelings of shame, inferiority and uncertainty, to mention but a few (Barry et al., 2017). In a study that assessed people's quality of life, participants with CVD scored significantly lower on the emotional subscales in comparison to a normally-sighted control group (Barry et al., 2017). Learners with CVD, in particular, may experience negative psychological effects, such as embarrassment, shame and anxiety due to this condition (Klooster, 2016; Hui, 2021). As people with CVD have limited colour naming ability (Nagy et al., 2014) they "may feel embarrassed about not knowing colours" (Barry et al., 2017, p. 7). A study by Gupta et al. (2017) indicates that learners with CVD may, as a result, try to hide the challenges they experience due to the fear of being labelled as different. According to Thomas et al. (2018), people with CVD may experience feelings of loneliness or be shy, confused and potentially sad. CVD can even lead to social withdrawal (Barry et al., 2017) due to having a limited colour naming ability and potentially feeling embarrassed about this (Barry et al., 2017).

As indicated earlier, learners often learn through visual stimulation that involves colours during early education (Bailey, 2013). Due to the inability to perform and subsequently receive praise from the teacher having a negative impact on a young learner's self-esteem; early education may, as a result, be experienced as frustrating and even psychologically harmful to a learner with CVD (Bailey, 2013). Such negative effects are likely to influence a learner's confidence and self-esteem in a negative way.

Even though contradicting findings on CVD and school performance can be found in existing literature, many learners with CVD will experience challenges that can cause frustration in addition to the CVD having a negative effect on their confidence (Chan et al., 2014; Chakrabarti, 2018). Closely related, a learner not following instructions may be misunderstood and labelled by others as disobedient instead of having CVD (Kvitle, 2018).



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For learners with CVD, feelings of disappointment and anxiety may be intensified when they are not able to learn the names of different colours that teachers teach them. As an example, Cole (2007) describes a man who experienced a sense of relief at the age of 80 years as he, up to that stage, had thought, “he was not bright enough to have learned his colours properly when he was at school” (p. 158). Closely related, a study by Tanuwidjaja et al. (2014) indicates that the participants, even when they were able to identify colours in certain situations, doubted their ability and felt uncomfortable with themselves. Kvitle (2018) notes that learners with CVD may, as a result, progress more slowly and make more mistakes when performing colour-related tasks. Not being aware of their condition can pose an additional risk of developing low self-esteem due to them not succeeding.

Teachers’ perceptions may furthermore have a negative effect on learners with CVD within the classroom (Suero et al., 2005) as CVD may influence the perceptions of teachers that may, in turn, affect the learning of learners with CVD (Klooster, 2016). In certain cases, learners with CVD may thus be subject to discrimination due to teachers’ (mis)perceptions of their abilities (Klooster, 2016). For example, teachers may potentially misinterpret poor performance as cognitive challenges instead of challenges associated with colour discrimination (Torrents et al., 2011).

The challenges explained by people with CVD in terms of daily living may add to the psycho-social challenges they experience. For example, people with CVD may be criticised and even scrutinised based on the (in)ability to match colours and choose outfits for specific occasions (Tanuwidjaja et al., 2014). In addition, CVD may even be treated as a joke by peers (Barry et al., 2017). In this regard, Prieto et al. (2021) argue that learners with CVD should be provided with consultation or counselling services to understand CVD and find ways to improve their learning whilst coping with possible mockery and teasing by others.

It follows that the negative reactions and lack of understanding of peers may negatively impact learners with CVD and possibly contribute to their feelings of embarrassment or exclusion (Birch, 2012). Mashige and Van Staden (2019) point out that such reactions can manifest in behaviours such as teasing or exclusion, negatively impacting the self-esteem and social confidence of individuals with CVD. The longing to fit in with peers can intensify when faced with additional challenges, thereby highlighting the importance of promoting an awareness and understanding among peers to foster a more inclusive and supportive environment for children with CVD (Birch, 2001).



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### 2.5.5 Challenges associated with career choices

The career choices of young adults with CVD may be limited due to a number of occupations that include tasks that rely on colour (Hui, 2021). Standards for employment and CVD were put in place in the past in fields where a risk for human injury was present (Tanuwidjaja et al., 2014), after a train conductor with CVD missed a signal in 1875 (Tanuwidjaja et al., 2014). This led to people with CVD previously being banned from certain occupations due to the challenges they may experience when performing certain tasks (Simunovic, 2010). Occupation and career choices that are included in the group of careers less suitable for people with CVD relate to the careers of commercial airline pilots, air traffic controllers, naval officers, train drivers, railway engineers and maintenance staff, careers in industrial colour matching and colour quality assurance, careers in fine art reproduction, and some electrical and electronic engineering careers (Simunovic, 2010; Tanuwidjaja et al., 2014). In addition to certain careers excluding people with CVD based on the possibility of injury or harm, Hui (2021) notes that “because of the difficulties and ridicule encountered in their early art experiences, many children with colour vision deficiency often avoid the art field when they choose to work in the future” (p. 661). In his study, Hui (2021) interviewed artists with CVD who indicated that they preferred to use black and white due to the risk of getting a colour wrong when using colour.

Hui (2021) offers valuable insights into possible strategies to support learners with CVD in art. To be more specific, Hui's (2021) research underscores the importance of guiding people with CVD through explicit colour identification techniques so that they can fully engage in the artistic learning process. This scholar recommends the use of high-contrast colour palettes, providing clear labelling of colours, and incorporating tactile experiences to enhance the understanding of artworks by people that have CVD. In support, Hauta-Kasari and Kohonen (2008) advocate the incorporation of multisensory experiences, adaptive technology and collaborative learning approaches to create an inclusive art environment that caters for the diverse needs of people with visual impairments.

Taking into consideration the possible limitations with regard to career choice and quality of life, Bailey (2013) emphasises that people with CVD may take initiative and educate themselves to become better prepared and open up alternatives in terms of the careers they may pursue. Additionally, Bailey (2013) calls on parents, teachers and employers to equip themselves to provide better support and assistance to people with CVD. Career counselling for these individuals is encouraged to enable them to make suitable choices for their future (Simunovic, 2010).



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People with CVD may also experience challenges during tertiary education. In this regard, Berisso (2018) argues that university students with CVD may experience difficulty to access information in programming classes due to the use of colour in presentations, instruction and other educational media. The challenges that medical students with CVD may experience include recognising skin rashes and body colour changes, reading charts, decoding test-strips for blood and urine, identifying tissue during surgical procedures, icterus, titration end points, throat and oral lesions, and identifying tissue in surgery and blood and bile in urine (Tanuwidjaja et al., 2014). These challenges may result in medical errors, for example, when incorrectly identifying patterns of rashes or a slight change of colour (Serrantino et al., 2015).

## 2.6 SUPPORTING LEARNERS WITH CVD

Even though a number of dated studies (e.g. Cumberland et al., 2004; Mandola, 1969) indicate limited differences between the performance of learners with normal vision and those with CVD, more recent research associates the condition of CVD with learning and psycho-social behavioural challenges (Ramachandran et al., 2014). However, the scarcity of research on the long-term effect of CVD on children (Berger et al., 2016) calls for ongoing research in this field.

Despite the fact that there is no cure or treatment for CVD, a variety of strategies can be relied on to assist and support people with CVD with the challenges they typically face (Wu et al., 2019; Berisso, 2018). Central to providing support to this group of people is a general awareness of CVD and the challenges associated with the condition amongst the general public, teachers and other role-players involved in the education of learners with CVD. Even though CVD has not been historically regarded as a disability, learners with CVD are often at a disadvantage due to the associated challenges they face.

According to Collins (2015), simple adjustments can be made to support and better accommodate learners with CVD in the school context. At its core, Maule and Featonby (2016) highlight the importance of teacher understanding of CVD and the possible challenges that learners with CVD may experience, an awareness of common mistakes that learners with CVD may make to avoid misdiagnosing these learners with other challenges or conditions, and a constant awareness of teaching and presentation styles as well as the topics in the curriculum that may potentially confuse learners with CVD (Maule & Featonby, 2016; Berisso, 2018). In addition to assisting learners with CVD, adjustments in class may



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assist learners with CVD, whilst also providing additional information to other learners (Collins, 2015).

### 2.6.1 Inclusive education policy as background to supporting learners with CVD in school

Rooted in human rights ideology, inclusive education has brought about change in schools' approach, not only to allow learners with different abilities but to cater for them. Although different views exist on the meaning of inclusive education, this phenomenon is generally seen as providing opportunities for full participation for all learners, including those with different abilities in mainstream education. Inclusive education therefore propagates the accommodation of all learners in one class irrespective of the intellectual, linguistic, physical, social and emotional challenges experienced by individuals (Landsberg et al., 2016).

According to UNESCO (1994)[6], inclusive education implies an education system that responds to the diverse needs of learners by accommodating different tempos and styles of learning whilst ensuring quality education to all learners through suitable teaching strategies, resources, appropriate curricula, organisational arrangements and partnering with relevant role-players and communities (Landsberg et al., 2016). As such, inclusive education accommodates learners through equity, equality, access and redress (Ngubane, 2019). When implementing inclusive education, learning is supported for all learners with the aim of developing the holistic learner despite their diverse needs through the adaptation of the learning environment within mainstream school settings (Du Plessis, 2013).

South African policies such as the South African Constitution of 1996 (Republic of South Africa, 1996a), the Bill of Rights (Republic of South Africa, 1996a), the South African Schools Act (Republic of South Africa, 1996b) and White Paper 6 of 2001 (Department of Education, 2001) guided the country towards adopting the philosophy of inclusion within the education system (Ngubane, 2019). The White Paper 6 (Department of Education, 2001) provides a framework for systemic change through strategies that can build the capacity of the education system to respond to barriers to learning in schools on ground level (DoE, 2001; Howell & Lazarus, 2008). The White Paper 6 (Department of Education, 2001) further emphasises that all children of school-going age should have access to schools regardless of their background or the challenges they may experience.

[6] I acknowledge that this is a dated source. However, I relied on the original author who conceptualised the theory.



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In South Africa, the Curriculum and Assessment Policy Statement (CAPS) documents (Department of Basic Education, 2011) form a foundational guide for curriculum implementation in schools. CAPS aims to cater for the diverse needs of all learners by fostering an inclusive education approach and recognising the importance of adapting teaching and assessment practices to ensure that learners, including those with CVD, can actively engage with educational content (Department of Basic Education, 2011). Furthermore, the South African Integrated Schooling System (SIAS) policy (Department of Basic Education, 2019) complements the inclusive principles of CAPS. The SIAS policy focuses on providing support and resources for learners with diverse needs (Department of Basic Education, 2019). This policy encourages schools to implement inclusive strategies that cater for the unique learning requirements of learners with conditions such as CVD, promoting a more supportive and accessible education system for all.

As such, the inclusion of learners with CVD in South African schools is not only supported by overarching policies like the White Paper 6 (Department of Education, 2001), the South African Schools Act (Republic of South Africa, 1996b) and the Bill of Rights (Republic of South Africa, 1996a) but is also rooted in its practical implementation through the CAPS (Department of Basic Education, 2011) and SIAS (Department of Basic Education, 2019) documents. These policies collectively underscore the commitment to an inclusive education system that embraces the diverse needs of all learners, ensuring that individuals with CVD have equal access to quality education. Given the prevalence of people with CVD, it is astounding how seldom CVD is taken into consideration within education (Kvitle, 2018; Berisso, 2018) and even though most teachers are aware of CVD, they seemingly seldom make any adjustments to better support and accommodate such learners in class (Maule & Featonby, 2016). In this regard Bailey (2013) argues that “with color deficiency being one of the most common disorders of vision it is important to spread awareness of this invisible disability, so as to provide a greater role in advocacy and assistance” (p. 2).

Despite South Africa’s inclusive education policy (Department of Education, 2001) being in place, many challenges and inequality within the South African education system have remained, resulting in the policy not yet implemented in practice as initially envisioned (Ngubane, 2019; Mpu & Adu, 2021). Amongst the most prominent reasons, teachers often feel inadequately trained and unprepared to implement inclusive education (Phasha et al., 2017; Louw et al., 2020) in terms of both the Revised National Curriculum Statement (RNCS) (Department of Education, 2002) and the CAPS (Department of Basic Education, 2011). The implementation of these education policies is associated with several challenges,



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including the resource constraints faced by many schools, particularly in terms of funding and specialised support for learners with diverse needs, including those with CVD. Recent studies, such as that by Mpu and Adu (2021), call attention to the ongoing challenge of resource allocation and support for teachers, with this having a negative effect on their implementation of inclusive education policy in South Africa across all schools. As such, teachers may experience difficulties in adapting their teaching methodologies to accommodate learners with special needs, such as those related to CVD.

Even though teachers are often expected to play an important role in creating an educational environment that is conducive to learners' optimal performance (Ngubane, 2019), the National Teacher Education Audit (Department of Education, 2017) indicates that many teachers are under- or unqualified, in addition to schools in rural areas being generally poorly resourced, with these factors impacting the implementation of inclusive education policy (Ngubane, 2019). Another challenge relates to awareness and understanding among teachers regarding the specific needs of learners with CVD due to limited training and awareness programmes hampering the effective integration of learners with CVD in mainstream classrooms. In this regard, research by Mpu and Adu (2021) emphasises the importance of ongoing professional development for teachers to enhance their understanding of inclusive education principles, particularly in catering for the diverse needs of learners.

Finally, many schools still lack the necessary infrastructure to accommodate learners with disabilities, with this hindering the successful implementation of inclusive education policies (Department of Basic Education, 2011). The work of Gore (2023) stresses the need for addressing infrastructure challenges to create more accessible environments for all learners. Recent studies on the challenges of implementing inclusive policies stress the need for sustained efforts to address these constraints in the context of inclusive education in South Africa. Additionally, factors such as a lack of parental involvement and support, overfull classrooms, labour union activities leading to the disruption of classes and socio-economic challenges may have a negative impact on inclusive education policy implementation (Landsberg et al., 2016).

### 2.6.2 Role of the teacher in supporting learners with CVD

Despite the central role of teachers to implement inclusive education and support all learners to perform optimally, several studies indicate that teachers are often unaware of CVD and the challenges associated with the condition (Collins, 2015; Maule & Featonby, 2016; Tofts,



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2007). As a result, teachers often do not realise that the media used for teaching, such as textbooks, worksheets and educational software may not have been designed to accommodate learners with CVD (Maule & Featonby, 2016). In order to be able to better support learners with CVD there is a need for an increased awareness of the condition and the challenges that such learners may experience within the classroom, by not only the general public, but in particular by people in the teaching sector (Berisso, 2018; Maule & Featonby, 2016), with an associated understanding of the unique needs of learners with CVD.

To this end, Klooster (2016) argues for teachers to be aware of learners with CVD to be able to be proactive and implement strategies that can assist such learners. Closely aligned, Collins (2015) found that elementary school librarians often do not feel sufficiently informed about CVD and the associated challenges yet want to learn more about the condition to facilitate the necessary positive change by lending the necessary support to learners affected by the condition. As background to this general limited awareness amongst the teachers of learners with CVD, various studies point to teachers not receiving any training on CVD or how to support these learners (Maule & Featonby, 2016). In support, Hui (2021) argues that teachers ought to “provide physical and emotional help to children with color vision deficiency” (p. 664).

Therefore, even though evidence of CVD has been existing for years (Nuñez et al., 2018) teachers often indicate that they are not aware of the needs of such learners (Collins, 2015). For best practices to be implemented, teachers thus need to be sensitised to these learners’ needs (Klooster, 2016; Maule & Featonby, 2016; Berisso, 2018). In this regard, Chan et al. (2014) argue that an increased awareness of CVD amongst teachers can, in turn, assist in the identification and development of corresponding coping strategies for learners with CVD.

It goes without saying that teachers will fulfil an important role in fostering an inclusive and supportive learning environment for learners with CVD. As stated earlier, CAPS provides a framework that guides curriculum and assessment in South African schools (Department of Basic Education, 2011), with this policy clarifying the role of the teacher as one including differentiated instruction to accommodate diverse learning needs. Teachers are accordingly expected to adapt their teaching methods to cater for the unique needs of individual learners, including those with diverse abilities. Furthermore, teachers play a pivotal role in the assessment and evaluation of learners' progress, with various assessment methods being recommended to gauge learners' understanding and mastery of learning content



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(Department of Basic Education, 2011). Therefore, teachers can make use of various strategies to ensure that learners with CVD have equitable access to educational materials, experiences and assessments. The use of differentiated instruction in support of learners with CVD means that various formats, such as written text, verbal explanations and visual media with distinct patterns or textures can be incorporated by teachers in class. This approach, which is supported by several studies (Rose & Meyer, 2002; Meeks et al., 2016; Rubin et al., 2009; Berisso, 2018), acknowledges the diverse learning styles and visual abilities of different learners, including those with CVD.

In addition to attending to teaching and assessment strategies in class, teachers are encouraged to collaborate with professionals in support services, including special education professionals, that may further enhance the support provided to learners with CVD. By engaging in a collaborative approach, teachers can tap into specialised knowledge and resources that may assist them in the implementation of individualised accommodations in support of all learners, including those with CVD (Mpu & Adu, 2021). Yet, teachers' roles are diverse and multifaceted, stretching further than the mere awareness of CVD and adapting teaching and assessment strategies in support of learners with unique abilities. As such, the roles of teachers are crucial regarding providing overall support to learners with CVD within the school context.

Teachers will, for example, often serve as mentors by fostering a supportive environment that acknowledges and celebrates diversity. Through the promotion of an inclusive atmosphere, teachers can model respect and understanding that may contribute to creating a positive learning space for learners with CVD to feel valued and accepted (Adelman & Taylor, 2017). In addition, teachers are responsible for classroom management and should consider factors such as seating arrangements, classroom displays, and the use of colour-coded educational media to create an organised and accessible space for all learners (Klooster, 2016; Chan et al., 2014; Kvitle, 2018). Additionally, Prieto et al. (2021) recommend that teachers consider existing tools and strategies used by learners with CVD, building on what is already in place, in consultation with the learners with CVD. In this way, teachers can identify the learners that may be integrated into the development of learning content and the preparation of suitable learning material. Such a collaborative approach will not only respect the expertise of learners with CVD but may also promote a more inclusive and effective learning environment for all learners.



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### 2.6.3 School-based support strategies

Different learners with CVD experience different challenges with certain colours, depending on the type and severity of their CVD. Therefore, it seems important that school-based efforts should be planned to accommodate a variety of possible needs of these learners. In this regard, Collins (2015) posits that it may be challenging firstly to identify learners with CVD, and secondly, to become aware of the specific needs of each learner. This scholar subsequently recommends a learning environment that is accessible to learners with any type of CVD. To this end, the over-all needs of learners with CVD should be considered when preparing learning environments, teaching material and strategies, and developing educational content (Cole, 2004) to create a learning environment that is inclusive of all learners (Prieto et al., 2021).

The use of a universal design for instruction may offer a potential way of accommodating learners with CVD, amongst other learners with special needs. A universal approach to learning aims to address as many of the needs of learners as possible so that the learning opportunity is accessible to all learners in class (Collins, 2015; Prieto et al., 2021). The implementation of a universal design in support of inclusion has gained field in recent years (Kvitle, 2018; Prieto et al., 2021) and was specifically designed to create a flexible curriculum with access points for the range of learners who may experience barriers to learning (Rose & Meyer, 2002). This implies support for the recognition of learning by using multiple, flexible methods of presentation; support for strategic learning by incorporating multiple, flexible methods of expression; and support for effective learning through the use of multiple, flexible methods of representation. As attention should be focused on the complex interactions between learning objectives, outcomes, performance support strategies and technology rather than merely the environment (Edyburn, 2010), a universal design for learning does not simply imply the incorporation of multimedia and web tools (Edyburn, 2010).

#### *2.6.3.1 Supportive teaching and classroom instruction practices*

The Colour Universal Design Organization (CUDO, 2006) stresses the importance of information being represented in class in a way that considers the needs of all learners, including those with CVD to convey information in an effective way to as many learners as possible. Through the use of a universal design, lessons are accordingly prepared beforehand to accommodate all learners and their unique needs, thereby creating a welcoming environment for all (Collins, 2015). In this way, accommodations can be focused



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on the learning environment and teaching practices, utilising several practical strategies to accommodate learners with CVD.

In terms of the learning environment, good lighting and clear visibility are important. As such, the classroom should be equipped with sufficiently bright lighting with no glare or shadows being projected on boards where learning content is demonstrated (Colour Blind Awareness, 2022). In addition, learners with CVD may benefit from sitting close to the board where work is explained, large text and enlarged visuals when colour is used, and the use of labelled colours with text when the use of colour is unavoidable (Colour Blind Awareness, 2022).

For teaching, teachers can rely on various strategies in support of learners with CVD. Firstly, teachers can communicate to learners, both verbally and in written format that they are available for private consultations to address any barriers to learning, specifically those associated with CVD. This proactive approach will encourage open communication and ensure that learners feel supported in their unique learning needs. Additionally, teachers should refrain from using red laser pointers, considering that they may pose visibility challenges to learners with CVD. To enhance accessibility, it is recommended to avoid exclusively referring to educational media by colour. Instead, teachers can describe these media using noncolour-based characteristics, promoting a more inclusive understanding of the learning content. Furthermore, in situations where the names of colours are essential, teachers should explicitly state the colour names to assist learners. Finally, it is advisable to avoid solely relying on colour when naming objects; for instance, using descriptors like *the triangle at the top* rather than referring to *the red triangle* to ensure that instructions are accessible to all learners, irrespective of their colour vision abilities.

Meeks et al. (2016) who developed a universal design for the unique challenges often faced by medical students with CVD suggest the use of high-quality grayscale images, and the adjustment of colour laser pointers when teaching. Although their research and recommendations are specifically for medicine learners at university level, the recommendations may also bear relevance in the school setting. In general, the application of universal design principles may create flexible learning environments by presenting information in multiple formats and accommodating diverse learning needs (CUDO, 2006). Through the use of various modalities, such as auditory or tactile elements alongside visual content, teachers may thus provide learners with CVD increased access to information (CUDO, 2006).



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Individualised Learning Plans are another way of providing tailored support for learners with CVD. Existing literature indicates that Individualised Learning Plans can provide a teacher with the opportunity to include a range of accommodations based on the specific needs of a learner. Adelman and Taylor (2017) emphasise the important role that Individualised Learning Plans play in addressing barriers to learning, as such plans may provide support to learners with CVD by recommending adjustments such as using alternative colour-coded media, using enlarged and high-contrast print materials, and allowing additional time for tasks that involve colour interpretation (Berisso, 2018; Simunovic, 2010). As such, Individualised Learning Plans, informed by the experiences and collaboration between teachers, learners, parents and other important educational role players may thus contribute to creating an inclusive learning environment for learners with barriers to learning, including those with CVD (Adelman & Taylor, 2017).

An alternative way of teaching and classroom instruction that may support learners with CVD relates to the integration of assistive technologies. Colour-filtering applications and screen overlays may, for example, be beneficial in adapting digital content for learners with CVD (Sakr et al., 2024). Audiobooks and e-learning platforms may also provide alternative ways for learners to engage with the learning content. Despite these possibilities being available, the question may be raised as to the accessibility of such resources by all teachers, specifically those in resource-constrained settings.

Peer support with regard to individualised assistance is another valuable way of supporting learners who experience barriers to learning. Collaborative learning structures may, for example, encourage peer interaction, which can include learners working together on projects and sharing notes (Mpu & Adu, 2021). Furthermore, engaging in discussions that consider the diverse visual perspectives and needs of learners may fulfil an important role. To this end, teachers play a central role in fostering effective peer support and creating a supportive and empathetic classroom culture (Mpu & Adu, 2021).

#### *2.6.3.2 Adapting teaching resources*

Learners with CVD are often required to develop adaptive strategies themselves to overcome the barriers they face due to limited teaching resources being available that consider their needs (Torrents et al., 2011). In terms of some adaptations that can be made to teaching resources, Meeks et al. (2016) propose that teachers avoid the use of colour to distinguish or note items in presentations and examinations, but rather use arrows or numbers in black ink together with high quality grayscale images. Jenny and Kelso (2007)



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similarly recommend that colours used in maps and graphics be supported by labels and changed saturations, hues and line widths to assist learners with CVD. Through the use of computer monitor adjustments to grayscale, the texture of images and the contrasts used can also be adjusted for learners with CVD (Rubin et al., 2009), enabling them to differentiate visually between information that is colour-coded.

According to Berisso (2018), a relatively easy way to create content that accommodates learners with CVD is to consciously avoid colour combinations that may pose challenges to them. Instead of relying on colour-coded information, alternative methods, such as the incorporation of patterns, annotations or varying shades of black and white can be considered. Berisso (2018) suggests that these modifications may enhance the accessibility of materials for learners with CVD, making it easier for them to interpret and engage with the learning content. Through the use of such inclusive design practices that consider the visual needs of those with CVD, teachers and content creators may provide not only more inclusive and supportive resources but also a learning environment inclusive of learners with CVD.

Various authors have made practical recommendations to enhance the accessibility of teaching resources and subsequently address the challenges often faced by learners with CVD (Frane, 2015; Berisso, 2018; Bigman, 2015; Prieto et al., 2021). When teaching online or using electronic boards, teachers can, for example, consult developers for available media specifically designed to support learners with CVD. Additionally, teachers can customise the settings of technological resources such as computers and projectors by adjusting font size, screen resolution, colour usage, contrast and brightness to cater for the visual needs of learners with CVD (Frane, 2015). The use of black font and lines on a white background for instructional media such as slides, handouts, graphs and text is also recommended. Furthermore, using black markers on whiteboards may enhance the accessibility of information for learners with CVD.

To address the challenges related to colour discrimination, it is suggested that teachers avoid small or thin elements and opt for larger text and visuals. By implementing the so-called 6 by 6 rule – presenting six or fewer points of information, each with no more than six words – teachers can practise this suggested strategy (Bigman, 2015; Prieto et al., 2021). The incorporation of symbolic elements alongside colour may be another inclusive way to present information in support of learners with CVD (Prieto et al., 2021). To be more specific, different shapes, patterns, line thickness and textual labels linked to graphic elements are



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recommended for multiple distinctions. Diverse elements, such as positions, shapes, line types and patterns can thus be used instead of colour to convey information (Berisso, 2018; Prieto et al., 2021). Further recommendations include underlining text or using bold and italics to emphasise or highlight information. Using letters, numbers or symbols instead of colours for lists, and employing clear lines and labels on tables and graphs may furthermore enhance the possibility of learners with CVD to access all the information presented to them (Frane, 2015).

When colour is used teachers need to ensure high contrast between foreground and background to reduce the blending of colours for learners with CVD. Considering the prevalence of red-green type CVD, caution is also advised against using contrasting green and red colours (Berisso, 2018; Bigman, 2015). Alternatives such as blue vs. red, blue vs. orange, and green vs. magenta are recommended. It is further suggested to avoid low-saturation colours, and to rely on differences in lightness rather than on hues alone (Berisso, 2018). It is recommended to also avoid dark backgrounds with a red foreground. In addition, teachers can test graphics with someone with CVD before a presentation. In summary, the overarching guideline is never to rely on colour alone when conveying information (Berisso, 2018).

Although several recommendations are made in support of learners with CVD, it is also important not to neglect the needs of other learners in class as colour may play an important role in learning for learners with normal vision (Dzulkifli & Mustafar, 2013; Reppa et al., 2020). Keeping other learners in mind, Wu et al. (2019) created a set of texture composition principles that can enable learners with CVD to distinguish colours, while maintaining the necessary visibility and aesthetics for learners with normal vision. These can enable learners with CVD to access website designs and commercial advertisements easily without losing the aesthetic value for others (Wu et al., 2019). Furthermore, Prieto et al. (2021) propose adapted packaging designs of certain art and stationery materials to support people with CVD, such as the use of patterns and labels on different colour art supplies to assist learners with CVD to differentiate between colours.

#### *2.6.3.3 Relying on assistive devices*

Recent years have seen several technological developments in support of people with CVD (Tanuwidjaja et al., 2014); for example, in the form of filter applications, such as those used in corrective glasses, and also in terms of software that can filter images to assist people with CVD to distinguish between colours (Wu et al., 2019). Technological adaptive strategies



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that can support learners with CVD accordingly include tinted lenses that may enhance the ability to discriminate between specific colours (Simunovic, 2010; Birch, 2012). Tinted lenses selectively alter the wavelengths of light that reaches the eyes, thereby enhancing colour perception and improving the contrast between certain hues (Simunovic, 2010). These lenses are available in different tints and shades, allowing for customisation based on individual needs and preferences. For instance, individuals with red-green colour deficiencies may benefit from lenses that specifically enhance the possibility to differentiate between red and green hues. Tinted lenses can be integrated into various visual aids and assistive technologies, such as glasses, contact lenses or specialised devices designed for specific tasks (Kalmus & Wiethaus, 2010). Electronic devices such as tablets or computer screens equipped with colour adjustment settings can also be paired with tinted overlays or filters to optimise visual content for individuals with CVD (Birch, 2012). These overlays can be adjusted to emphasise or modify specific colour ranges, making digital information more accessible.

Additional assistive technology options include daltonising algorithms and colour transparency overlays (Serrantino et al., 2015). These technologies, including specialised glasses, aim to enhance colour perception and facilitate a more inclusive experience for individuals with CVD. The assistive technologies do not only cater for different types of CVD but also offer customisation based on individual preferences and needs (Simunovic, 2010). To be more specific, daltonising algorithms entail digital tools designed to transform images or visual content to make them more distinguishable for individuals with CVD. Software applications such as Visolve or Color Oracle employ daltonising algorithms to modify digital content on screens, making it more accessible for users with CVD (Serrantino et al., 2015). However, colour transparency overlays entail physical overlays that can be placed on printed materials to modify the appearance of text or images. These overlays can enhance colour contrast and readability for individuals with CVD. Products such as ColorADD or Irlen Coloured Overlays offer various coloured overlays that can be placed on reading materials, potentially providing individuals with CVD with an improved reading experience (Serrantino et al., 2015; Birch, 2012).

As stated, some devices can assist learners with CVD by altering the appearance of objects through image processing algorithms. These may decrease the natural appearance of objects; however, they will enable the learner to differentiate between certain colours (Gómez-Robledo et al., 2018). One of these possibilities, EnChroma glasses, for example, uses optical filters to block certain parts of the visible light spectrum, thereby changing



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colours that are captured and presenting these in a supportive way during daily activities (Tanuwidjaja et al., 2014). Although a coloured filter can change the appearance of certain objects, it will still be different from a normal observer's vision (Hui, 2021). As such, a customised colour filter for a person with CVD will not enable them to see a new colour but to see colours differently, allowing them to distinguish between colours more easily. Because of contradicting conclusions in terms of the effectiveness of these devices for people with CVD (Gómez-Robledo et al., 2018), ongoing research in this field of interest is important.

Lin et al. (2019) developed another supportive tool in the form of an image enhancement technique that makes use of CVD-proof colours while preserving the naturalness of a scene to assist people with CVD. This technique makes use of real-time processing and can possibly be implemented at a low cost on technological devices to be used in everyday life (Lin et al., 2019). This real-time functionality enhances its practicality and usability, making it suitable for integration into various technological devices commonly used on a daily basis. What adds to its appeal is the potential for cost-effective implementation of an image enhancer, making it a feasible solution with widespread use (Lin et al., 2019). In practical terms, this tool could be integrated into devices such as smartphones, tablets or other display screens, providing individuals with CVD with access to a visually enhanced environment without compromising the naturalness of the scenes they view.

Computer programs, filters and software programs on smartphones offer other valuable tools to assist learners with CVD. One notable example entails the utilisation of colour correction software that allows users to adjust the colour settings on their computers. Applications like Windows Magnifier or macOS Accessibility offer customisation options that cater for the specific needs of individuals with CVD by including settings that provide features to modify colour contrast, adjust saturation or enable grayscale modes (Birch, 2012; Simunovic, 2010).

Moreover, smartphones equipped with accessibility features may further provide support for learners with CVD. To be more specific, both Android and iOS devices offer built-in accessibility features that include colour adjustments. For instance, iPhone users can access the Display and Text Size settings that provide options for increasing contrast, reducing motion and enabling colour filters that cater for different types of colour deficiency. Android devices offer similar functionalities, allowing users to adjust colour inversion,



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enhance contrast or activate the grayscale mode to enhance visual clarity for individuals with CVD (Birch, 2012; Simunovic, 2010).

In addition to built-in features, various third-party applications are designed specifically to assist individuals with CVD. Applications such as Colour Blind Pal or Chromatic Vision Simulator use real-time processing to provide users with live visual feedback, helping them to distinguish between different colours. These applications can be valuable tools for learners with CVD, aiding them in tasks that involve colour-coded information, such as reading charts or interpreting colour-specific data in educational media (Simunovic, 2010). The integration of such software into the daily activities of learners with CVD may enhance their accessibility in the school context.

## 2.7 POTENTIAL VALUE OF TEACHER GUIDANCE IN SUPPORT OF LEARNERS WITH CVD

As indicated, there has been a global shift towards the inclusion of learners with barriers to learning in mainstream education in recent years (Kurniawati et al., 2014), which implies the accommodation of learners with CVD in terms of their specific needs. From an inclusive perspective, learners with barriers to learning are to be taught, accommodated and supported by teachers within mainstream education (Kurniawati et al., 2014; Jerlinder et al., 2010). Teachers may, however, feel uncertain about the ways in which to support learners with special needs, more so in the case of, for example, CVD, for which limited awareness currently exists.

One of the ways in which teachers can acquire the necessary knowledge and skills to support learners with barriers to learning is through in-service training (Eurydice, 2004; OECD, 2005). Existing studies confirm the possible value of in-service training in terms of strengthening the quality of education (Theunissen & Veenman, 1998; The European Commission, 2012; Eurydice, 1995). As In-service programmes generally aim to encourage and provide opportunities for teachers to acquire professional knowledge and skills, such training opportunities can contribute to the improvement of teaching and ultimately benefit the learners (Egert et al., 2018). In line with its attempt to promote the continued professional development of teachers in South Africa, the CPTD Management System Handbook (South African Council for Educators, 2013) from South African Council for Educators (SACE) states the following:

> *Like all professionals, teachers need to grow their knowledge and skills throughout their careers. Like all professions, teaching requires deep knowledge which is*



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> *continuously updated and widened, and it involves complex skills that need to be continually adapted to new circumstances. Because teachers are entrusted by parents with profound responsibilities, teachers need to continuously strengthen their capacity to help children along the path of learning, understanding and development* (p. 4).

Due to inclusive education necessitating a radical change in the education system, teachers are viewed as key stakeholders in this transition. Teacher training and attitudes have been found to play an important role in improving inclusive practices, as teacher learning and development may not only benefit teachers, but also the learners in their class (Lieberman et al., 2016). To be more specific, the use of inclusive practices within the school setting can contribute to access to quality education for learners with diverse needs, yet teachers ought to be equipped to be able to address such diverse needs. The view that professional development can foster improvements in practice is widely accepted, with teachers being encouraged to engage in professional development practices and continue studying and learning throughout their careers (Darling-Hammond, 2017). In South Africa, for example, SACE requires teachers to engage in a certain amount of professional development activities on a yearly basis with the aim of enhancing the teaching profession (South African Council for Educators, 2016).

The training of teachers can play an important role in preparing them to maintain a positive attitude and be confident when teaching learners with diverse needs (including those with CVD) in addition to developing skills in instructional adaptation to meet the specific needs of learners with CVD (Moore, 2015). To this end, a study by Coelho and Sousa (2017) indicates that teachers who engage in continued education and development practices will display more positive attitudes to inclusive practices in schools. In the same way, Moore (2015) suggests that teacher training can improve teachers' understanding of inclusion and increase positivity to the diverse needs of learners.

A teacher guidance intervention holds the potential of empowering teachers to support learners with CVD, as teachers' confidence and ability to teach learners with diverse needs have been found to improve through in-service training (Hardin, 2005). This finding is supported by Kosko and Wilkins (2009) who found that training can impact teachers' perceived ability of adapting instruction, suggesting that enrichment training may enhance teachers' confidence to teach learners with diverse needs.

A school-based intervention implies an interim teaching programme, with specific objectives to support learners requiring additional support (Poulou, 2017). A school-based intervention



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for teachers may focus on equipping teachers with the necessary skills and knowledge to support learners more effectively (Poulou, 2017). Through a teacher guidance intervention, other professionals can thus guide teachers on how to support learners with CVD during teaching and classroom instruction activities. To apply this to the focus of my study, the conceptualised teacher guidance intervention in support of learners with CVD may in future equip teachers with the necessary knowledge and skills to support learners with CVD within the school environment.

According to Ayvaz-Tuncel and Çobanoğlu (2018), the purpose of in-service training is determined according to teachers' specific needs, whilst the content ought to be practical. Furthermore, attitudes and values should be integrated within the development of knowledge and skills (Ayvaz-Tuncel & Çobanoğlu, 2018). As such, the current study focused on teachers' personal experiences in using colour and teaching learners with CVD in the classroom to determine how teachers accommodate (or do not accommodate) these learners, with the ultimate goal of conceptualising a teacher guidance intervention in support of learners with CVD.

## 2.8 CONCEPTUAL FRAMEWORK OF THE STUDY

The conceptual framework that guided my study is based on an integration of Vygotsky's theory of dysontogenesis (Vygotsky et al., 1993) and the socio-constructivist theory of Vygotsky (1987). In this section, I explain these two theories as well as the way in which I integrated the theories in compiling a conceptual framework.

### 2.8.1 Vygotsky's theory of dysontogenesis

Vygotsky's theory of dysontogenesis acknowledges the fact that every child's development is different and that all children possess unique abilities. As contemporary theory on inclusive education rests on Vygotsky's theory of dysontogenesis (Rodina, 2007), the theory is regarded as the root of modern-day inclusive education. Due to the theory emphasising the uniqueness of each child's psychological development, it accommodates a wide range of disabilities and/or abilities. For the purpose of this study, CVD is viewed as one such a condition that may negatively affect the daily living of individuals with CVD (Tofts, 2007). To this end, the theory of dysontogenesis may be relied on to explain some of the interactions between a person with CVD and their environment in support of such learners.

According to Vygotsky's theory of dysontogenesis, disability that I – in this case – relate to CVD can be considered a sociocultural developmental phenomenon rather than a condition



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simply biological in nature. From Vygotsky's perspective, sensory or neurological impairment is thus not viewed as the main problem of a disability but rather its social implications (Vygotsky, 1983). In this way the human eyes, ears and limbs are, for example, not regarded as mere physical features, due to the view that impairment "... leads to a restructuring of social relationships and to a displacement of all the systems of behavior" (Vygotsky, 1983, p.102).

Vygotsky`s theory of dysontogenesis proposes a positive societal view of children with disabilities, as the focus is shifted away from weaknesses and disorders to strengths and the empowerment of the individual. In this regard, Vygotsky (1983) argues that disability is multifaceted with a primary disability, secondary and/or tertiary disability being possible. The primary disability is accordingly regarded as the actual physical impairment with the secondary disability often caused by cultural misrepresentations of communally habituated psychological functions (Rodina, 2007). In applying this differentiation to the current study, CVD can be considered a primary disability, with several factors possibly contributing to a secondary disability, such as social interactions within the school context and the use of colour in instruction and school resources.

Vygotsky (1983) furthermore reasons that marginalisation of children in social, cultural and learning environments may be caused by a primary disability, such as vision and auditory, language and speech-related, motor and central nervous system-related injuries (Rodina, 2007). As such, it is possible that teachers may misinterpret the importance of the inclusion of learners with different abilities in social situations due to them not having sufficient information on the value of inclusive education. In the current study, the aim was to investigate teachers' perceptions of CVD and the extent to which the condition is considered during lesson planning and instruction, in order to conceptualise a teacher guidance intervention in support of learners with CVD. Such a teacher guidance intervention holds the potential of teachers being sensitised to create a more inclusive social and classroom environment for learners with CVD in support of meeting their unique needs.

### 2.8.2 Socio-constructivist theory (SCT) of Vygotsky

As one of the first social constructivists, Vygotsky led the way to understanding the cognitive processes of childhood development (Shaw, 2010). From a socio-constructivist approach, knowledge is socially constructed by means of a communicative practice, meaning that knowledge is considered as the act of people doing together rather than a mere cognitive skill (Gergen 1985). Thus, at the core of Vygotsky's socio-constructivist theory lies the idea



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that learning is a social process that occurs through interactions with others (Vygotsky, 1978); in the case of this study, interactions between teachers and learners with CVD.

According to Vygotsky, children do not construct higher mental functions independently, but through social interactions with adults that mediate the development of mental processes (Karpov, 2005). For the purpose of my study teachers are viewed as the knowledgeable adults that can mediate learning. According to Thorne (2005), Vygotsky's concept of mediation does not merely imply a method for solving problems and creating learning possibilities, as "the process of mediation-in-interaction can be understood as part of the methods by which members construct learning environments, tasks, identities and contexts" (Thorne, 2005, p. 399). Teachers can leverage this principle by promoting learning environments that take into account and include learners with CVD. This can be done by teachers being mindful of their use of colour when engaging with the learners in class and when facilitating peer interaction. During the learning process, adults' interactions with children may include questions, rephrasing, demonstrating tasks or parts of tasks, and providing hints and clues (Charlesworth, 2008).

Furthermore, children, also those with CVD, can be regarded as active participants in their own learning as they construct knowledge and understanding through the support of knowledgeable adults such as teachers. In this way, knowledgeable adults can enable children to take charge of their own thinking through interaction and collaboration (Excell et al., 2015; Vygotsky, 1978). As such, group activities, discussions and cooperative projects may not only enhance social interaction and learning but also provide opportunities for learners with CVD to share their perspectives, strategies and insights with their classmates and teachers. In addition, these social interactions may entail collaborative learning experiences for teachers and learners that can, in turn, contribute to the awareness and inclusion of learners with CVD.

Vygotsky (1978) emphasises the importance of cultural tools and artefacts in the learning process. In the case of learners with CVD, teachers can be mindful of these learners and employ various visual educational media, adaptive technologies, and colour-friendly materials that may enhance their understanding and engagement. By incorporating accessible resources and technologies, educators can ensure that learners with CVD obtain the necessary tools to actively participate in the learning process.

Another key aspect of Vygotsky's theory is the concept of the Zone of Proximal Development (ZPD) that stresses that developmentally appropriate instructions are important for optimal



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development and learning to be possible. In this regard, Vygotsky defines the ZPD as follows:

> *… the distance between the actual developmental level as determined by independent problem-solving and the level of potential development as determined through problem solving under adult guidance (Vygotsky, 1978, p.86).*

For the purpose of this study, the ZPD refers to the range of tasks that learners with CVD can perform with the help of more knowledgeable teachers in a way that accommodates the learners' specific colour-related learning challenges. In the case of learners with CVD, teachers can thus identify and scaffold tasks that align with the learners' current abilities (including their limited colour-related abilities) while gradually introducing more challenging work that encourages growth. By understanding the unique needs and abilities of learners with CVD, teachers can tailor interventions and support within the learners' ZPD, fostering a supportive and inclusive learning environment. For the purpose of the current study, I considered the ZPD when conceptualising the teacher guidance intervention in support of learners with CVD. To be more specific, I believe that teachers can alter the level of support (scaffolding) they offer to learners to match the needs of specific learners, such as those with CVD. As such, through the incorporation of principles from Vygotsky's socio-constructivist theory (1987) teachers may create inclusive and collaborative learning environments that cater for the diverse needs of learners, including those with CVD.

### 2.8.3 Integration of Vygotsky's theory of dysontogenesis and the socio-constructivist theory

Inclusive education provides a child with a disability the opportunity and right to function and flourish in mainstream education. From an inclusive education stance, there is no room for isolation or segregation of learners on whatsoever ground. Although learners with CVD are generally included in mainstream education, the use of colour in teaching, teaching resources and the school environment may cause limitations or restrict their participation in learning activities. Against this background I integrated Vygotsky's theory of dysontogenesis (Vygotsky et al., 1993) and the socio-constructivist theory of Vygotsky (1987) to compile a conceptual framework where both positive and negative perceptions of disability, in this case CVD, are taken into consideration, while emphasising possible measures that may enhance the accommodation of such learners in school. To this end, Vygotsky's theory of dysontogenesis looks at how all learners' unique abilities can be acknowledged and how all learners can be included in mainstream education. I accordingly did not compile a framework on how to teach a class of learners with CVD but rather focused on how learners with CVD



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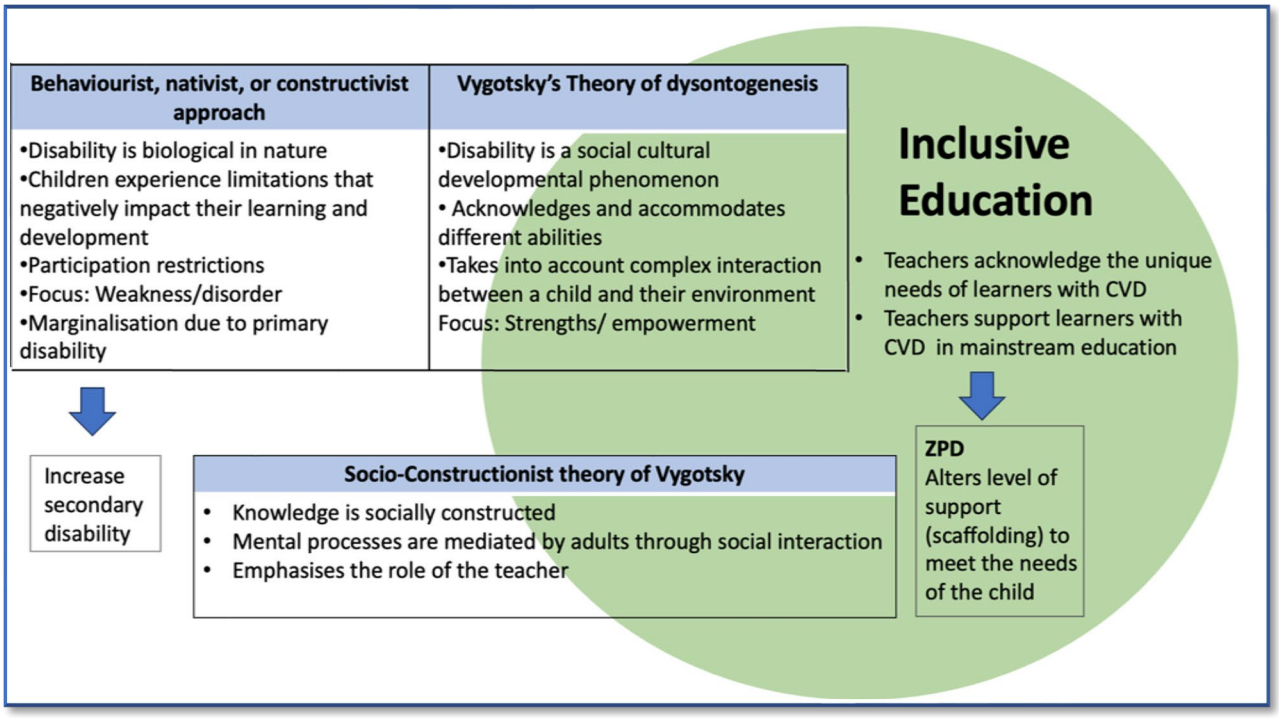
may be included in mainstream classes through changes in social interactions that may be supportive of various learners with CVD.

Based on Vygotsky`s socio-constructivist theory (1987), a unique vision for future models of special education has been formed that relies on inclusion and positive differentiation (Gindis, 2003). Vygotsky`s theory of dysontogenesis similarly stresses a positive resource-oriented approach where societal views of children with disabilities are shifted away from traditional views that focus on weaknesses, to strengthening and the empowerment of individual skills. In integrating these concepts from the two theories, I compiled a conceptual framework that could guide me in determining the way in which teachers consider CVD during lesson planning and teaching, with the purpose of ultimately conceptualising a teacher guidance intervention that may strengthen the way in which teachers support these learners in school. My conceptual framework is provided in Figure 2.9.

**Figure 2.9:**

*Conceptual framework of the study*




According to Rodina (2007), both Vygotsky's theory of dysontogenesis and the socio-constructivist theory provide for the practical implementation of inclusive education. To be more specific, social constructivism forms the basis of Vygotsky`s theory of dysontogenesis that, in turn, forms a theoretical basis for inclusive education. Therefore, in an inclusive education model, the borderlines between mainstream and special education become less distinctive (Rodina, 2007), with mainstream education becoming inclusive (Vygotsky et al.,



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1993), as represented in Figure 2.9. To apply this to the current study, even though learners with CVD are typically taught in mainstream schools, the educational media that are used may not be inclusive and supportive in terms of such learners' specific needs. Against this background, the conceptual framework of my study stresses the importance of not merely acknowledging different abilities but also accommodating different abilities, such as in the case of learners with CVD within the school context.

As Vygotsky's theory of socio-constructivism (1987) highlights how knowledge is socially constructed through communicative practice, it follows that teachers' communicative practices can either inhibit or support the performance of learners with CVD. Accordingly, the focus falls on learners' developmental stages rather than on CVD as a medical condition. As the current study is focused on the extent to which CVD is considered during lesson planning and teaching, the way in which the use of colour may prevent learners with CVD from reaching their ZPD comes to the fore. For the purpose of my study, the aim was specifically to determine how learners with CVD can be supported to reach their ZPD to perform optimally.

When building on Vygotsky's concept of interaction as the basis for learning, teachers become mentors to learners, with their role in facilitating learning and in the process helping learners reach their ZPD being emphasised. As I aimed to conceptualise a teacher guidance intervention in support of learners with CVD, the focus thus falls on teachers and the role that they can play in supporting learners with CVD to perform optimally. Through the incorporation of the socio-constructivist theory and more specifically the ZPD, the focus is shifted to the teacher and how their knowledge and skills may support learners with CVD.

In this manner, the integration of these two theories provides a framework for the optimal development of all learners' unique abilities, including learners with CVD through social interactions with teachers. More specifically, Vygotsky's theory of dysontogenesis stresses the unique abilities of each learner and the importance of social interactions in their development, whilst Vygotsky's socio-constructivist theory provides guidance on how learners can learn with the support of teachers that scaffold information. Thus, the integration of these theories emphasises the unique abilities of each learner with CVD and views them as capable of learning whilst drawing attention to the role of teachers in the learning process. The emphasis does not fall on CVD *per se* but rather on the social interaction between teachers and learners with CVD, and how these interactions can foster optimal development. When teachers shift the focus away from a learner with CVD's



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challenges to their abilities, they can change their teaching and instruction to support such learners. The ZPD further emphasises the important role of the teacher in the optimal development of learners with CVD. When teachers are cognisant of learners with CVD's abilities during teaching and classroom instruction and make use of communication and supportive tools that can support the performance of learners with CVD it is more likely that optimal learning will take place.

## 2.9 CONCLUSION

In this chapter, I discussed the existing literature on CVD and the effect of the condition on individuals, more specifically on learners in school. I explored the causes, types and prevalence of CVD and then described the identification, screening and diagnosis processes involved. I explained the potential effect of CVD on people's lives across the lifespan with regard to school-related challenges, possible psychological implications, and possible challenges experienced with career choices. Next, I reported on possible ways of supporting learners with CVD, focusing on current education policy, the role of teachers as well as possible school-based support strategies. I also explored the potential value of teacher guidance interventions and then concluded the chapter with an explanation of the conceptual framework that guided my study.

In the following chapter, I discuss the research design and methodological strategies of the current study in more detail. I explain the paradigms that informed my study as well as the associated methodological choices I made. I also report on the rigour of my study and the ethical considerations I adhered to in undertaking my research.

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# CHAPTER 3 - RESEARCH DESIGN AND METHODOLOGICAL STRATEGIES

## 3.1 INTRODUCTION

In the preceding chapter I explored CVD and the challenges associated with the condition. I discussed existing literature on the use of colour, especially in the school context, and reported on the current body of knowledge regarding the challenges associated with CVD as experienced by learners in school. I further explored existing literature on ways of supporting learners with CVD within the school context, touching on literature that focuses on inclusive approaches. Finally, I explained the conceptual framework that guided my study.

In this chapter, I discuss the empirical part of my study in terms of the selected paradigms, research design and associated methodological strategies I utilised. I conclude the chapter by describing the quality criteria I endeavoured to meet and the ethical principles I respected in undertaking this study. As an introduction to my discussion, I provide an overview of the selected research methodology in Figure 3.1.



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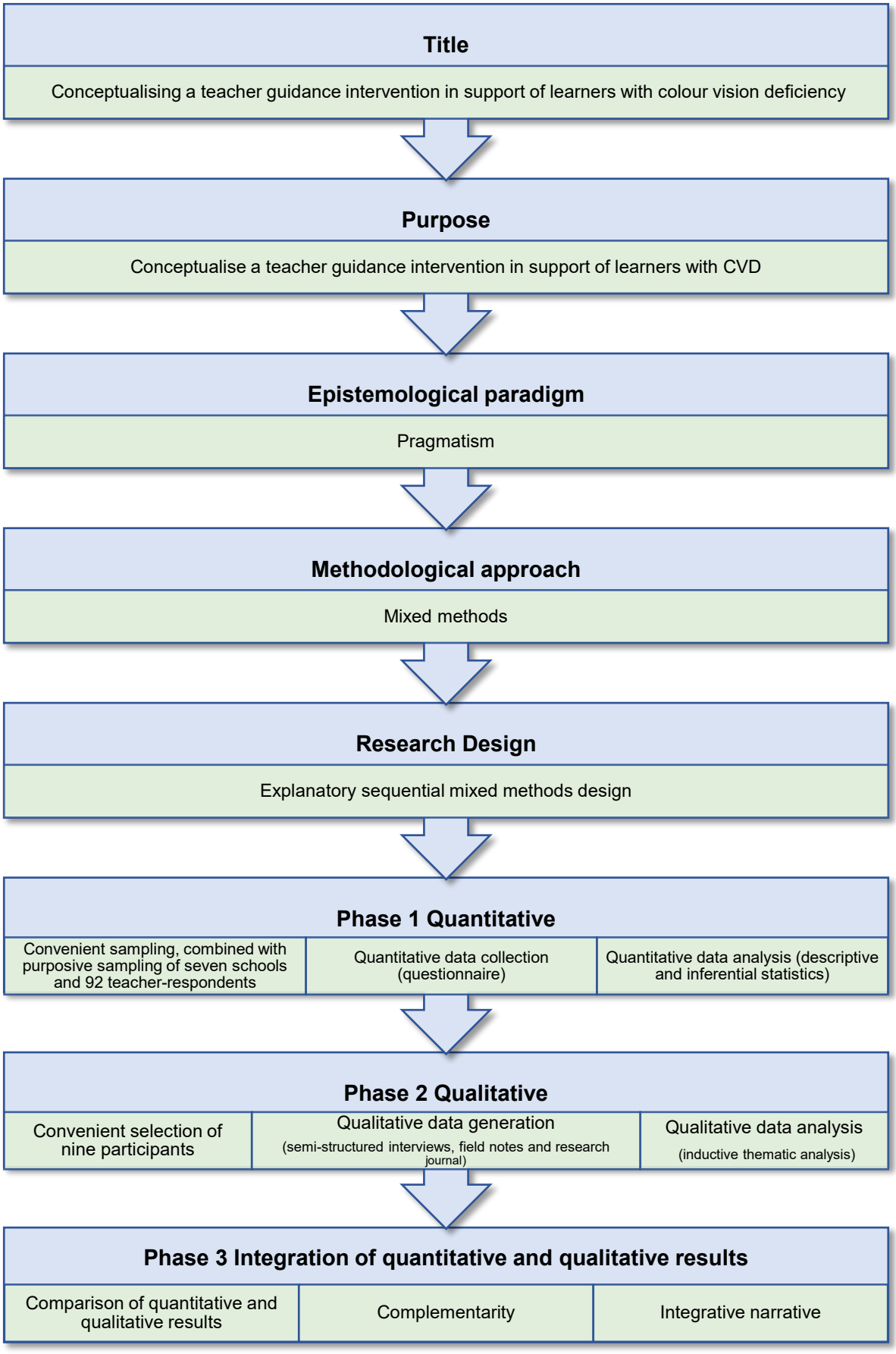
**Figure 3.1:**

*Brief overview of the research methodology*



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## 3.2 PRAGMATISM AS EPISTEMOLOGICAL PARADIGM

The use of specific philosophical underpinnings in research enables the researcher to connect the research to intellectual traditions and influences the practice of research (Creswell & Creswell, 2022). Methodological frameworks are grounded in such philosophical underpinnings that determine the epistemological paradigm adopted for a study. A paradigm is often referred to as a *world view* and can be described in terms of certain assumptions about the world along with actions that take place within it (Rossman & Rallis, 2011). As such, a paradigm implies a specific set of assumptions based on reality and knowledge.

The current study is positioned within pragmatism as epistemological paradigm. Pragmatism arose from "actions, situations, and consequences rather than antecedent conditions" (Creswell, 2013, p. 10), based on the work of Charles Sanders Pierce, Willian James, John Dewey and George Herbert Mead (Creswell, 2013). Inspired by an evolutionary perspective where interaction and integration were highlighted (Rylander, 2012), pragmatism focuses on the research problem rather than the method (Creswell, 2013). This paradigm promotes a holistic view, implying the possibility of two worlds merging, with different techniques from different pragmatic perspectives being used in the same study (Creswell & Creswell, 2022). This paradigm allows the researcher to use different methodological strategies (Creswell, 2009; Creswell & Plano Clark, 2018) and follows a process of adapting logical thinking to practical constraints of real-life situations (Creswell, 2009).

Pragmatism provided a suitable framework for the mixed methods study I undertook (Biesta, 2010). I positioned my study within pragmatism as this paradigm aligns with the solving of real-world problems (Teddlie & Tashakkori, 2009). According to Johnson et al. (2016), pragmatism focuses on what works, rather than on the dogmatic of a priori claims related to what can be done in research. Thus, from a pragmatic perspective, researchers will collect data based on *what works,* with the aim of finding solutions and answering research questions (Creswell & Plano Clark, 2018). In such cases, all available approaches to understanding a research problem will be employed, rather than merely focusing on one specific method (Creswell & Creswell, 2022). Creswell (2014), Morgan (2007), as well as Tashakkori and Teddlie (2010) recommend this epistemology when conducting mixed methods research specifically within the field of social science, as "pragmatism is not committed to any one system of philosophy and reality" but rather "opens the door to multiple methods, different worldviews, and different assumptions, as well as different forms of data collection and analysis" (Creswell, 2014, p. 11).



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In elaborating on the reasons for pragmatism being regarded as suitable when following a mixed methods approach, Creswell (2009) firstly refers to the procedures, techniques and methods chosen with a specific goal in mind when adopting this epistemology. Next, according to the pragmatist view, the world is not seen as an absolute unity that can be associated with the use of multiple approaches to conduct data collection/generation and analysis. Thirdly, by combining quantitative and qualitative data, the researcher may be able to gain an in-depth understanding of the research question. Finally, mixing methods and adopting a pragmatic perspective correspond with each other, as both focus on the *what* and the *how* of research.

Creswell and Plano Clark (2018) further describe pragmatism as a worldview that stems from actions, situations and consequences. In this way, pragmatism can allow for various viewpoints in terms of how knowledge is generated (Biesta, 2010) by acknowledging both single and multiple realities (Mertens, 2008). Multiple realities in the current study include the different perspectives of the teachers who were involved in the study, the use of colour in the school context and their experiences of teaching learners with CVD (Creswell, 2009). To be more specific, the collected/generated data in my study portrays the experiences of teachers of how colour is generally used in school and how learners with CVD are accommodated (or not) within this context.

Pragmatism is, however, often critiqued for lacking usefulness in research that is aimed at addressing general problems (Feilzer, 2009). To this end, I remained mindful of the purpose of my study, namely, to explore and describe teachers' current disposition to CVD and the extent to which the condition is considered during lesson planning and instruction, in order to conceptualise a teacher guidance intervention in support of learners with CVD. I reminded myself that my purpose was not to address any other problems perceived in schools or to immediately address the challenges faced by learners with CVD. The possibility, however, existed that the teachers who participated may have acquired knowledge during the research process that they can potentially apply in practice. Future development of a teacher guidance intervention may also contribute to solving such problems.

Pragmatism may be further critiqued for its practical objectives (Bacon, 2012; Biesta, 2010; Malachowski, 2004), with this view being based on earlier concerns relating to pragmatism lacking clarity in rigour (Bernstein, 2010). As present-day pragmatism rationally addresses how knowledge is created (Bacon, 2012), I do not regard this criticism as relevant to my study. In this regard, according to Biesta (2010), pragmatism allows researchers to see



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knowledge not as absolute truths but rather as the outcome of assumptions that are derived from relationships of causes and effects. To this end, Kolenda (1999, p. 251) states that, if people can live next to each other in peace, the "co-existence of alternative beliefs or schemes of thought is not a drawback, but an advantage".

For this reason, the value of pragmatism lies in there not being any limits to the methods of enquiry and consequently the available resources that are utilised to make sense of the phenomenon that is researched within the social and political world (Bacon, 2012; Creswell, 2014). In this way, pragmatism is beneficial to promote a holistic view of research by merging different world views into one and encouraging the use of methods from different paradigmatic stances to address the research questions guiding a study (Bacon, 2012). Pragmatism therefore acknowledges the compatibility of and value both quantitative and qualitative methods (Ivankova et al., 2010). Since pragmatism allows for flexibility in terms of the techniques that are used for an investigation, a wide scope of depth of knowledge can be generated when adopting this epistemology (Onwuegbuzie & Leech, 2007).

In my study pragmatism accordingly allowed me to gain a wide and deep view of teachers' use of colour in the classroom as well as of their experiences of teaching learners with CVD. This was achieved by gaining a broad understanding of the use of colour in the school context through quantitative data collection and thereafter obtaining an in-depth understanding of the phenomenon by means of qualitative data generation. In order to gain a rich understanding of the phenomenon, teachers were asked to complete a questionnaire and thereafter participate in semi-structured interviews (selected participants). During this process I remained cognisant of the research questions that guided my study.

### 3.2.1 Ontological assumptions of pragmatism

Ontology focuses on the fundamental nature of existence. It emphasises the form and nature of reality, alongside what can be known about reality (Guba & Lincoln, 1994). Pragmatism implies a dual perspective that incorporates both positivist and interpretivist ontologies (Goldkuhl, 2012). The traditional top-down approach is rejected by pragmatism, enabling researchers to focus on the connection between methodology and epistemology as well as the selected methodology and methods (Morgan, 2007). Hence, the choice of methodology can be focused on the purpose of a study instead of being philosophical (Mertens, 2008).



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### 3.2.2 Epistemological assumptions of pragmatism

Epistemology is regarded as the theory of knowledge, according to Johnson et al. (2016). As such, epistemology emphasises the nature of the relationship between the knower and what can be known (Packer & Goicoechea, 2000), and focuses on inter-subjectivity through objective and subjective views (Morgan, 2007). As a result, I searched for facts in my study, in objective and quantifiable terms (Guba & Lincoln, 1994) and also for data produced through experiential and practical methods (Heron & Reason, 1997). According to Rorty (cited in Johnson et al., 2016), postmodern pragmatism integrates truth "with the consensus of a community rather than a relation to a nonhuman reality" (p. 23).

### 3.2.3 Methodological assumptions of pragmatism

Pragmatism justifies the mixing of quantitative and qualitative methods as it stresses practical theory building (Johnson et al., 2016). As a result, research embedded in pragmatism is focused on problem-solving *via* research as well as practice (Creswell & Creswell, 2022). In this way, pragmatism legitimises the use of both quantitative and qualitative methods to answer different parts or sections of the same research question (Creswell & Plano Clark, 2018; Ivankova et al., 2010). Such use of a mixed methods methodological paradigm may provide for an in-depth investigation of a phenomenon to address a specific research question (Johnson & Christensen, 2012). Therefore, from a pragmatic perspective, the focus falls on the consequences of research. For this reason, pragmatism is regarded as pluralistic and concerned with practicality (Creswell & Plano Clark, 2018).

### 3.2.4 Axiological assumptions of pragmatism

Axiology stresses the nature of value and is concerned with "values of being, about what human states are to be valued simply because of what they are" (Heron & Reason, 1997, p. 287). Value plays an important role when conducting research and interpreting results within the pragmatic paradigm (Tashakkori & Teddlie, 2021). To be more specific, social values are embedded in postmodern pragmatism (Johnson et al., 2016). Rorty (as cited in Johnson et al., 2016) notes in this regard, "in the end … what matters is our loyalty to other human beings clinging together against the dark, not our hope of getting things right" (p. 103). In the current study, teachers' personal experiences and values and how they accommodate (or not) learners with CVD within the classroom were used to conceptualise a teacher guidance intervention in support of learners with CVD.



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## 3.3 MIXED METHODS METHODOLOGICAL APPROACH

I followed a mixed methods approach that enabled me to integrate quantitative and qualitative strategies in a way that the research questions could be answered (Tashakkori & Teddlie, 2021). When conducting mixed methods research, the diversity of data sources and analysis allows for confirmable results based on so-called *methodological eclecticism* (Teddlie & Tashakkori, 2012). Through the use of a mixed methods research approach, I was able to combine elements of quantitative and qualitative research with the aim of gaining both breadth and depth in my understanding of the phenomenon under study (Johnson et al., 2007; Creswell, 2009).

As stated, two types of data, namely quantitative and qualitative data are combined when following a mixed methods research approach. The incorporation of these data sources can lead to in-depth and detailed data that may increase the validity and trustworthiness of the findings of a study (Maree & Wagner, 2007). By merging the quantitative and qualitative data I obtained, I was able to obtain a holistic view of the use of colour in the classroom and of teachers' awareness and experiences of the phenomenon of CVD. Bryman (2006) builds on Greene et al.'s (1989) work and elaborates on the purposes of using a mixed methods approach. These purposes of this methodological approach are summarised in Table 3.1.

**Table 3.1:**

*Rationale for following a mixed methods approach*

| PURPOSE | DESCRIPTION |
|---|---|
| Credibility | The use of both approaches may enhance the integrity of the findings. |
| Context | Quantitative findings may be generalisable, provide external validity or broad relationships and may be used together with qualitative findings that can provide a more contextual understanding. |
| Illustration | Qualitative data may be used to illustrate quantitative findings, thereby, *putting meat on the bones* (quantitative data). |
| Usefulness (utility) | By combining quantitative and qualitative data the results may be more useful. |
| Confirm and discover | In a single study, qualitative data may be used to generate hypotheses that can then be tested using quantitative methods. |
| Diversity of views | Combining different perspectives and uncovering relationships is possible when following this approach. |

***Note:*** Adapted from Schoonenboom and Johnson (2017)



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In the current study the mixed methods approach I followed allowed for credibility, context, illustration and usefulness of the data and results. In undertaking my study, I conducted research in different phases, as is customary for data collection/generation in mixed methods research. Such phases can be combined at different points during mixed methods studies, which are usually determined by the methodological needs of the study (Maree & Wagner, 2007). In this regard, Creswell and Plano Clark (2018) identify three ways of merging the data of a mixed methods study. Firstly, the data can be merged by bringing the data together. Secondly, data can be merged by connecting the data with one phase and the related data set building on the other. Lastly, data can be merged by embedding the one data set into the other dataset with one data set fulfilling a supportive role for the other. As the ultimate purpose of my study was to conceptualise a teacher guidance intervention in support of learners with CVD, the two data sets I obtained were connected in such a way that the qualitative data could build and elaborate on the quantitative data.

By relying on both quantitative and qualitative methods, I could benefit from the strengths of both these approaches to research (Tashakkori & Teddlie, 2021), thereby allowing for an increased understanding of the phenomenon under study (Creswell, 2009; De Vos, 2005; Hesse-Biber & Leavy, 2006). According to Creswell (2014), a more in-depth understanding of a phenomenon is possible when combining quantitative and qualitative methods, more specifically in cases where one approach (quantitative or qualitative) is not sufficient to answer the research question(s) of a study (Creswell, 2014).

In line with this argument, I was motivated by the strengths of both research approaches and strove to build on these strengths in the current study. I was further motivated by the way in which a mixed methods approach combines methods to ensure complementary strengths and addresses non-overlapping weaknesses (Punch, 2009; Johnson & Christensen, 2012). As such, the combination of quantitative and qualitative methods enabled me to obtain a deep understanding of the phenomenon under study while allowing for increased comprehension to address the research questions. As such, through the use of a mixed methods approach I was able to meet the purpose of my study.

Due to different research approaches having different strengths and weaknesses, a mixed methods approach may support the quality of research that is conducted. In support of this view, Johnson and Christensen (2012) explain that by mixing two or more methods in a single study, each with different strengths and weaknesses, the chances of making a mistake or missing something important can be limited.



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Despite the benefits associated with this approach to research, mixed methods research has been criticised for requiring more skills and resources than in the case of a single approach (Creswell & Creswell, 2022; De Vos, 2005). Researchers may furthermore have to draw on the expertise of other professionals when conducting such a study (Creswell & Creswell, 2022). I aimed to address this potential challenge by drawing on the guidance of an expert statistician at the University of Pretoria who assisted me with compiling the questionnaire as well as with the analysis of the quantitative data. Mixed methods approaches are also criticised for potentially taking longer due to collecting/generating data from multiple sources, having to analyse numerous sources of data and triangulate the data (Creswell & Creswell, 2022). Due to mixed methods research possibly taking a long time I planned carefully and allocated specific times to the various phases of my study.

## 3.4 OVERVIEW OF THE RESEARCH PROCESS

The study consisted of three phases. The quantitative phase was conducted first, with the aim of obtaining information on the use of colour in the school context and teachers' experience and awareness of CVD. The qualitative phase was conducted second, aiming to obtain supportive in-depth information on teachers' experiences and understanding of CVD (Creswell & Creswell, 2022). During the third phase of the study, I triangulated the data obtained during Phase 1 and 2 and reported on the findings. In Table 3.2 I provide a brief overview of the different phases of the study.

**Table 3.2:**

*Overview of the phases of my study*

| | | |
|---|---|---|
| **Phase 1** | Stage 1 | A combination of convenient and purposive sampling of seven schools and 92 teacher- respondents |
| | Stage 2 | Survey (questionnaire) |
| | Stage 3 | Data analysis of quantitative data by means of descriptive and inferential statistics. |
| **Phase 2** | Stage 4 | Convenient selection of nine teacher-participants from those who participated in Phase 1 |
| | Stage 5 | Semi-structured interviews |
| | Stage 6 | Inductive thematic analysis of qualitative data |



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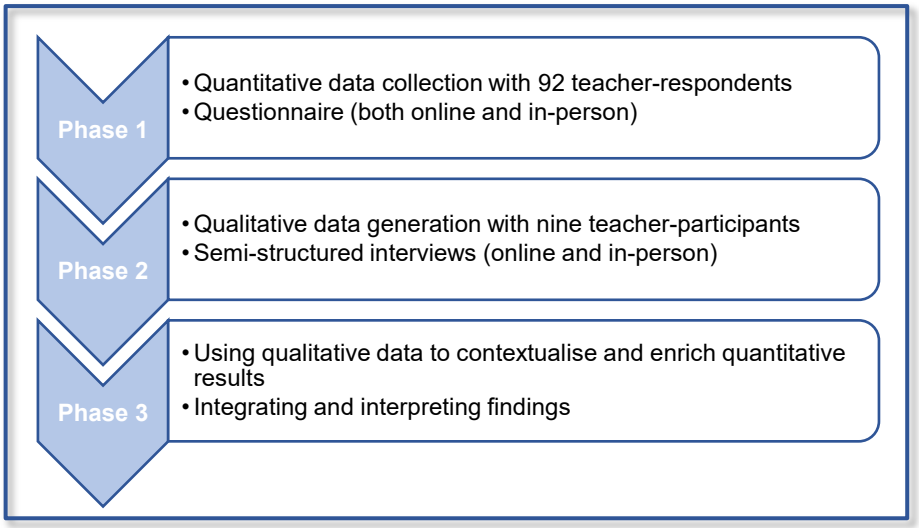
| | | |
|---|---|---|
| **Phase 3** | Stage 7 | Reporting and dissemination:<br><br>❖ Reporting on quantitative findings<br>❖ Reporting on qualitative findings<br>❖ Triangulation of the findings from quantitative and qualitative phases |
| | Stage 8 | Reporting findings in relation to existing literature |
| | Stage 9 | Answering the research questions |

### 3.4.1 Research design

Different types of mixed methods designs can be distinguished for example, convergence (simultaneous) and sequential designs (Creswell 2014). When employing a convergence design, both quantitative and qualitative methods are used simultaneously, whereas a sequential design implies that the methods are employed in a sequential manner, with the one following the other (Creswell, 2009; Creswell 2014). The methods employed in a study may either have equal status or some may be dominant (Jogulu & Pansiri, 2011). An exploratory sequential design applies when qualitative data is generated first, followed by quantitative data collection. However, an explanatory sequential design implies that the qualitative data generation follows the quantitative data collection phase (Creswell, 2009). In this study, I implemented an explanatory sequential mixed methods design, as depicted in Figure 3.2.

**Figure 3.2:**

*Application of a sequential explanatory mixed methods design*




***Note:*** Adapted from Creswell and Creswell (2022)



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In accordance with the explanatory sequential mixed methods design I implemented, I collected/generated data in a sequential manner by means of a three-phase project (Guest et al., 2012. By implementing this design I was thus able to combine quantitative and qualitative data collection/generation and analysis procedures in such a way that I could gain in-depth comprehension of the phenomenon I studied (Almeida, 2018). As indicated, during this three-phased process, the qualitative data I generated assisted me in explaining and building upon the quantitative data that was collected (Guest et al., 2012). By first collecting quantitative data I was able to gain a broad understanding of the phenomenon and thereafter structure qualitative data generation in such a way that I could gain an in-depth understanding of specific parts of the data.

To be more specific, during the first phase a survey was sent to teacher-respondents. Through the use of the survey, I thus collected broad baseline data regarding teachers' knowledge, understanding and attitudes to CVD and how they use colour within the classroom. During the second phase of the study, I conducted semi-structured interviews with a few teachers that participated in the first phase. As such, whilst the quantitative phase allowed for a broad overview of the use of colour in the classroom and teachers' understanding of CVD, the qualitative phase provided me with the opportunity to gain a deeper understanding of the use of colour in the classroom and teachers' personal experiences in teaching learners with CVD. Therefore, my selected research design enabled me to explain the quantitative data collected during Phase 1 by means of qualitative data generated during Phase 2 (Creswell 2014). I was furthermore able to cross-validate the findings I obtained through triangulation (Creswell 2014). Hence the quantitative data provided me with a general picture whilst the qualitative data assisted me in refining and explaining this picture (Guest et al., 2012).

The benefits of a sequential explanatory design include that it is easy to implement and can assist the researcher to maintain a clear focus as the one data set builds on the other (Almalki, 2016). By implementing a sequential explanatory design, quantitative data can furthermore inform the qualitative data selection process that "is a great strength in that it enables researchers to specifically pinpoint data that is relevant to a specific research project" (Almalki, 2016, p. 293). Hence, qualitative data is generally used in a supportive secondary role to provide a fuller understanding of the phenomenon under study (Creswell & Plano Clark, 2018).



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Although a sequential explanatory mixed methods design may be easy to execute and report on, it has also been critiqued for potentially being time-consuming and resource-intensive (De Vos et al., 2011). To this end I compiled a time frame to ensure enough time for data collection/generation without the study becoming too lengthy. I also drew on the skills of an expert statistician at the University of Pretoria to assist me with the analysis of the quantitative data. Furthermore, I made use of convenience sampling to assist me in recruiting respondents/participants more easily and speed up the research process (Creswell & Creswell, 2022).

Another potential challenge associated with a mixed methods research design relates to aligning the two methods of data collection/generation effectively. I drew upon the expertise of my supervisor and the statistician who assisted me with my study in planning and formulating a reasonable time frame in terms of the sequence and alignment of the quantitative and qualitative phases of my study. Due to COVID-19 related challenges, the data collection/generation however took longer than I initially planned, asking of me to remain flexible and employ additional strategies to ensure the successful completion of the research.

### 3.4.2 Phase 1: Quantitative research

Quantitative research implies a systematic, objective approach to an empirical investigation that uses numerical data and statistical analysis to draw conclusions and make inferences about a phenomenon. In quantitative research, data is collected through structured surveys, experiments, observations, or from existing datasets, employing standardised instruments and methods to ensure replicability. When using a quantitative approach, the emphasis falls on quantifiable variables while using statistical techniques such as regression analysis, hypothesis testing, and inferential statistics to analyse and interpret the collected data (Creswell & Poth, 2017). In the current study I used a structured survey for data collection and inferential statistics to assist me in analysing the data.

Quantitative research aims to uncover patterns and relationships and generalise findings that can be applied to a larger population (Creswell & Creswell, 2022). When following a quantitative approach, researchers strive for objectivity while limiting researcher bias (Leavy, 2017). In line with these objectives, quantitative research relies on the principles of positivism to enhance the reliability and validity of results (Creswell & Poth, 2017). Quantitative data generally relies on large sample sizes as this can enhance statistical power whilst reducing the margin of error (Creswell & Creswell, 2022). Due to the empirical



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nature of quantitative research, quantitative studies can thus result in empirical evidence that may inform policy, practice and decision-making in the academic and real world (Creswell & Creswell, 2022).

#### *3.4.2.1 Sampling procedures*

Sampling can be defined as the vigilant selection of respondents from a larger population with the purpose of obtaining and generating information that can be empirically verified (Creswell, 2014; Flick, 2011) and generalised to the population group it represents (De Vos et al., 2011). As the research question(s) of a study outline the various aspects that require investigation, these are typically used to determine the sample frame (Wahyuni, 2012). In my study, I aimed to explore and describe teachers' disposition to CVD and the extent to which the condition is considered during lesson planning and instruction, with the ultimate purpose of conceptualising a teacher guidance intervention. Against the background of this purpose, I thus selected public primary and secondary schools as research cites within Ekurhuleni, Gauteng. I decided to focus on public schools for my study, for the sample to be representative for the majority of teachers in the region. My decision to include both primary and secondary schools was based on existing research indicating that the challenges learners with CVD experience within the school context occur in both settings (Simunovic, 2010; Chan et al., 2014; Collins, 2015; Maule & Featonby, 2016). My choice to focus on schools in the specific geographical region was based on the fact that I reside in Ekurhuleni and know several teachers and school principals within the area, whom I had easy access to. The reason for choosing this specific region was further based on working as an educational psychologist within the Ekhuruleni area and leveraging existing connections with local schools and teachers.

Therefore, my target population was teachers of primary and secondary schools in the Ekurhuleni district, Gauteng, South Africa. Initially, I planned to purposefully select both urban and rural schools to obtain an understanding of the use of colour in different school settings. I opted to rely on this non-probability sampling technique often used in quantitative research where researchers deliberately select specific respondents, as I sought to obtain insight from teachers employed at both urban and rural primary and secondary schools (Patton, 2015). Purposive sampling implied the possibility of also identifying variations between primary and secondary schools as well as urban and rural schools (Palinkas et al., 2015).



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Despite my initial planning, I was not able to visit schools due to COVID-19-related restrictions and had to contact schools telephonically or *via* email during the recruitment phase of my research. This resulted in a low response rate from schools that indicated a willingness to participate in my study. In addition to the poor response rate of the urban schools I contacted, I approached eight rural schools in the area but was not able to find any rural school willing to participate. Several of the schools I contacted indicated that the teachers were under high levels of stress at the time, due to the COVID-19 pandemic, and that they did not want to add to the teachers' stress or workload by participating in my study. As a result, I adopted my sampling procedure and employed convenience sampling as a second sampling strategy by contacting schools where I knew some teachers who could potentially be available and willing to participate.

Convenience sampling provided me with the opportunity to select additional schools within the Ekurhuleni district that were easily available and accessible (Babbie & Mouton, 2019). Since I reside in Ekurhuleni and know teachers and the headmasters of certain schools, I could easily access these schools (Flick, 2011). According to Flick (2011), convenience sampling is utilised when a researcher chooses research cites (schools in this case) that are "most easily accessible under the given circumstances" (p. 76). Advantages of convenience sampling include that it may be time and cost-effective to involve sites and cases that are conveniently available (Fowler Jr, 2013), as proved to be the case in the current study, with me relying on social connections to gain entrance to schools and recruit suitable respondents for the quantitative phase of my study.

However, it is also important to note that convenience sampling may imply bias in research, due to respondents not being randomly selected, and the sample not necessarily being representative of the larger population (Babbie & Mouton, 2019). Researchers who rely on convenience sampling should also be cautious when generalising the findings of a study where convenience samples are involved (Creswell & Creswell, 2022). To this end, I remained cautious of how my selection of respondents could have influenced the findings and aimed to involve a number of schools in the Ekurhuleni district and also comparable numbers of teacher-respondents from primary and secondary schools. In Table 3.3 I provide a summary of the schools and teachers that were involved in the quantitative phase of my study.



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**Table 3.3:**

*Distribution of schools*

| SCHOOLS | URBAN SCHOOLS | | RURAL SCHOOLS | |
|---|---|---|---|---|
| | Number of schools | Number of teacher-respondents | Number of schools | Number of teacher-respondents |
| **Primary Schools** | 4 | 43 | 0 | 0 |
| **Secondary Schools** | 3 | 49 | 0 | 0 |

All teachers across all schools who participated in the study, with the exception of one primary school, were invited to contribute to the study by completing the questionnaire. In the case of the primary school with restricted participation, only teachers in the foundation phase were authorised to participate, as the principal expressed concern about overburdening the rest of the staff who were already facing a significant workload.

In addition to conveniently accessing the selected schools and respondents, I applied certain selection criteria, which implies a component of purposeful sampling. In line with the benefits put forward by Creswell (2014), purposeful sampling enabled me to recruit respondents who possessed specific characteristics or experiences, and were informed about the topic I set out to explore. Another advantage of this approach includes that it can enhance data richness that may lead to an in-depth understanding of the research phenomenon (Patton, 2015). The following selection criteria applied to the teacher-respondents:

- They had to be teaching at a primary or secondary school.
- They had to be employed at a public school in Ekurhuleni, Gauteng.
- They had to understand and speak English or Afrikaans[7].
- They had to provide informed consent to participate in the first phase of the current study.

### *3.4.2.2 Quantitative data collection and capturing*

For the quantitative phase of my study, I developed a questionnaire (consult Appendix B1) based on the information obtained from a school EXPO project that was conducted in 2019 by Gerthyo Ferreira, focusing on amongst other things, teachers' perceptions and understanding of CVD and what it implies for such learners. Based on Creswell's (2009)

[7] Afrikaans is one of the 12 official languages of South Africa and is widely spoken in the country. It is also my home language.



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statement that a survey can result in a numeric or quantitative description of a population, the data collected during this phase of my study was used to understand the current use of colour in the school context and teachers' understanding of CVD. As indicated earlier, the information obtained from the school EXPO project by Gerthyo Ferreira guided me in formulating questions that could be included in the structured questionnaire I compiled. I reformulated the questions included in the school EXPO project based on my literature review and also in line with my formulated research questions.

The questionnaire that I implemented consisted of two parts. The first part introduced me as the researcher, the aims of the study and the ethical considerations that I respected (Maree & Pietersen, 2016). The second part of the questionnaire entailed questions about the phenomenon I set out to explore. As a survey can include various types of questions depending on the type of required data (Creswell, 2014; McMillan & Schumacher, 2001), the format of the questions I included in the questionnaire was determined by my purpose of investigating teachers' predispositions to CVD and the use of colour in the classroom, with the ultimate aim of conceptualising a teacher guidance intervention.

The instrument maintained lucidity, starting with questions that did not require in-depth reading or understanding. Questions were grouped into themes, such as demographic information and the use of colour in the classroom; yet care was taken to ensure that a single question was contained in each question. The multiple-choice questions that were included contained mostly five possible distractors, enabling me to gain information without the respondents feeling uneasy about providing one specific response (Maree & Pietersen, 2016; McMillan & Schumacher, 2001).

Questionnaires are widely used as a data collection method in quantitative research due to the efficiency of this method and the option of gathering structured data from a large number of respondents fairly quickly (Creswell & Creswell, 2022). Questionnaires are thus often used due to the method being cost-effective and the option of reaching a broad audience, making it suitable for large-scale surveys (Dillman et al., 2014). Questionnaires can furthermore be designed to collect data on a wide range of topics and variables, thereby allowing for the investigation of various research questions. Additionally, questionnaires offer a degree of anonymity to respondents that may encourage honest and candid responses, particularly in cases where sensitive or personal information is collected (Fowler Jr., 2013).



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According to Maree and Pietersen (2016), online questionnaires ought to be user friendly with an easily readable font. Questions should be unambiguous and easy to understand. Respondents should be informed about how to move forward and know the estimated time it will take to complete the questionnaire. In this regard, Maree and Pietersen (2016) recommend that the completion of a questionnaire should not take more than 30 minutes. Adhering to these guidelines, the questionnaire I utilised for the current study took approximately 20 minutes to complete.

I originally conducted the survey through Qualtrics (Qualtrics, 2018), which is an online survey platform, while being supported by an expert statistician at the University of Pretoria. Even though there has been an increase in the use of technology for data collection, it is relevant to note that online surveys tend to have a lower response rate than paper and pencil questionnaires (Sinclair et al., 2012). Online questionnaire responses are often lower due to technical barriers, respondent fatigue, privacy concerns and a lack of personal connection compared to pen-and-paper surveys. However, online surveys hold the advantage of creating a survey in addition to receiving and analysing responses (Mondal et al., 2018).

In conducting this phase of my study, I circulated a link to the online electronic survey on Qualtrics to the secretaries of the participating schools; they then distributed it to the teachers at their schools. Before circulating the link, I gained permission from the school principals and governing bodies to conduct research at the respective schools. Except for one primary school where the principal gave permission for Foundation Phase teachers only to participate, all teachers of the initial five participating schools received the link for completing the questionnaire during Phase 1 of the study.

To be more specific, three secondary schools and two primary schools out of the 24 schools that I initially contacted responded and participated in the completion of the online questionnaire. However, the response rate per school was fairly low with only 33 respondents submitting completed questionnaires after a period of four months. As a next step, I distributed hard copies of the questionnaire to the schools in an attempt to collect additional data. To this end, I delivered printed questionnaires to the participating schools for teachers to complete manually. This resulted in 59 additional completed questionnaires. Hard copies of the questionnaire were distributed to schools following the conclusion of the first wave of the COVID-19 pandemic. Throughout the data collection process, strict adherence to social distancing guidelines was maintained. After my decision to rely on hard copy questionnaires and not only depend on the online option an additional two schools



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agreed to participate. For this part of the study, I manually captured all the responses of the completed hard copy questionnaires on Qualtrics. In Table 3.4 an overview is provided on the various schools that participated, indicating the number of respondents per school.

**Table 3.4:**

*Respondents and format of data collection per school for Phase 1*

| SCHOOL | MODE OF QUESTIONNAIRE DATA COLLECTION | NUMBER OF RESPONDENTS |
|---|---|---|
| Primary School 1 | Online | 7 |
| Primary School 2 | Online | 6 |
| Primary School 3 | Hard copy | 20 |
| Primary School 4 | Hard copy | 10 |
| **Total number of primary school respondents** | | **43** |
| Secondary School 1 | Online and hard copy | 22 |
| Secondary School 2 | Online and hard copy | 23 |
| Secondary School 3 | Online | 4 |
| **Total number of secondary school respondents** | | **49** |
| **Total number of respondents** | | **92** |

Questionnaires, as a data collection method, imply certain possible limitations. One drawback associated with quantitative questionnaires concerns the possibility of non-response bias, where certain groups of individuals may be more likely to complete the survey than others, leading to a skewed sample (Fowler Jr., 2013). Furthermore, the design of effective questionnaires can be challenging, as poorly constructed questions or response options may introduce response bias or misinterpretation of the data (Dillman et al., 2014). For this purpose, I worked alongside a statistician of the University of Pretoria in customising the questionnaire.

Questionnaires may also be limited as they will collect data only on what is explicitly asked. This may restrict the depth of information obtained and make questions less suitable for exploring complex or nuanced research questions (Babbie & Mouton, 2019). I aimed to address these possible limitations in the second phase of my study by generating qualitative data through a semi-structured interview that was guided by open-ended questions.



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#### *3.4.2.3 Quantitative data analysis*

Quantitative data analysis involves a structured process that combines descriptive and inferential statistics to make sense of numerical data collected through surveys (Creswell & Poth, 2017). I was supported to conduct an in-depth analysis of the data obtained through the survey by an expert statistician. The process of quantitative data analysis involved a systematic examination and interpretation of the numerical data that had been collected by means of descriptive and inferential statistics to be able to draw meaningful conclusions from the data (Bryman & Bell, 2015).

Before conducting the statistical analysis, data cleaning and preparation was taken care of in support of good data quality that could ensure the validity and reliability of the results I obtained (Acock, 2014; Cohen et al., 2018). The process of data cleaning and preparation involved the steps of checking for missing data, outliers and data entry errors, and making the necessary adjustments or imputations where needed (Acock, 2014; Cohen et al., 2018). Out of 101 questionnaires that had been completed, 92 were used for analysis purposes due to missing data or respondents not completing the section where they had to provide their consent for participation.

During the quantitative data analysis process, I followed a deductive reasoning approach (Leedy & Ormrod, 2013). Unlike inductive research, which builds theories from observations, quantitative research starts with a predetermined hypothesis that acts as a premise from which the researcher seeks to draw logical conclusions based on the collected data (Cohen et al., 2018; Leedy & Ormrod, 2013). During this approach predefined statistical procedures were chosen based on the research questions and the type of data I wanted to obtain before data collection commenced (Cohen et al., 2018; Leedy & Ormrod, 2013). This process ensured structured and objective analysis.

##### 3.4.2.3.1 Descriptive statistics

I included descriptive statistics to summarise and describe the key characteristics of the data. Descriptive statistics thus assisted me in gaining an initial sense of the data distribution and patterns, trends and tendencies indicated in the data (Creswell, 2009). In addition, I relied on descriptive statistics to gain an understanding of score variations (Creswell, 2009). For the trends that could be identified in the data, I relied on measures of central tendency, the spread of the scores, and the relative ranking of the scores. These included measures of central tendency (e.g. mean, median, mode) that provided me with information about average responses, and measures of dispersion (e.g. standard deviation, range) that



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indicated the variability of the data (Trochim & Donnelly, 2008). To be more specific, the mean provided a measure of central tendency measure, while the standard deviation indicated the degree to which answers deviated from the mean (Bryman & Bell, 2015).

I used a Likert scale for several questions included in the questionnaire. In analysing the data collected through the Likert scale, I once again relied on descriptive statistics and measures of central tendency, such as the mean or median to determine the average responses for the Likert scale items (Norman, 2010). The descriptive statistics of the Likert scale provided a clear overview of the respondents' overall responses.

I also used pie diagrams for certain responses to questions to represent the distribution of responses for categorical and continuous variables visually. Pie diagrams, also known as pie charts, are commonly used to visually represent quantitative data in a circular format (Field, 2018). They are specifically useful to display the distribution of categorical or discrete data as parts of a whole, with each segment representing a category or group with the size of each slice being proportional to the quantity it represents (Field, 2018).

#### 3.4.2.3.2 Inferential statistics

In quantitative data analysis inferential statistics are used to draw conclusions about a larger population from a specific sample (Cohen et al., 2018; Leedy & Ormrod, 2013; Teddlie & Tashakkori, 2009; Wackerly et al., 2021). Inferential statistics can serve as a valuable tool to illuminate patterns within quantitative data, enabling researchers to test hypotheses (Cohen et al., 2018; Wackerly et al., 2021). In this study, inferential statistics provided me with the opportunity to test my formulated hypotheses and make generalisations about the population with a degree of certainty (Ferguson, 2013; Cohen et al., 2018).

In Chapter 1, I formulated the hypotheses I wanted to test. I then collected data from the representative sample by means of a questionnaire. Thereafter I made use of statistical tests to analyse differences and correlations to explore the relationships between variables, which assisted me in testing my hypotheses. Throughout this process I was guided by an expert statistician.

During hypothesis testing a p-value represents the probability of obtaining the observed data ($H_1$), or more extreme data ($H_0$), assuming that the null hypothesis is true (Cohen et al., 2018; Wackerly et al., 2021). A null hypothesis ($H_0$) represents the *no effect* scenario, assuming that no significant difference or relationship exists between the identified variables (Cohen et al., 2018; Ferguson, 2013). The alternative hypothesis ($H_1$) reflects the



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researcher's actual prediction about the relationship between the variables. In other words, it reflects the likelihood of results occurring purely by chance. A lower p-value indicates a lower probability of extreme results occurring by chance, thereby providing more compelling evidence for rejecting the null hypothesis (Cohen et al., 2018; Ferguson, 2013).

Inferential statistics can be a valuable tool in quantitative data analysis. In the current study, it allowed me to move beyond the sample and make inferences about the population, providing valuable insights into the phenomenon I studied (Wackerly et al., 2021). However, it should be noted that statistical tests indicate the likelihood of an effect and never an absolute (Ferguson, 2013).

Due to the nature of my questionnaire I made use of the Fisher's Exact Test to determine the association between two categorical variables in a contingency table. Unlike the commonly used chi-square test, the Fisher Exact Test is particularly valuable when dealing with small sample sizes and when various assumptions regarding frequencies are not met (Field, 2013). The Fisher Exact Test can provide an accurate p-value for small sample sizes and will calculate the exact probability of observing the data or something more extreme by considering the various possible arrangements of the data within the observed marginal totals (Mehrotra & Rom, 2007).

### 3.4.3 Phase 2: Qualitative research

Qualitative research focuses on exploring and understanding complex phenomena through in-depth examination (Creswell & Creswell, 2022). Unlike quantitative research, which primarily relies on numerical data and statistical analysis, qualitative research entails a non-numerical approach where data generation methods such as interviews, observation and textual analysis are utilised to gain insight into the experiences, perspectives and behaviours of participants (Creswell & Poth, 2017).

Qualitative research is specifically valuable when researchers aim to investigate the subjective experiences of people, cultural contexts or the meanings that individuals assign to their actions (Creswell & Creswell, 2022). One of the primary advantages of qualitative research is the option to obtain rich and in-depth insight into specific phenomena (Creswell & Poth, 2017). The qualitative phase of the current study accordingly enabled me to obtain an in-depth understanding of teachers' use of colour in the classroom and their personal experiences in teaching learners with CVD by conducting semi-structured interviews with nine participants, all of whom also participated in the first phase of the study. Qualitative



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methods such as interviews and opportunities for participants to express themselves provide an avenue to uncover in-depth nuances and intricacies in data that is a distinct benefit of qualitative research (Denzin & Lincoln, 2018).

Qualitative research is, however, often criticised for subjectivity and the possibility of researcher bias in terms of data generation, analysis and interpretation (Creswell & Poth, 2017) as a qualitative researcher's perspective and preconceptions may influence the data generation and analysis process. Qualitative research furthermore typically has smaller sample sizes than in the case of quantitative research, where findings may not be generalisable to broader populations (Denzin & Lincoln, 2018). By following a mixed methods approach and integrating the qualitative data with the quantitative data, I was able to gain a broader and more nuanced perspective of the topic I researched, which potentially provides for a more comprehensive and impactful research contribution. Since my research focused on how the use of colour during teaching and classroom instruction may limit learners with CVD, I recognised the potential of my own experiences as a learner, teacher and current educational psychologist influencing the study and thereby remained conscious of potential biases during data generation and analysis. To this end, reflexivity formed a central part of the strategies I relied on during qualitative data generation and analysis to ensure rigour and minimise the potential effect of personal bias. I maintained a research journal to document my assumptions and how they could have influenced my interpretations, did member checking to ensure that my findings accurately reflected the participants' perspectives, and engaged in regular discussions with my supervisor in attempting to avoid the influence of bias (Lincoln & Guba, 1986).

#### *3.4.3.1 Selection of research sites and participants*

The selection of participants for a qualitative study entails the selection of people in a specific environment who may be able to assist a researcher in answering the formulated research questions (Morgan & Sklar, 2012). For the current study, I conveniently selected teacher-participants who had participated in the first phase and had indicated their willingness to participate in the second phase. To be more specific, I contacted all teachers who had indicated their willingness to participate in Phase 2 of the study *via* email or telephonically, depending on the contact information they had provided during Phase 1, to set up appointments for semi-structured interviews. From the 19 teachers I contacted, nine were available for interviews, with two of them being primary school teachers and seven secondary school teachers at the time of the fieldwork. As I conducted two dyadic interviews, the total number of interviews with the participants was seven. I employed both individual



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and dyadic interviews to leverage the strengths of each method, gaining in-depth insights from individual interviews and observing valuable interactions between participants in dyadic interviews.Table 3.5 provides an overview of the teachers who participated in Phase 2 of the study as well as the format of the interviews they participated in.

**Table 3.5:**

*Teacher-participants in Phase 2*

| Participant | Interview number and format | In person/ telephonic | School | Grade | Subject/ Responsibility at school |
|---|---|---|---|---|---|
| 1 | 1. Dyadic interview | Telephonic | Secondary School | Gr.8 and 10 | ❖ Engineering and Graphic Design<br>❖ Mathematics |
| 2 | 1. Dyadic interview | Telephonic | Secondary School | Gr.8 to 10 | ❖ Mathematics<br>❖ Mathematical Literacy |
| 3 | 2. Individual interview | Telephonic | Secondary School | Gr.8 to 12 | ❖ Physical Science<br>❖ School principal |
| 4 | 3. Individual interview | Telephonic | Secondary School | Gr.11 | ❖ Geography<br>❖ History<br>❖ Head of Social Sciences Department |
| 5 | 4. Individual interview | In person | Primary School | Gr.1 | ❖ Foundation Phase: Languages, Mathematics and Life Skills |
| 6 | 5. Individual interview | Telephonic | Secondary School | Gr.8 | ❖ Geography<br>❖ History |
| 7 | 6. Dyadic interview | Telephonic | Secondary School | Gr.9 | ❖ Mathematics<br>❖ Mathematical Literacy |
| 8 | 6. Dyadic interview | Telephonic | Secondary School | Gr.9 | ❖ Mathematics<br>❖ Mathematical Literacy |
| 9 | 7. Individual interview | In person | Primary School | Gr.3 | ❖ Foundation Phase: Languages, Mathematics, Life Skills |

Convenience sampling allows for the selection of participants who are easily and conveniently available to a researcher (Maree & Pietersen, 2016). In my study, this involved the recruitment of participants who were readily available and indicated their willingness to participate in Phase 2. While convenient and cost-effective, convenience sampling also implies some limitations. Primarily, this method of selection may compromise representativeness as the sample will not be chosen randomly and may not reflect the broader population (Maree & Pietersen, 2016). This may lead to potential biases and reduce



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the generalisability of findings. In an attempt to address these potential challenges, I triangulated the qualitative data (Etikan et al., 2016) with the quantitative data to gain additional perspectives and enrich my understanding of the phenomenon I explored. I further attempted to include both primary and secondary school participants teaching a variety of subjects to gain a broader view of the use of colour at school level and of the challenges that learners with CVD may experience. Furthermore, several of the participants that were readily available were acquainted with me (Creswell, 2013), thereby requiring of me to ensure that they were fully informed that their rights were protected, and that their consent was freely given, without me coercing them into participation.

#### *3.4.3.2 Qualitative data generation and documentation*

In addition to conducting telephonic as well as face-to-face semi-structured individual and dyadic interviews with the selected teacher-participants, I made use of field notes and a research journal for qualitative data generation and documentation.

##### 3.4.3.2.1 Interviews

The majority of the semi-structured interviews I conducted were done telephonically due to COVID-19-related restrictions in South Africa at the time of my fieldwork. Only two interviews could be conducted in person. When conducting the interviews, I was directed by an interview guide (consult Appendix B2) consisting of open-ended questions. All interviews were conducted in English and lasted between 15 and 40 minutes. All interviews were recorded, and I relied on field notes throughout the process. The audio-recordings were subsequently transcribed verbatim (consult Appendix C1) to document the contributions of the teacher-participants and for data analysis purposes.

Semi-structured interviews are commonly used for qualitative data generation as they offer a flexible way of gathering in-depth information from participants on their experiences and views on a specific phenomenon that is being researched (Creswell & Creswell, 2022). A set of open-ended questions is typically used to guide the conversation and allows for spontaneous follow-up questions and further exploration of answers provided by the participants (Smith et al., 2009). This flexibility allows participants to elaborate on their experiences and perspectives, potentially generating rich and nuanced data (Denzin & Lincoln, 2018).

Semi-structured interviews are generally utilised to explore the lived experiences of individuals or groups related to a specific phenomenon; to obtain an in-depth understanding



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of participants' perspectives on a particular issue; or to gather rich data on sensitive topics where participants may feel comfortable sharing their views in a conversational setting (Denzin & Lincoln, 2018). In the current study, I utilised semi-structured interviews to explore teacher-participants' experiences of teaching learners with CVD as well as their use of colour in the school context. Due to the conversational nature of the interviews I facilitated, I was able to establish rapport with the participants, encouraging them to feel comfortable in sharing their experiences and perspectives in an open way (Denzin & Lincoln, 2018).

Semi-structured interviews imply several advantages, such as the possibility of obtaining rich, contextual data and allowing participants to express their perspectives and experiences in their own words (Kvale & Brinkmann, 2009). Semi-structured interviews furthermore allow for flexibility through the option of adapting questions when needed and using probes to ensure that the data generation is comprehensive (Creswell & Creswell, 2022). The flexible nature of semi-structured interviews allowed me to adapt the questioning based on the participants' specific responses (Creswell & Creswell, 2022). In addition, I was able to follow up on unexpected insights or delve more deeply into specific aspects of the participants' stories, which could, in turn, contribute to rich and more nuanced data.

Telephonic semi-structured interviews offer a specific valuable tool for qualitative data generation, allowing researchers to connect with participants when facing accessibility challenges (Denzin & Lincoln, 2018), such as during my study. To be specific, telephonic interviews enabled me to reach participants during a time when the COVID-19 pandemic restrained physical contact among people. Furthermore, telephonic interviews are generally more cost-effective than face-to-face interviews, making this approach particularly beneficial for research when financial resources are limited (Flick, 2014). Finally, telephonic interviews offered convenience to both the participants and me, as we could participate from our own preferred locations, thereby benefitting from greater flexibility and reducing scheduling difficulties. This was particularly advantageous with the teacher-participants who were often involved in school-related after hour activities, thereby limiting their time available for participation.

Semi-structured interviews, however, also imply possible limitations such as the potential of interviewer bias, as the researcher's background and preconceptions may influence the interview process and interpretation of responses (Kvale & Brinkmann, 2009). For this reason, I incorporated additional methods of data generation. Social desirability bias may furthermore influence participants to tailor their responses in an attempt to be perceived



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favourably by the interviewer (Maree & Pietersen, 2016). I aimed to address this potential challenge by creating a safe and supportive environment where participants could feel comfortable in expressing their honest perspectives (Morse, 2015). Additionally, I made use of reflexivity throughout the research process in an attempt to acknowledge and minimise the impact of my personal biases (Creswell & Creswell, 2022).

One key limitation of telephonic interviews relates to the lack of ability to observe non-verbal cues such as facial expressions and body language, which may limit the researcher's ability to fully understand the participant's experience and interpret their responses accurately (Stake, 1995). I aimed to ensure a sound understanding of what the participants shared with me by making use of additional probing questions or follow-up clarification probes throughout the interviews. In addition, technical difficulties may hinder the interview process and compromise data quality, specifically in the case of telephonic interviews. To minimise these risks, I tested my recording equipment beforehand and selected reliable communication platforms. Finally, participants may be more easily distracted in their own environment during a telephonic interview when compared to an in-person interview setting, which may impact the focus and depth of the responses received. To address this challenge, I encouraged participants to choose quiet and distraction-free environments for the interview and emphasised the importance of their undivided attention. Even though I employed these techniques, one of the participants did seem distracted during one of the telephonic interviews, requiring of me to strongly rely on follow-up questions and additional probing techniques.

Conducting effective semi-structured interviews requires specialised skills, which for example, include active listening, probing for deeper responses, and maintaining a neutral and non-judgmental stance (Creswell & Poth, 2017). Interviewers with limited experience might struggle with these aspects, potentially compromising the quality of the data that is generated. As an educational psychologist, I was training in and often use active listening, probing and maintaining a neutral and non-judgemental stance in my work. I was thus able to incorporate these skills during the interview process. Semi-structured interviews have also been critiqued for potentially being a time-consuming and resource-intensive process (Creswell, 2014). To this end, I critically reviewed my open-ended questions to ensure that the interviews remained focused and would gather specific data. In addition, I used the Otter software programme to transcribe the audio-files, and then checked the transcripts to ensure accuracy to reduce the time of transcription.



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#### 3.4.3.2.2 Field notes

Field notes form an important part of qualitative research, as this method provides a way to document and record observations, interactions and insights gathered during fieldwork (Creswell & Poth, 2017). According to Denzin and Lincoln (2018), field notes can be a rich source of data that provides researchers with the opportunity to engage with the research environment, while developing a deeper understanding of the phenomenon under study. As a critical tool for data generation, analysis and interpretation, field notes may enhance rigour, and add depth to qualitative research by preserving the authenticity and context of a study (Denzin & Lincoln, 2018).

I made field notes throughout the research process, capturing my experiences, thoughts and occurrences during the data generation sessions, more specifically during the various interactions that transpired as part of the individual and dyadic interviews. I compiled field notes during and after the interviews with the teacher-participants (Emerson et al., 2011), noting the sequence of events, and then detailed my own impressions of the data generation process. These notes allowed me to portray details of the research context along with my own reflections and notes on what had transpired (Creswell & Poth, 2017). Field notes were further used to capture information that stretched beyond the core content captured in the audio-recordings or transcripts, as I was able to document my initial impressions and reflections on the interview data (Morse, 2015). These notes offered valuable context during the data analysis phase. I further noted my informal conversations with participants and other individuals within the research setting, capturing these interactions, preserving insights and noting potential avenues for further exploration during the data generation process (Flick, 2014).

Although I had the intention to compile thorough field notes during the interviews with the participants, I became so engaged in conversations that I often forgot to make detailed notes and add reflections. It was, however, easier for me to compile field notes during telephonic interviews as I did not have to maintain eye contact during these sessions. I tried to address this challenge by making additional notes directly after the interviews with the participants. Even though the possibility exists that I may have lost some of the specific details as a result, the audio-recordings of the interviews enabled me to listen to these at a later stage and elaborate on my field notes as I saw fit (Denzin & Lincoln, 2018; Morse, 2015).

As such, field notes enabled me to document details beyond the formal interview recordings, resulting in me obtaining a more comprehensive picture of the research scene (Creswell &



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Poth, 2017). Through prompt documentation of my thoughts and experiences in the field, I avoided the effects of memory lapses and could retain important details for later reflection and analysis (Stake, 1995). Follow-up field notes aided me in identifying emerging themes, connections and potential areas for further exploration during later stages of the research process (Morse, 2015).

Even though field notes imply the potential challenge of a researcher's understanding of an observed phenomenon being influenced by their own biases and interpretations (Stake, 1995), I made use of reflexivity and acknowledged my own potential biases in an attempt to reduce this possible influence. Furthermore, time constraints or memory lapses may result in incomplete field notes, which may, in turn, hinder the comprehensiveness of the data that is recorded. To this end, I tried to document my experiences, thoughts and feelings as soon as possible to minimise this risk. I further combined my field notes with other data generation methods to offer a more comprehensive and triangulated view of the research phenomenon (Denzin & Lincoln, 2018).

#### 3.4.3.2.3 Research journal

I also made use of a research journal (consult Appendix C2) to document my developing insights, reflections and decision-making processes (Saldaña, 2016). As such, my research journal allowed me to effectively document and capture my personal experiences, emotions and insights while conducting fieldwork, interviews and the data analysis. My research journal furthermore supported my ability to maintain transparency, as I could continually document my research study through in-depth notes detailing my methodological choices, emerging themes and conceptual developments (Maxwell, 2012). This contributed to the trustworthiness and credibility of my study's findings (Denzin & Lincoln, 2018), as it provided a rich source of context, giving the reader an opportunity to understand the study I completed.

During the process of reflection, I could thus examine my own biases, assumptions and emerging insights. I also used my research journal to capture my personal experiences and detail the challenges I faced in conducting the study (specifically related to COVID-19 and recruiting suitable participants), and how I addressed these challenges. In this regard, I stated the challenges I faced and reflected on possible ways of addressing these. Due to the restrictions of COVID-19, and limited contact with other researchers, my research journal became a mirror that helped me identify my own biases and possible ways of addressing the challenges I faced. As such, it assisted me in gaining valuable insight into my own



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understanding of the phenomenon I investigated and provided me with a deepened awareness of my potential biases (Ellis & Adams, 2011).

The research journal further allowed me to engage with the data on a deeper level by providing me with the opportunity to not only reflect on my experiences, but also draw connections, identify potential avenues for further investigation and list emerging themes (Morrow, 2000). In addition, the research journal assisted me in maintaining my focus and motivation throughout the research process through the documentation of my experiences, thoughts and feelings, which assisted me in gaining clarity on my goals and identifying possible challenges I had to address (Klenke, 2008). My research journal contributed to the richness and depth of the data I obtained by providing a unique lens through which I could offer my perspectives and thoughts throughout the research process (Klenke, 2008). It further contributed to my critical thinking and analysis process.

Research journals as data generation tool may be criticised for potentially being subjective as they entail the researcher's personal records (Klenke, 2008). I thus triangulated my research journal with other sources of data in an attempt to reduce the subjectivity of the reflections I noted. Research journals may also be time-consuming and require dedication and effort on the part of the researcher (Morse, 2015). I thus made notes with my electronic pen on my iPad that typed it over to reduce the time spent on writing in my research journal. I had my iPad with me throughout my working day so that I could quickly access it to add notes or reflections when required. In addition, I set weekly time aside when I could privately write in my journal without any disturbances, and elaborate on the thoughts I had jotted down throughout the week.

#### *3.4.3.3 Qualitative data analysis*

Qualitative data analysis entails a systematic and rigorous process of examining data to obtain meaningful insights by identifying patterns and themes. As such, thematic analysis is a widely used approach for qualitative data analysis that involves the process of identifying, analysing and reporting on patterns that emerge from the data (Braun & Clarke, 2021b). Inductive thematic analysis is specifically used to uncover and develop themes or patterns from textual, visual or audio data in an open and data-driven manner. Unlike deductive thematic analysis, which starts with pre-established codes or themes based on existing theories or prior research, inductive thematic analysis allows themes to emerge from the data itself (Braun & Clarke, 2021a).



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For the current study, I inductively analysed the data generated through semi-structured interviews (consult Appendix C1), field notes (Appendix C3) and my research journal (Appendix C2). For this purpose, I analysed the transcribed audio-recordings of the interviews as well as the data captured in my field notes and research journal. Inductive thematic analysis enabled me to identify patterns and recurring themes within the data without prior preconceptions or established theories (Braun & Clarke, 2021b), also listing unexpected and context-specific patterns. As such, categories and patterns could be derived without me being guided by predetermined topics or ideas (McMillan & Schumacher, 2014). Such categorisation of data without predetermined themes is referred to as a *bottom-up* approach (Braun & Clarke, 2021b).

I followed Braun and Clarke's (2021b) guidelines for thematic data analysis, utilising a structured framework to make sense of the data in a way that could enhance the trustworthiness of my study (Braun & Clarke, 2021b). The first step involved familiarisation with the data, which I completed by reading and re-reading the transcribed interviews, field notes, and my research journal. This process assisted me in gaining a comprehensive overview of the data and research context, and in identifying potential themes or patterns that were evident in the data. Thus, I started with a clean slate, familiarising myself with the data through multiple readings with initial coding being open-ended. During this process I paid close attention to details, nuances and recurring patterns across the data set (Braun & Clarke, 2021b).

Next, I started the process of generating initial codes (consult Appendix C4, p. 4) by clustering the data into units of meaning through categorisation, interpretation and coding into possible subthemes and themes (Cohen et al., 2004). Codes were systematically generated, and themes were based on what had been observed in the data. The initial coding process was iterative, which allowed me to refine and develop the coding scheme as themes emerged from the data (Braun & Clarke, 2021a). This involved a process of systematically tagging or labelling segments of the data that was relevant to the research question, with the codes being derived from the data itself and representing the most basic elements of the analysis I completed. After generating the initial codes, I engaged in a process of searching for possible themes (consult Appendix C4, p.8 & 9), which could capture the essence of what the data was conveying. I did this by grouping and comparing the codes based on their similarities and differences (consult Appendix C4 & C5). During this critical thinking process I searched for patterns and linkages within the data in addition



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to focusing on the identification of themes that would encompass and connect the coded data (Braun & Clarke, 2021b).

As a following step, I reviewed and refined the potential themes I had identified. This step required me to revisit and refine the initial themes by checking if they accurately represented the coded data, were internally coherent and would address the research question. During this process I merged, split or discarded themes based on the further data analysis that occurred. I thus considered how the themes were related to one another (consult Appendix C4 & C5) and whether or not they required further refinement or consolidation (Braun & Clarke, 2021b). The final step of inductive thematic analysis that I completed, as outlined by Braun and Clarke (2021b), involved the naming of and writing up of the themes. For this step I developed clear and concise descriptions of the various themes, their scopes and significance, which were supported by excerpts from the data. Additionally, I explored the relationships between the themes and highlighted how these interacted or connected with one another (Braun & Clarke, 2021b). In Chapter 5, I explain how the themes I identified contributed to an understanding of the phenomenon under investigation and in Chapter 6 how these can address the research questions.

Inductive thematic data analysis offers several advantages for qualitative researchers. Firstly, it allows researchers to explore new research areas or phenomena without imposing preconceived ideas or theories on the data. This approach can facilitate the discovery of new insights purely based on the data of the study (Braun & Clarke, 2021a). Furthermore, inductive thematic analysis implies a flexible approach that can accommodate a wide range of data types and sources, including the data obtained from interviews, observations, existing documents and visual material (Guest et al., 2012). The flexibility of this approach enhances its compatibility with diverse research questions and contexts.

However, inductive thematic analysis is not without limitations, as it can be time-consuming due to the iterative process of data immersion, coding and theme development (Nowell et al., 2017). I made use of Atlas.ti (ATLAS.ti Scientific Software Development GmbH, 2023) to reduce the time spent on data analysis. To this end, I underwent formal training for using the software program, yet also reviewed online broadcasts focusing on the different steps and features of Atlas.ti. I further created a time frame that allowed sufficient time for the analysis that had to be completed.

Another potential limitation of inductive thematic analysis relates to the subjectivity of interpretation that may introduce bias, which I aimed to avoid by means of reflexivity



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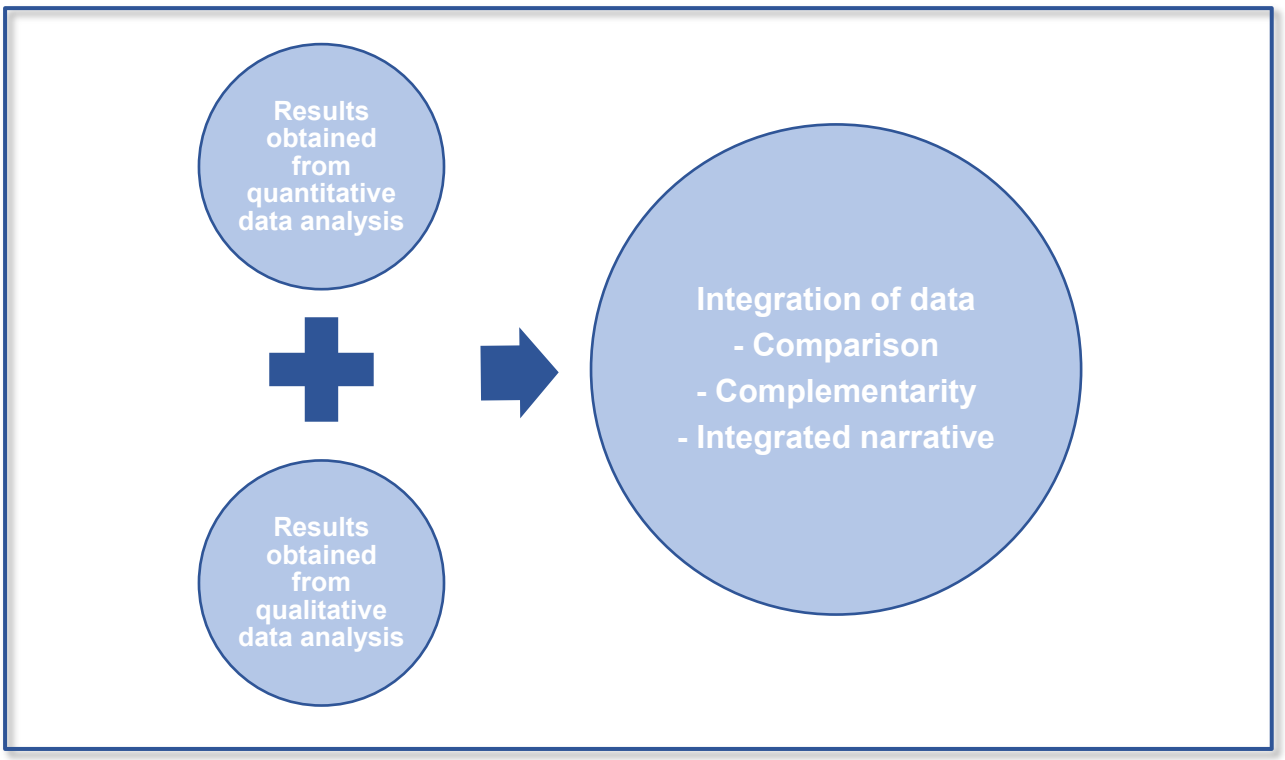
throughout the analysis process (Braun & Clarke, 2021b). To this end, I reflected on my own assumptions, biases and experiences, acknowledging how these might influence the data analysis (Braun & Clarke, 2021b). I also relied on regular debriefing sessions with my supervisor who assisted in checking the analysis I had completed.

### 3.4.4 Phase 3: Integration of quantitative and qualitative results

After analysing the quantitative and qualitative data, I integrated the results of these two phases during the third phase of the study. For this purpose, I completed a systematic process of merging and comparing the results of the two data sets with the aim of providing a comprehensive understanding of the phenomenon I focused on. By integrating the quantitative and qualitative results I was able to explore both the numerical trends and the underlying contexts and nuances, and how these informed each other. Figure 3.3 provides an overview of the integration of the results that I completed.

**Figure 3.3:**

*Integration of quantitative and qualitative results*




I started this integration process by comparing the results from the quantitative and qualitative analysis processes, looking for points of convergence or divergence between the two data sets (Creswell & Plano Clark, 2018). During this process I thus identified how qualitative insights could assist in explaining, elaborating on and providing context to the



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quantitative results I obtained. I also searched how the qualitative findings could shed light on the patterns identified in the quantitative data and add depth and meaning to the quantitative results I obtained. Subsequently, I explored how the two data sets complemented or enriched each other. I thus focused on how the qualitative data could assist me in explaining the quantitative results and enrich my interpretation of the statistical data (Creswell & Poth, 2017). As a final step, I developed an integrated narrative of the quantitative and qualitative results I obtained in explaining the phenomenon under study (Teddlie & Tashakkori, 2009).

Through the integration of the quantitative and qualitative data I was able to gain a more comprehensive and holistic understanding of the data, enabling me to answer the research questions. This was possible as I could explore the breadth of numerical trends and combine them with the depth of the contextual insights I had gained (Teddlie & Tashakkori, 2009). Creswell and Plano Clark (2018) argue that the integration of the quantitative and qualitative data sets enhances the robustness of findings in addition to contributing to a more nuanced and enriched interpretation of the data. In addition, I was able to triangulate the data by comparing and contrasting the quantitative and qualitative results, thereby strengthening the credibility of my study (Teddlie & Tashakkori, 2009). However, such an integration process can be resource-intensive and time-consuming, demanding careful planning on the side of a mixed methods researcher (Creswell & Creswell, 2022).

## 3.5 RIGOUR OF THE STUDY

Rigour in mixed methods studies is important to ensure credibility and trustworthiness. To this end, I relied on strategies that could enhance the validity and reliability of the quantitative results as well as the trustworthiness of the qualitative findings I obtained (Creswell & Creswell, 2022).

### 3.5.1 Validity and reliability of quantitative results

Validity determines whether or not an instrument measures what it is intended to measure, whereas reliability concerns whether or not the results of a quantitative study are credible (Welman et al., 2005) and whether the results of research can be reproduced in another study (Hayes, 2000). I aimed to ensure the validity of the questionnaire that I implemented by making certain that it measured what it was intended to measure (Hayes, 2000). I attended to three types of validity during the quantitative phase of my study, namely surface validity, content validity and internal validity. Surface validity was ensured through a surface



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examination of the items included in the questionnaire to determine whether the questions and ultimately the questionnaire measured what they were supposed to measure (Wilson & MacLean, 2011). For surface validity I worked through the questionnaire several times and reflected on each question to ensure that the language was clear, concise, and easy to understand for my target audience. After the questionnaire had been uploaded to Qualtrics for online distribution I worked through the questionnaire again and completed it electronically to ensure it was well-organised and visually appealing to minimise confusion and encourage participation (Rea & Parker, 2012). In addition, the EXPO project that served as a pilot study guided me in formulating the questions I included in my questionnaire.

Next, content validity was important to ensure that the instrument measured the specific content area it was developed for (Gay et al., 2011). For this process I reviewed existing literature and research relating to the construct I wanted to measure (Polit & Beck, 2017). I furthermore relied on an expert statistician at the University of Pretoria who assisted me, as well as on my supervisor to review my questionnaire and provide feedback on the appropriateness and comprehensiveness of the items (DeVellis, 2017). I thus attended to constructing validity by ensuring that the questionnaire reflected the *theoretical constructs* it was developed for (Gay et al., 2011; Hayes, 2000).

In terms of reliability, McMillan and Schumacher (2001) define this construct as the stability and consistency of a data collection instrument. Reliability is concerned with whether or not a questionnaire would obtain similar results if the study was repeated under similar conditions. According to Heale and Twycross (2015), the three elements of reliability are homogeneity in support of internal consistency, stability and equivalence. To this end, equivalent questions (different questions probing the same aspect) were included in the questionnaire I compiled.

A pilot study may increase reliability by assisting the researcher to identify problems or potential inconsistencies in the data collection procedures, instruments or analysis methods (Rea & Parker, 2012). By relying on an EXPO project that served as a pilot study I was able to refine my research approach and processes before conducting the full-scale study, with this minimising potential errors in my data. I also include detailed documentation on the data collection procedures, analysis methods and decisions made throughout the research process as part of my research journal. In this thesis this documentation serves as a trail of evidence and allows for transparency and possible replication of the study and its findings.



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I further relied on an internal validity metric, namely the Cronbach's (1951) Alpha to determine internal consistency of the Likert scale items included in the questionnaire. Cronbach's (1951) Alpha predicts the correlation of the items in a scale and can provide an indication of reliability. It estimates the average correlation between all possible pairs of items within a questionnaire. To be specific, a higher Alpha value indicates a greater level of internal consistency, meaning that the items tend to measure the same underlying construct. A score of 0.70 or above is generally considered to indicate an acceptable internal consistency, suggesting that the items are measuring a common construct. A score of 0.80 and above indicates good internal consistency, signifying a strong likelihood that the items are capturing the intended concept. Lastly, a score of 0.90 and above refers to exceptional internal consistency; however, it may also suggest redundancy in the items. An expert statistician from the University of Pretoria's Department of Statistics assisted me in determining the internal consistency between items by calculating the Cronbach (1951) Alpha.

For the purpose of my study, I considered the Cronbach's (1951) consistency of the following themes included in the questionnaire:

- The use of colour in the school context, with a Cronbach's (1951) Alpha of 0.5589.
- Use of colour during classroom activities, with a Cronbach's (1951) Alpha of 0.7584.
- Teachers' general perception of the use of colour for school-related activities, with a Cronbach's (1951) Alpha of 0.6290.
- Colour and the use of technology in the classroom, with a Cronbach's (1951) Alpha of 0.9118.
- Teachers' level of readiness, knowledge and skills to support learners with special needs in general, with a Cronbach's (1951) Alpha of 0.6728.
- Support and accommodations for learners with CVD, with a Cronbach's (1951) Alpha of 0.7143.

As all of the Cronbach's (1951) Alpha measures were above 0.5, the questionnaire did not include poor groups, and all themes could be taken as having decent internal reliability, with the exception of *Colour in the school*, where the Cronbach's (1951) Alpha measure was not very high. This value, however, still fell within the acceptable bounds for internal reliability, thereby implying that overall the questionnaire had acceptable internal reliability for the various themes that were tested with Likert scales.



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### 3.5.2 Trustworthiness of qualitative findings

Trustworthiness is comparable to reliability and validity in quantitative studies (Guba & Lincoln, 1981). To this end, I attempted to meet the criteria of transferability, credibility, confirmability, authenticity and dependability, as identified by Lincoln and Guba (1986) to ensure rigorous findings. As qualitative methods emphasise the role of human beings in constructing reality I relied on reflexivity throughout my study, ensuring the continuous examination of my potential influence on the research process (Dowling, 2008). I acknowledge the influence I may have had on the data generation and my position within the study, and thus used a research journal to document my reflections on this (Sullivan, 2010).

#### *3.5.2.1 Transferability*

Transferability refers to the applicability of the findings of a study to other similar contexts (Lincoln & Guba, 1986; Babbie & Mouton, 2006). This criterion is therefore concerned with the relevance of a study's findings for another context (Lincoln & Guba 1986; Babbie & Mouton, 2006). This does not refer to generalising findings, but rather focuses on the meaningful application of research insights to other settings, populations or situations (Patton, 2015; Seale, 2016).

According to Patton (2002), rich descriptions foster transferability, as detailed accounts of the research setting, participant characteristics and the research process itself can provide readers with a deep understanding of the context and allow them to draw parallels between their own context and the study setting that is described. Through this process, readers are thus able to determine the potential applicability of the research insights beyond the current study (Patton, 2015). I aimed to enhance the transferability of the findings of my study by including a detailed description of the research process and methodology I relied on in this thesis (Babbie & Mouton, 2006; Yin, 2018). Through a comprehensive description of my study, I provide information regarding the context and the schools where the teachers who participated taught to provide the reader with sufficient information to determine to what extent the findings of this study can be applied in a similar context (Patton, 2015).

Seale (2016) emphasises the critical role of reflexivity in enhancing transferability. Through the use of reflexivity about my own biases, experiences and assumptions throughout the current study, I offer the reader a transparent and nuanced understanding of the research and its potential limitations. By incorporating transparency, the reader may be able to make informed decisions about the transferability of the findings of my study to their own contexts.



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In addition to these strategies, the fact that I used a component of purposive sampling (Lincoln & Guba, 1986) implies that I was able to involve teachers from urban public schools teaching Grade 1 to Grade 12 learners who may potentially be informed about the phenomenon under study. The perceptions and experiences of these teachers may align with other teachers in similar school settings.

#### *3.5.2.2 Credibility*

Credibility implies consistency and the ability to draw accurate conclusions from a study (Patton, 2015). I aimed to conduct my study in a manner that can ensure credibility by being transparent and honest during the data generation and analysis process (Creswell & Creswell, 2022). I incorporated an audit trail (Seale, 2016) by documenting the research process, data generation methods, analytical decisions and rationale for my interpretations, allowing for replication and verification of these by others. During the course of my study, I continually reflected on my research journey. This transparency can enable the reader to follow my research journey and assess the credibility of the findings, against their understanding of my methods and reasoning (Seale, 2016).

To promote credibility of the findings I further relied on triangulation (Patton, 2015; Seale, 2016). For this purpose, I incorporated various data generation methods (such as interviews, field notes and reflections) to support or challenge my emerging themes and interpretations. Through the use of triangulation I thus aimed to demonstrate the convergence of evidence from diverse sources (Patton, 2015; Seale, 2016).

Patton (2015) emphasises the importance of spending sufficient time in the field when engaged in interactions and data generation, as such prolonged engagement can allow researchers to develop a deeper understanding of the context and participants' perspectives. In addition, consistent and attentive observations and engagement with participants can strengthen the validity of findings as they may allow for the identification of patterns, inconsistencies and nuances that may be missed when engagements are brief (Seale, 2016). Due to COVID-19 related restrictions, I had limited in-person contact with the participants; however, I still used sufficient time for the data generation process and conducted seven semi-structured interviews during which I spent sufficient time with the participants and tried to obtain as much information as possible, despite some of the interviews being conducted telephonically.



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#### *3.5.2.3 Confirmability*

Confirmability plays an important role in establishing objectivity and neutrality of qualitative findings. As such, this criterion concerns the degree of neutrality during the interpretation phase of a research process (Patton, 2015; Babbie & Mouton, 2006; Yin 2018). According to Seale (2016), an audit trail of decisions, data and the methods used during a study may support confirmability.

From the onset of my study, I acknowledged my own biases and remained cognisant of these throughout the data generation and analysis process. In an attempt to ensure confirmability, I included an audit trail by providing detailed examples of the data and the analysis I completed in Chapter 4, as well as the related appendices (Babbie & Mouton 2006; Patton, 2015). The audit trail allows the reader to determine to what extent my interpretations, conclusions and recommendations were drawn from the data (Patton, 2015). Therefore, I aspired to present the data and my analysis and interpretations as truthfully as possible, keeping in mind the theoretical underpinnings of the study.

I also include my reflections on my own bias and experiences in my research journal. As such, I include examples of the way in which I considered the possible influence of my own ideas and experiences on the findings, thereby attempting to limit the potential influence on the findings.

#### *3.5.2.4 Authenticity*

Streubert and Carpenter (1999) describe authenticity as an accurate representation of participants' reality and experiences. As such, authenticity is focused on whether or not the results and findings of a study provide a true representation of the research events, participants and contexts (Lincoln & Guba, 1986). Authenticity is more than mere credibility and confirmability, as it is concerned with the essence and richness of participants' experiences and perspectives, while acknowledging the influence of a researcher's role and the dynamic interaction between researcher and participants throughout the research journey (Patton, 2015).

In this thesis, I present my research in a transparent and honest manner. I include the research content and attempted to present the teacher-participants' contributions in a truthful unbiased manner in Chapter 4 as well as in the related appendices (Creswell & Creswell, 2022). For this purpose, I aimed to include accurate findings, acknowledged and reflected on my potential biases, and avoided selective reporting of the results as this might



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misrepresent the research outcomes. I further made use of continuous reflections on my own biases, values and experiences, and how these might influence the research process and interpretations in an attempt to minimise my own influence and ensure that the participants' voices and perspectives were authentically represented (Patton, 2015). I aimed to represent the participants' voices authentically by incorporating participants' own words and expressions whenever possible, allowing their unique perspectives to resonate with the reader (Seale, 2016). I further aimed to achieve authenticity by asking the participants to comment on and check the transcripts for accuracy, when employing member checking (Patton, 2015).

#### *3.5.2.5 Dependability*

In qualitative studies, dependability is associated with the quantitative criterion of reliability (Lincoln & Guba, 1986). Merriam (1998) argues that this can be achieved in qualitative research by ensuring consistency between the raw data and the results that are reported. This can be done through careful documentation of the decisions, methods and data of a study (Seale, 2016).

I aimed to ensure that the findings of my study are dependable by focusing on consistent and repeatable findings (Lincoln & Guba, 1986; Babbie & Mouton, 2006). Both Patton (2015) and Seal (2016) stress the importance of meticulous documentation throughout a research process to enhance dependability. As such I included detailed descriptions of the research design, data generation methods, analytical procedures and thinking behind interpretations in this thesis. For this purpose, I made use of an audit trail to capture the data generation and analysis, reporting on these processes in detail to provide interested researchers with sufficient information to be able to repeat the study in future in similar research contexts (Babbie & Mouton, 2006). My detailed report of the research process can further allow researchers to follow and understand my decisions and reasoning, which may support the replication of this study (Patton, 2015; Seale, 2016). Finally, I aimed to ensure consistency in coding by applying the same coding scheme and criteria to all data segments consistently throughout the analysis process (Patton, 2015).

## 3.6 ETHICAL CONSIDERATIONS

Ethical considerations entail the principles and guidelines that researchers employ to ensure that research is conducted in an ethically responsible and morally sound manner. Ethical considerations do not only protect the rights, dignity and well-being of respondents/



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participants, but also play an important role in ensuring the credibility and validity of the research findings (Creswell & Creswell, 2022). In the subsections that follow, I discuss the ethical considerations I respected in undertaking the current study.

### 3.6.1 Permission to conduct research

I obtained permission to conduct my study from the University of Pretoria's Research Ethics Committee (consult Appendix A1), the Gauteng Department of Education (Appendix A2), as well as the principals of the participating schools and their respective School Governing Bodies (Appendix A3) prior to commencing with any data collection/generation. I conducted research within the stipulated time frames of the Gauteng Department of Education and remained cognisant of the conditions for conducting research stipulated by the principals and governing bodies. For example, one of the primary schools gave permission for teachers of the Foundation Phase only to participate in my study.

### 3.6.2 Voluntary participation and the right to withdraw

I obtained Informed consent from the respondents before commencing with data collection as part of Phase 1 of the study. For this purpose, I attached an informed consent section to the structured questionnaire, outlining the nature of the study and the implications of participation (consult Appendices B1). I thus provided the respondents with clear and comprehensive information about the research purpose, procedures, potential risks and benefits, emphasising their voluntary participation in the study. I further informed them about what their role would entail for both the questionnaire and semi-structured interviews (Babbie & Mouton, 2006; McMillan & Schumacher, 2014). The voluntary nature of participation implied that the respondents/participants could withdraw at any time, without giving an explanation. This was outlined to the respondents/participants as well as the fact that I would respect confidentiality and anonymity at all times (Babbie & Mouton, 2006; McMillan & Schumacher, 2014).

### 3.6.3 Trust

Trust underpinned the relationships between me and the teachers who participated. Throughout the research process, I focused on building and maintaining the trust of the teachers. Trust required of me to be transparent and honest about my intentions whilst making sure that the teachers understood the research process, potential risks and benefits of their participation (Creswell & Creswell, 2022; Patton, 2015). I further focused on maintaining relationships of trust by not subjecting any teacher to acts of deception or



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betrayal during the research process (Babbie & Mouton, 2006; McMillan & Schumacher, 2014). In addition, I avoided deception of the respondents/participants by being open and truthful about the nature of the study, and any potential risks associated with their involvement (Patton, 2015), which were, however, not applicable to my study.

### 3.6.4 Confidentiality, anonymity and respect for privacy

The participating teachers' privacy was respected by means of confidentiality and anonymity (Babbie & Mouton, 2006; Cohen et al., 2018). Confidentiality implies that respondents'/participants' identities and their specific data will not be revealed to others. This was achieved by omitting the names of the teachers from transcriptions and using pseudonyms when referencing the teachers in the transcripts and also when reporting on the data. Anonymity goes beyond confidentiality and refers to ensuring that respondents/participants cannot be identified at all, and involved removing all identifiable information from the data (Patton, 2015). Throughout my study, the identifying information was only available to me and my supervisor, and not disclosed to anyone else.

In addition, during the course of the data analysis and report writing, codes were assigned to the teachers who participated. For Phase 2 of the study, when keeping a record of all the information, I ensured that all electronic files with information on the study and the participants' contributions were password protected. All audio-recordings, field notes and reflections on the semi-structured interviews were safeguarded by either securing electronic files with passwords or keeping hard copy notes in a locked cabinet, with no one besides my supervisor and me having access to the documents. The identities of the teachers who participated are furthermore protected by the raw data being stored in a locked cabinet at the University of Pretoria for 15 years.

I further aimed to respect the privacy of respondents/participants by gathering only data that was necessary to answer my research questions and using the data for the intended research purposes only (Babbie & Mouton, 2019; Cohen et al., 2018; Creswell & Creswell, 2022). This action minimised the amount of information I had to protect and reduced the risk of potential privacy breaches (Patton, 2015). In addition, in support of respecting the privacy of the respondents/participants I remained mindful of any possible power dynamics that could be present in my research context, remaining transparent about my role and any potential conflicts of interest, and ensuring that the respondents/participants felt comfortable to withdraw from the study or refuse to answer any questions without facing any consequence (Seale, 2016).



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### 3.6.5 Protection from harm

Throughout my study I aimed to protect the teachers who participated from harm by minimising any potential physical, emotional or psychological harm they might encounter during the research process (Creswell & Creswell, 2022; Babbie & Mouton, 2019). To this end, I remained mindful of cultural sensitivities and avoided research practices that might be offensive or harmful to specific groups. Throughout, I treated all the teacher-respondents/participants fairly and without discrimination. This included avoiding biases associated with age, race, gender and other characteristics whilst providing equal opportunities for participation (Bryman & Bell, 2015).

I also aimed to protect the respondents'/participants' privacy and confidentiality by ensuring that the data is stored securely and was used only for the intended research purposes as discussed above. I further avoided coercion of the respondents/participants or undue pressure for them to participate in the research (Mays & Pope, 1995; Polit & Beck, 2017). In addition, I continuously monitored the research process to identify and address any emerging risks or concerns. This included maintaining open communication with the respondents/participants and being responsive to their feedback throughout my study (Mays & Pope, 1995).

## 3.7 CONCLUSION

In this chapter, I explained the empirical part of my study in detail. I discussed pragmatism as the selected epistemological paradigm and the mixed methods research approach I followed. I justified the implementation of a mixed methods research design and outlined the research process. More specifically, I explained the quantitative and qualitative phases of my study in terms of the respective sampling, data collection/generation, data capturing/documentation and data analysis and interpretation procedures. I concluded the chapter by explaining rigour and the ethical principles that I adhered to.

In Chapter 4 I present the results of my study. The quantitative and qualitative results are presented in separate sections, after which I integrate the results I obtained.

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# CHAPTER 4 - RESULTS OF THE STUDY

## 4.1 INTRODUCTION

In Chapter 3, I explained the research design and related methodological choices I made. I justified pragmatism as epistemology, the mixed methods approach I followed and the data collection/generation, data capturing/documentation and data analysis methods I used.

In this chapter, I present the results of my study. I first present the quantitative results based on the data collected through the questionnaire I implemented. Next, I discuss the results obtained from the qualitative data that was generated through semi-structured interviews, supported by field notes and reflections captured in my research journal. I discuss the qualitative results in terms of the themes and related subthemes I identified. I conclude the chapter with an integration of the quantitative and qualitative results I obtained.

## 4.2 QUANTITATIVE RESULTS OF THE STUDY

As explained in the previous chapter, quantitative data was collected by means of a self-administered questionnaire. Although 101 respondents participated, only 92 questionnaires were completed in full and subsequently included for data analysis. As such, the results I discuss in this section are based on the data obtained from 92 teachers who were employed at seven public schools in Ekurhuleni, South Africa at the time of my fieldwork.

### 4.2.1 Demographic results

Teachers from seven schools responded, of which three were secondary schools and four primary schools. Of the total number of respondents, 53% were teaching at secondary schools and 46% at primary schools at the time. The distribution of the respondents per school can be viewed in the previous chapter in Table 3.3.

#### *4.2.1.1 Gender of the respondents*

Of the 92 respondents, 15,2% indicated that they were male and 84,8% indicated that they were female, as depicted in Figure 4.1. The limited number of male respondents correlates with the demographic profile of teachers in South Africa, especially in primary schools.



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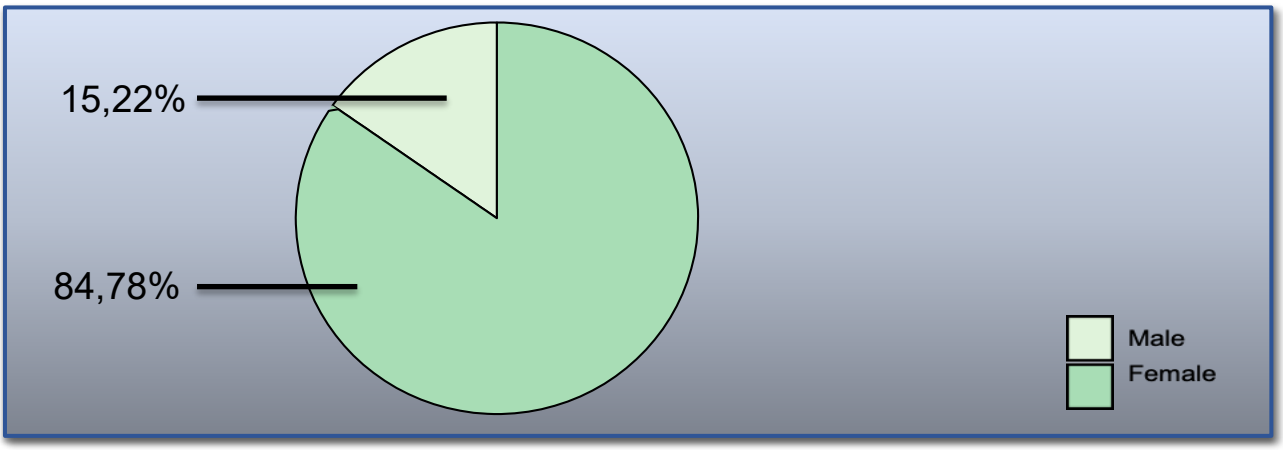
**Figure 4.1:**

*Gender distribution of respondents*




*4.2.1.2 Grades and number of subjects taught by the respondents*

Table 4.1 summarises the grades of the learners that were taught by the respondents at the time of the data collection. As they could give more than one response to this question, the percentages do not add up to 100%.

**Table 4.1:**

*Grades taught by the respondents*

| GRADE | FREQUENCY | PERCENTAGE |
|---|---|---|
| 1 | 16 | 17,39% |
| 2 | 10 | 10,87% |
| 3 | 7 | 7,61% |
| 4 | 3 | 3,26% |
| 5 | 5 | 5,44% |
| 6 | 3 | 3,26% |
| 7 | 7 | 7,61% |
| 8 | 22 | 23,91% |
| 9 | 23 | 25% |
| 10 | 25 | 27,17% |
| 11 | 27 | 29,35% |
| 12 | 24 | 26,09% |



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In terms of the number of subjects taught by the respondents, the majority (67, 39%) were teaching one subject at the time, with 19,57% teaching two subjects. Only a limited number of the respondents were teaching three or four subjects – 5,43% and 6,52% respectively.

#### *4.2.1.3 Teaching experience of the respondents*

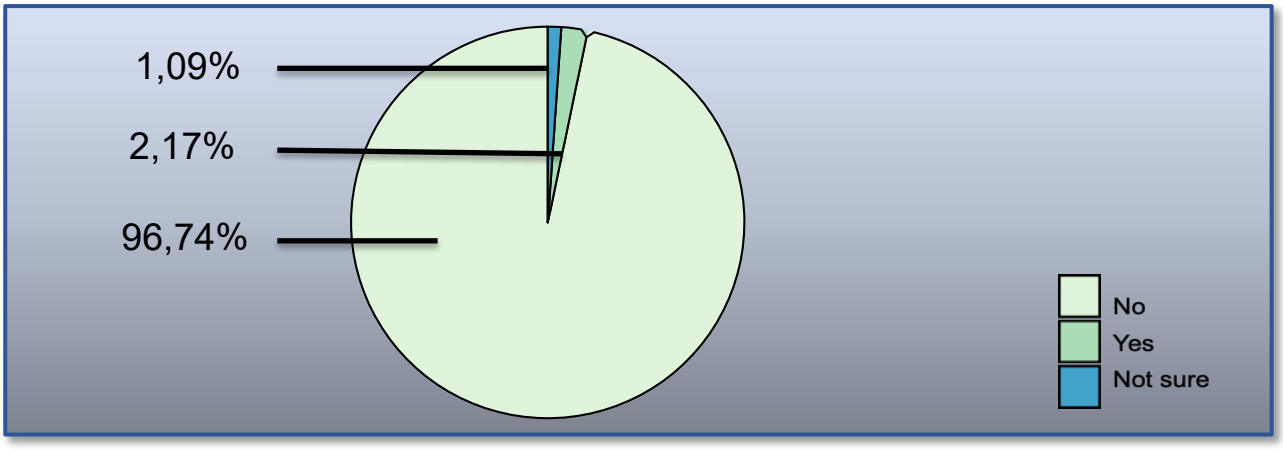
The respondents had taught an average of 14 years at the time of my study. A large standard deviation was indicated in respect of this question, indicating a broad range of experience amongst the teachers, ranging from one to 45 years. The mean is 13,57 that implies that on average, the teacher-respondents had taught for more or less 13 years whereas the median of 8 years indicates that the majority of the teacher-respondents actually taught for less than 13 years, as indicated by the mean, even though the mean was increased by the broad range of teaching experience of the respondents.

#### *4.2.1.4 Incidence of CVD amongst the respondents*

The majority of the respondents (96,74%) indicated that they did not have CVD, with 1,09% being uncertain about this and 2,17% reporting that they did have CVD. However, none of the respondents elaborated on the question about the impact of CVD on their lives. The responses are presented in Figure 4.2.

**Figure 4.2:**

*Number of respondents with/without CVD*




### 4.2.2 Teachers' general perception of the use of colour for school-related activities

Responses to the questions related to teachers' general perception of the use of colour are captured in Figure 4.3. The questions that apply are the following:

- Q27: Colour plays an important role in learning.



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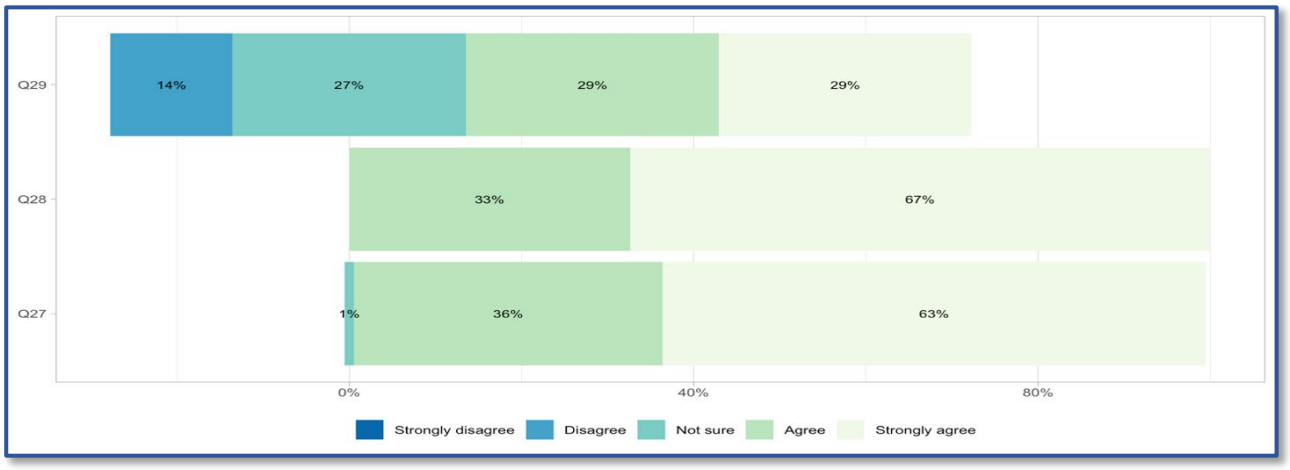
- Q28: Colour is valuable when wanting to highlight important concepts or work.
- Q29: Good performance in school can be linked to the ability to differentiate between different colours.

**Figure 4.3:**

*Teachers' general perception of the importance of colour for school-related activities*




The majority of the respondents (99% *Strongly agreed* or *Agreed*) indicated that colour plays an important role in learning. Furthermore, all of the respondents (100%) indicated that colour is valuable when wanting to highlight important concepts or work, and 58% *Strongly agreed* or *Agreed* that good performance in school can be linked to the ability to differentiate between colours. These results emphasise teachers' belief that colour is important for learning and the related activities that learners engage in.

### 4.2.3 Use of colour in the school context

The following questions were included in the questionnaire relating to the use of colour in schools:

- Q10: Colour is often used on notice boards and signs around your school.
- Q11a: Colour is used in extra-curricular activities.
- Q12a: During sport activities, teams wear different coloured clothing to identify team members.
- Q13: I generally make use of colour when coaching extra-curricular activities.

The distribution of the scores for these items are captured in Figure 4.4.



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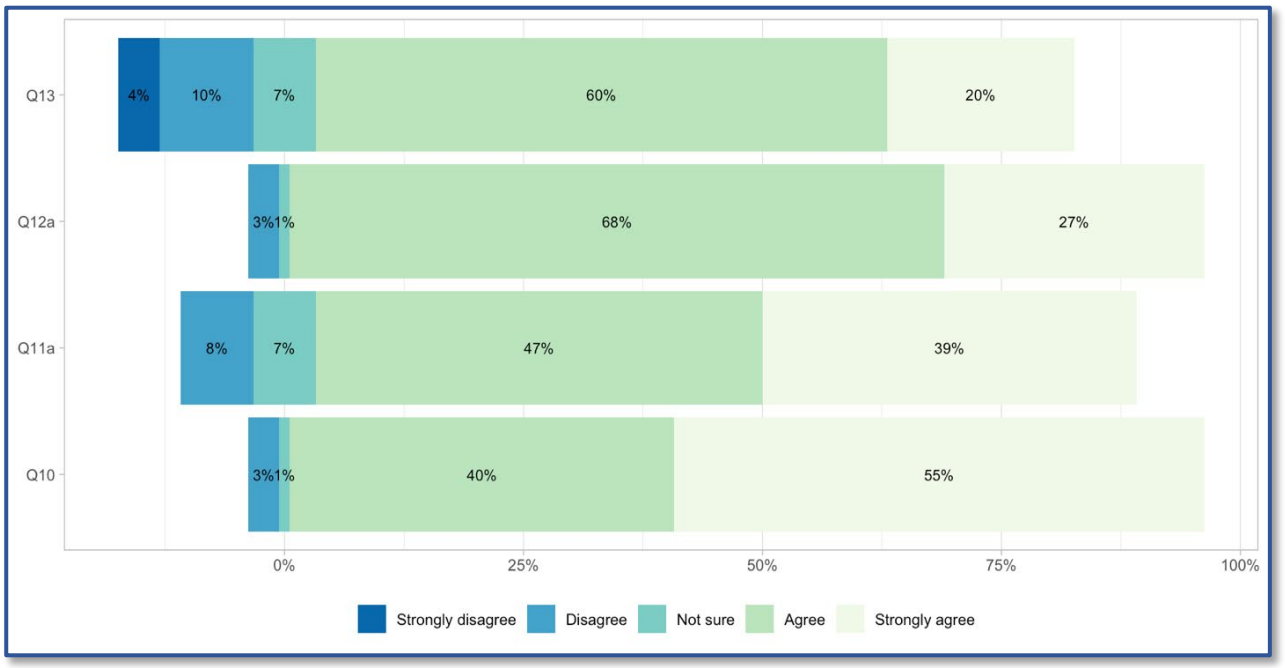
**Figure 4.4:**

*Use of colour in the school context*




As illustrated in Figure 4.4, 95% of the respondents indicated that colour is often used on notice boards and signs around their school (they selected either *Strongly agree* or *Agree*). In addition, the majority of the respondents (86%) indicated that colour is also often used during extra-curricular activities, with 80% of the respondents indicating the regular use of colour when coaching extra-curricular activities. Furthermore, the majority of the respondents (95%) indicated that sport teams typically wear different colour clothing to identify team members.

When asked to provide examples of how colour is used in extra-curricular activities after responding either *Agree* or *Strongly agree* to Question 11, respondents referred to the use of colour in cones and field markings as well as sport clothing as most prominent examples. In addition, several respondents reported that colour is often used for balls, score cards, uniforms and bibs as well as cue cards. The respondents furthermore referred to the use of colour to differentiate between various houses in schools. In terms of specific sport activities, respondents identified netball as a prominent area for using colour, with hockey as a less prominent area. A few respondents referred to the use of colour in drama, chess and worksheets.

When specifically prompted about the use of colour in the clothing of different teams when participating in sport, 95,7% of the respondents indicated that sport teams often wear different coloured clothing to distinguish them from other teams. The respondents identified



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netball, hockey and rugby as prominent sports where colour is used, with soccer, athletics, mini soccer and swimming to a lesser extent.

### 4.2.4 Use of colour during classroom activities

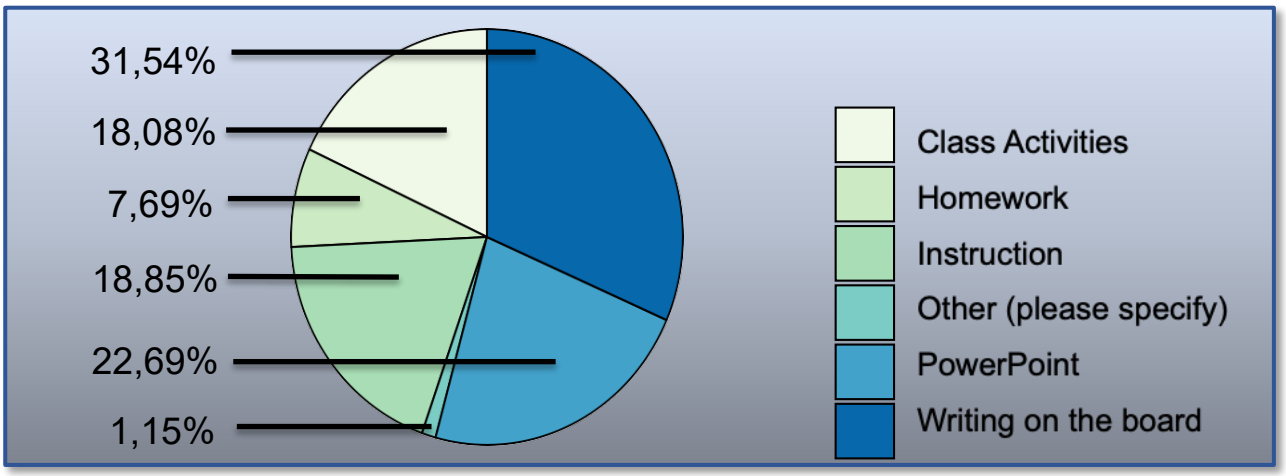
To explore the use of colour in the classroom, respondents were asked about the frequency of the use of colour, colours most often used, for which activities colour is used and why (questions 15, 16a, 16b, 17, 20, 21, 30 and 31 on the questionnaire).

With regard to the general use of colour in the classroom, the majority of the respondents (84,78%) indicated that they used colour on a daily basis, with 15,22% indicating their use of colour on a weekly basis. Therefore, all the respondents indicated that they used colour on a daily or weekly basis in their classrooms. In a related question, the respondents were asked which colours they used most frequently in the classroom. Although several respondents noted the use of a combination of various colours, a number identified blue and red as the colours most often used. Green and black were also indicated as colours that were often used in class, with purple and yellow being used less frequently.

In terms of the classroom activities where colour was often used, the respondents could select one or more of various options presented in Figure 4.5. As indicated, the most common activity where colour was used in class was writing on the board, with a fairly large proportion of use in the categories related to using colour in PowerPoint presentations during teaching and for class activities. The respondents who selected other uses noted that they used colour during extra lessons and in YouTube recordings.

**Figure 4.5:**

*Activities where colour was often used in the classroom*



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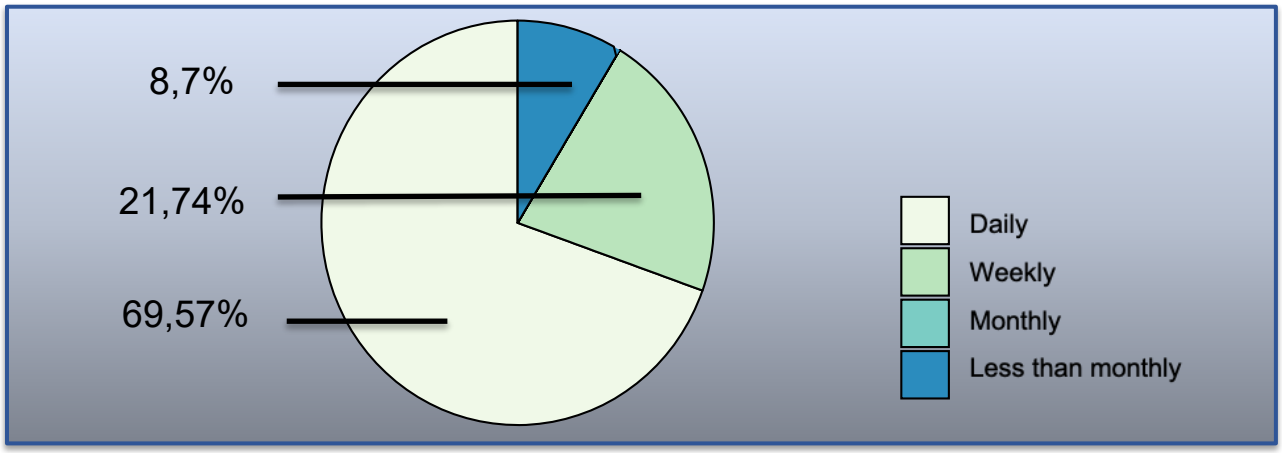
In terms of the frequency of the use of colour specifically during teaching and classroom instruction, the majority of the respondents (69,57%) indicated that they used colour on a daily basis, with the other respondents' frequency of use depicted in Figure 4.6.

**Figure 4.6:**

*Use of colour during teaching and instruction*




To further enquire about their reasons for using colour during teaching and classroom instruction, the questions captured in Figure 4.7 were included in the questionnaire:

- Q20: I use colour for structure and organisation in my classroom.
- Q21: I often use colour to code information.
- Q30: I use colour to explain the differences between objects/concepts in my classroom.
- Q31: I often use colourful pictures and/or worksheets to make the work more interesting.



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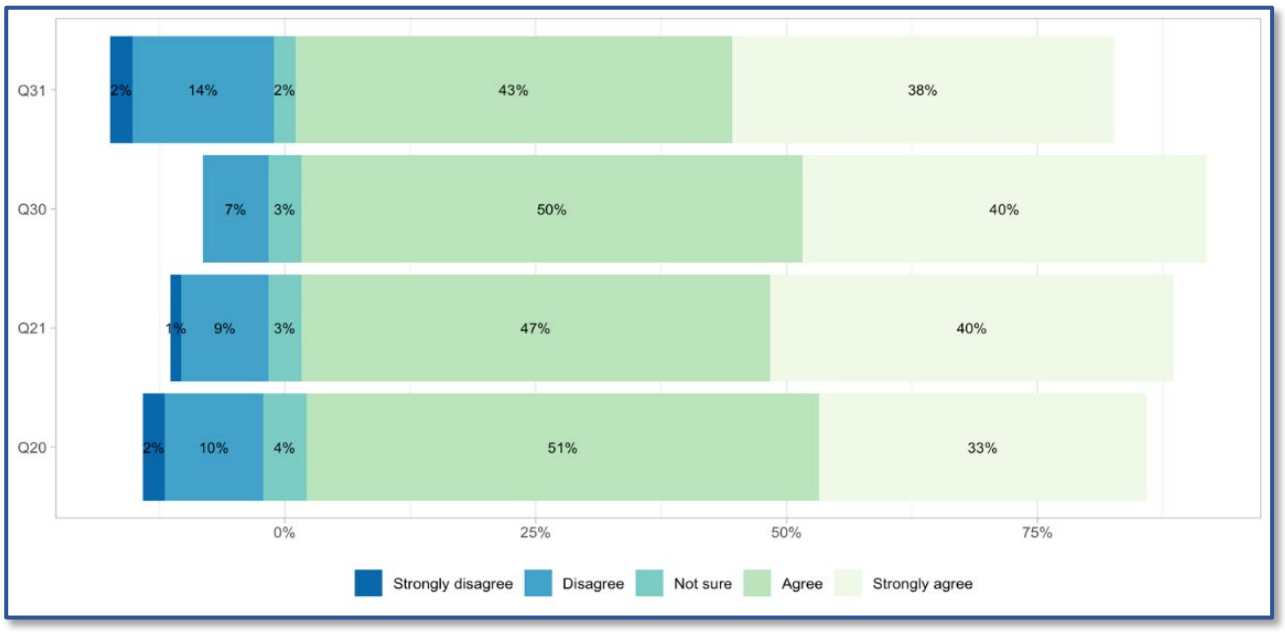
**Figure 4.7:**

*Reasons for using colour during teaching and classroom instruction*




As captured in Figure 4.7, 51% of the respondents *Agreed* and 33% *Strongly agreed* that they used colour for structure and organisation in their classrooms. Additionally, 40% *Strongly agreed* and 47% *Agreed* that they often used colour to code information, with 90% (*Agree* and *Strongly agree* combined) indicating that they used colour to explain the differences between objects or concepts. Finally, 38% of the respondents *Strongly agreed* and 43% *Agreed* that they used colourful pictures and/or worksheets to make the work discussed in class more interesting to the learners.

### 4.2.5 Use of colour in teaching resources

An overview of the responses to the questions on the use of colour in teaching resources is presented in Figure 4.8. The questions included in this regard were the following:

- Q19: The resources that I use, such as books, posters and worksheets, generally contain colour.
- Q23: The majority of the paintings/images/posters on the walls in my classroom are colourful.
- Q24: I generally use different coloured chalk or whiteboard markers when writing on the board.
- Q25: The majority of the manipulatives, blocks, puzzles and other objects that learners use in my classroom are colourful.
- Q26: The images I use to explain important concepts often contain colour.



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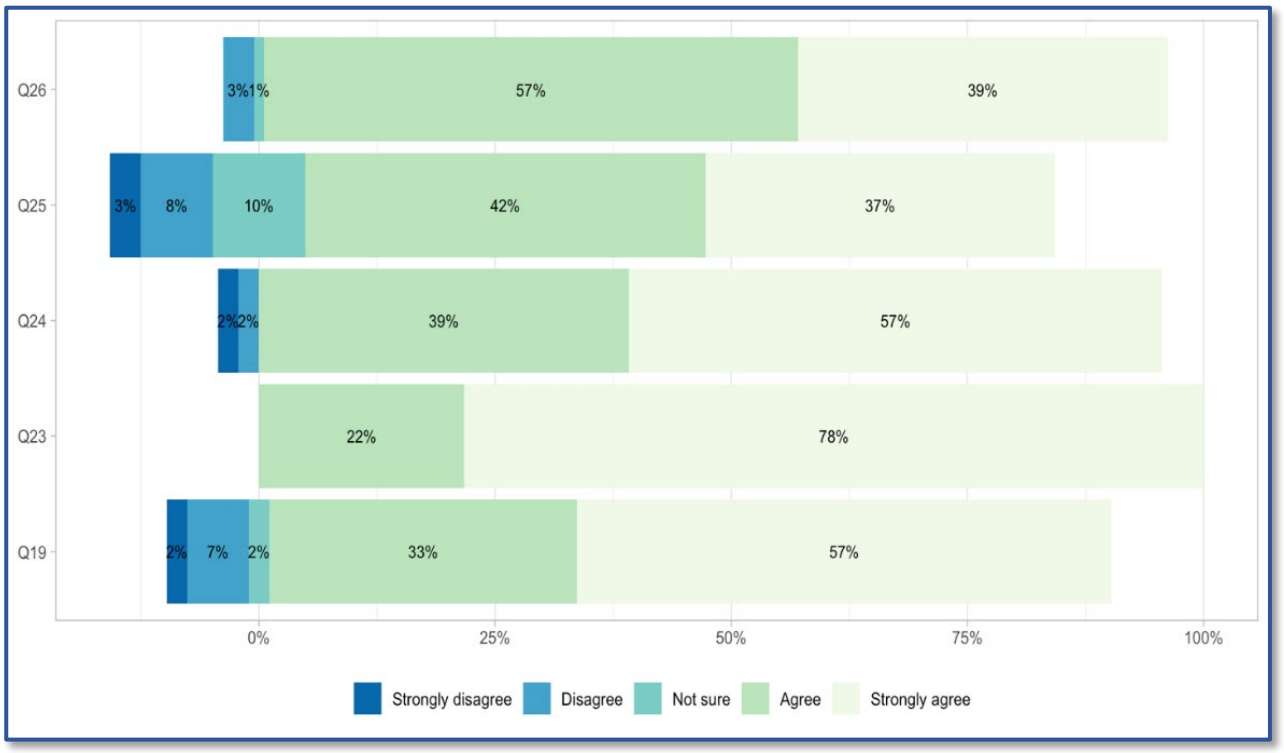
**Figure 4.8:**

*Use of colour in teaching resources*




As indicated in Figure 4.8, 57% of the respondents *Strongly agreed* and 33% *Agreed* (90% in total) that the media they used, such as books, posters and worksheets generally contained colour. In addition, 78% of the respondents *Strongly agreed* that the majority of paintings/images/posters on the walls of their classroom were colourful, with the remainder of the respondents (22%) agreeing on this statement. Similarly, 57% of the respondents *Strongly agreed* and 39% *Agreed* (96% in total) that they used different coloured chalk or whiteboard markers when writing on the board. In terms of supportive teaching resources in class, 37% of the respondents *Strongly agreed* and 42% *Agreed* that the majority of the manipulatives, blocks, puzzles and other objects used in their classes were colourful. Finally, 39% of the respondents *Strongly agreed* and 57% *Agreed* (96% in total) that the images they used to explain important concepts often contained colour.

In addition to the questions on teaching aids and resources used in class, the respondents were asked about the use of colour in textbooks. Most of them indicated that textbooks usually made use of black print on a white background, with occasional use of a grey scale. The respondents noted that some textbooks included coloured pictures, and that the prescribed curriculum workbooks included colour. They further noted that readers contained colour. One of the respondents who taught in the Foundation Phase was of the view that all colours were used in the textbook she utilised.



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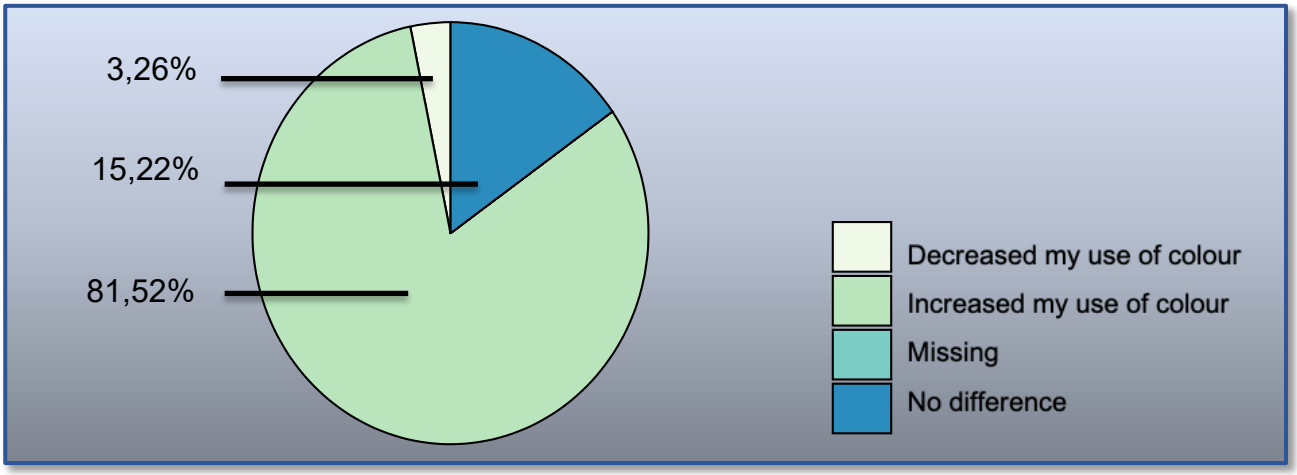
### 4.2.6 Colour and the use of technology in the classroom

The respondents' views on how the use of technology has changed the way that colour is used in the classroom are presented in Figure 4.9. According to the majority of the respondents (81,52%), the use of technology increased their use of colour in the classroom, with only 3,26% reporting their decreased use of colour as a result of the increase in the use of technology.

**Figure 4.9:**

*Use of technology in relation to the use of colour in the classroom*




To investigate this aspect, the following questions were included in the questionnaire, with the responses captured in Figure 4.10:

- Q22: I generally use colour when presenting content via the smartboard, Chromebooks, on a computer via PowerPoint presentations, etc.
- Q34: When choosing colours for PowerPoint presentations I consider the challenges that some learners may experience in seeing different colours.
- Q35: When choosing images and/or YouTube videos I consider the challenges that some learners may experience in seeing different colours.



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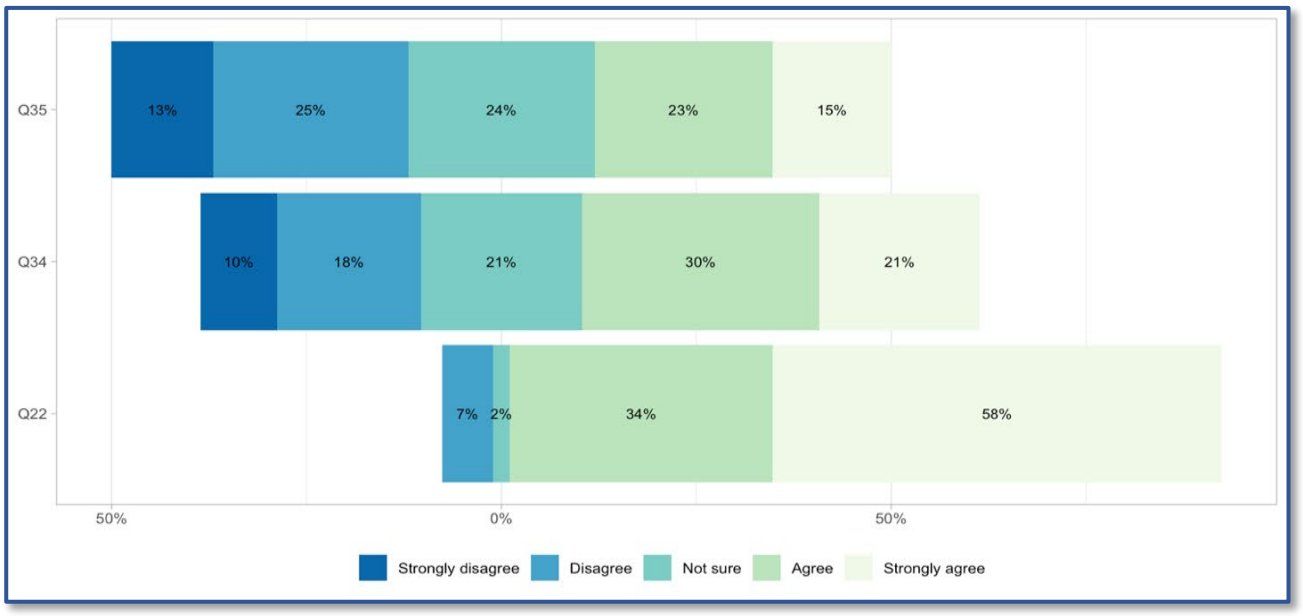
**Figure 4.10:**

*Use of colour when using technology*




As indicated in Figure 4.10, the majority of the respondents (58% plus 34%, totalled at 92%) indicated that they used colour when presenting content on an electronic device such as a smartboard, Chromebook or PowerPoint, yet only 51% of the respondents either *Agreed* or *Strongly agreed* that they considered the challenges that some learners might experience in seeing different colours when choosing colours for PowerPoint presentations. This indicates that a large percentage of the respondents (49%) used colour during presentations without consideration of the specific colours they included or the accommodation of learners with CVD. A similar trend can be seen in terms of the use of colour in, for example, images or YouTube videos.

### 4.2.7 Teachers' understanding and experiences of CVD

As part of the questionnaire, the respondents elaborated on their understanding of the condition of CVD in the form of short responses. The most common response amongst the respondents was that a person with CVD cannot see certain colours or shades of colours, with a fairly great proportion of the respondents (46,15%) providing this response. Some less common responses related to the ideas of people with CVD lacking photoreceptors in the eyes that perceive different colours, people seeing colour less saturated, people being colour blind, or people being affected by depth perception and Irlen syndrome. Some additional less common and less relevant responses related to CVD creating a barrier when working with technology, CVD impacting the outcomes of tasks, and learners with CVD learning on a different level than others.



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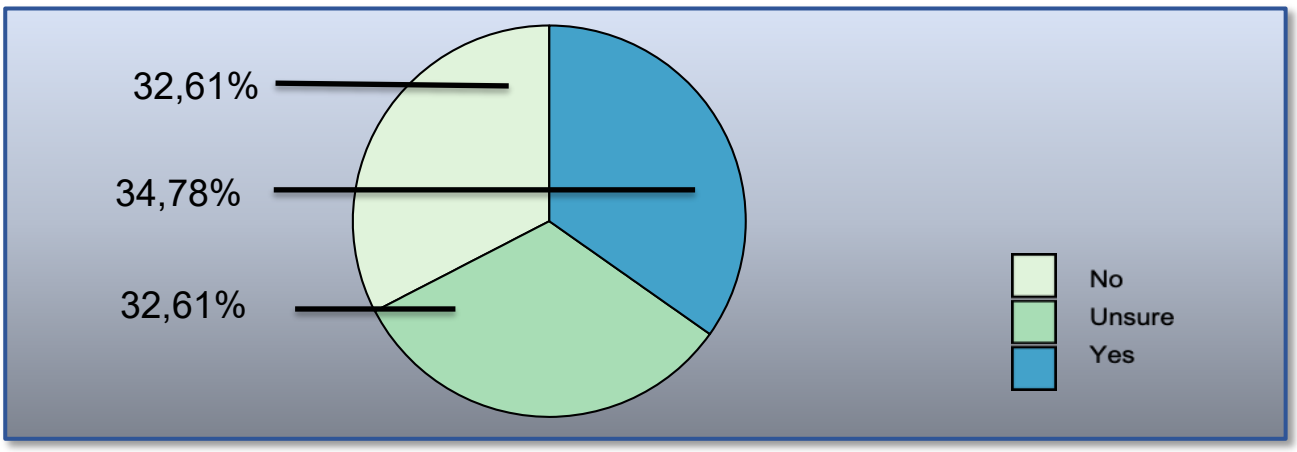
When asked whether or not they had taught learners with CVD in the past, the responses of *No*, *Unsure* and *Yes* were almost equally distributed, as captured in Figure 4.11.

**Figure 4.11:**

*Experience in teaching learners with CVD in the past*




The respondents who indicated that they had taught learners with CVD in the past were also asked about the number of learners with CVD they had taught. Responses ranged from 1 to 20, with an average of three learners with CVD having been taught by each of the respondents in the past.

Closely related to this question, the respondents were asked to indicate how they became aware of the learners with CVD whom they had taught in the past. As the respondents could select more than one option for this question, the descriptive statistics of these options were evaluated rather than the selections per respondent. In response, 39,02% of the respondents indicated that they were informed by the learner, 36,8% that they had noticed it through observation, 21,95% that they were informed by the parent and 2,44% that another teacher informed them.

### 4.2.8 Teachers' understanding of the effect of CVD on learners' functioning

When asked about the potential effect of CVD on a learner's scholastic performance, the majority of the respondents (53,12%) indicated that the condition affected scholastic performance; yet a large number (40,62%) indicated that there would not be an effect on the learners' performance, as indicated in Figure 4.12.



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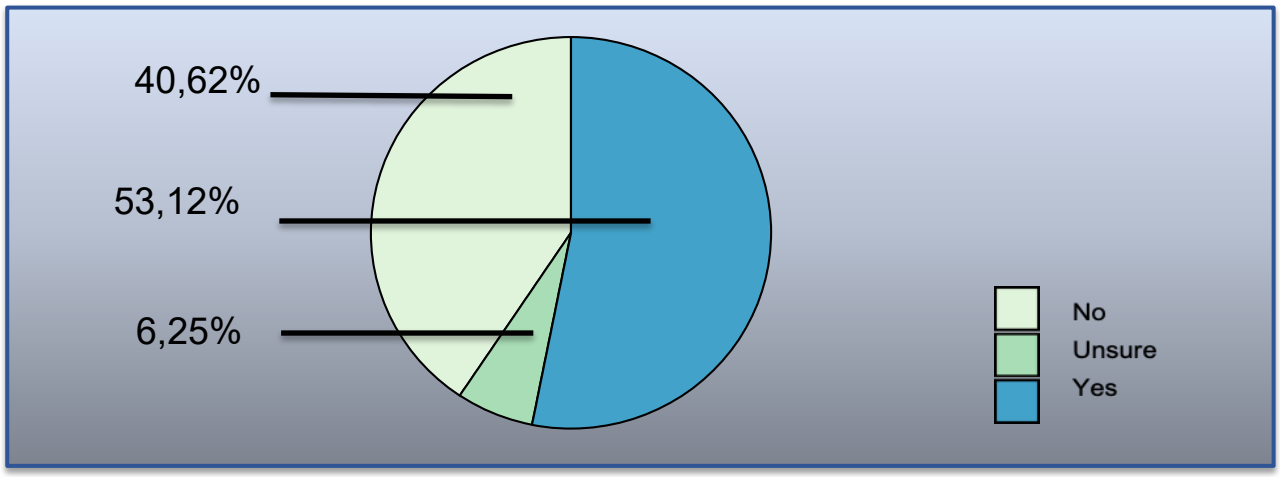
**Figure 4.12:**

*Effect of CVD on scholastic performance*




When prompted about the reasons for a *Yes* response, the respondents indicated that the challenges associated with CVD may affect a learner's marks, or cause the learner to struggle with work and identify colours. The respondents noted that teachers who were not aware of this would not be able to accommodate learners experiencing such challenges.

In response to the question on the possible effect of CVD on learners' learning (based on the respondents' experiences in the past) a fairly large proportion (20,59%) indicated that learning was not affected by the condition. Some of the other responses that were provided are captured in Table 4.2.

**Table 4.2:**

*Effect of CVD on learners' learning*

| EFFECT ON LEARNING AS EXPERIENCED BY RESPONDENTS IN THE PAST | FREQUENCY |
|---|---|
| Learner not able to see text/work in a certain colour | 17,65% |
| Learner struggled to see on the board | 11,76% |
| Learner struggled in class | 11,76% |
| Learner experienced difficulty to analyse images/charts when using certain colours | 5,88% |
| Learner struggled with art in different colours | 5,88% |
| Learner not able to see certain colours | 2,94% |
| Learner had to ask for help | 2,94% |
| Learner used incorrect colours | 2,94% |
| Learner could follow only certain instructions | 2,94% |
| Learner's marks were influenced | 2,94% |



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In a closely related question, the respondents were asked how the use of colour in the specific subjects they were teaching might have affected learners with CVD. The most prominent responses to this question related to learners experiencing challenges to see content such as diagrams and pictures that were in colour, follow instructions in class, gain a good understanding of the work or grasp the learning content quickly. According to the respondents, learners would, as a result, struggle or not be able to do their work as expected, due to them not being able to see clearly. A few respondents in the Foundation Phase noted that learners struggled when colour was used for assessment. Only a few of the respondents noted that CVD did not have an effect on learning.

With regard to the respondents' views on the potential effect of CVD on the emotional functioning of learners, 50% of the respondents indicated that CVD had such an effect, with 25% of the respondents being unsure of the possible effect, and 25% being of the view that learners were not affected on an emotional level. The respondents who indicated that CVD did affect a learner's emotional functioning provided several reasons for their responses, such as a lack of enthusiasm, limited confidence and heightened frustration amongst such learners. Additional factors identified by the respondents included that these learners might feel insecure and self-conscious, or face differential treatment that might adversely affect their marks, while experiencing ridicule for inadequate academic performance.

When asked about learners with CVD having been singled out by peers because of their condition, the vast majority of the respondents (81,25%) were of the view that this did not often occur, with the minority indicating uncertainty (6,25%) or that this was not regularly the case (12,5%). Respondents who answered in the affirmative to this question were asked to explain how learners who had CVD were singled out. In response, a respondent indicated that a learner with CVD in her class was singled out by other learners because of not being able to see red, resulting in negative remarks by fellow learners in class; for example, when the teacher wrote the learner's test score and mark allocation in a different colour than for other learners.

In terms of the possible effect of CVD on a learner's social functioning, only 31,25% of the respondents were of the view that this area of functioning would be affected. The responses to this question are captured in Figure 4.13. When prompted to provide examples, a few respondents referred to learners with CVD being excluded or teased by peers.



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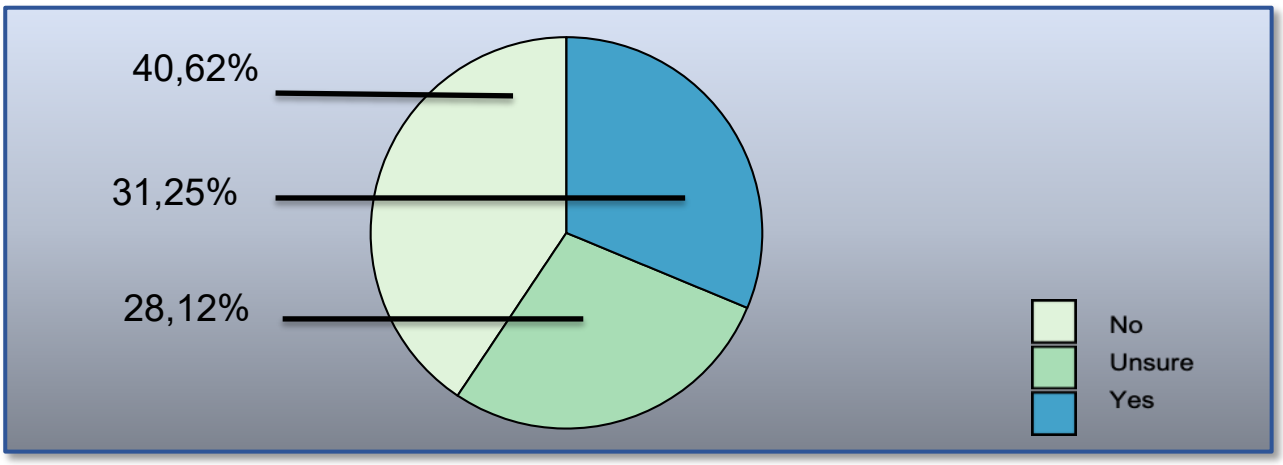
**Figure 4.13:**

*Possible effect of CVD on social functioning*




### 4.2.9 Teachers' attempts to support learners with CVD

In this section the results of the respondents' views and experiences of supporting and accommodating learners with barriers to learning, specifically learners with CVD, are presented.

#### *4.2.9.1 Teachers' level of readiness, knowledge and skills to support learners with special needs in general*

Various questions were included in the questionnaire that related to teachers' willingness, level of readiness and practices to support learners with barriers to learning. These questions, of which the results are depicted in Figure 4.14, are the following:

- Q49: I am aware of the different needs of learners in my classroom and consider this when planning and presenting lessons.
- Q52: I use a variety of teaching methods and assessments to give all learners in my classroom equal opportunities, despite their learning preferences and abilities.
- Q55: I believe that learners with mild disabilities or who experience learning challenges should be accommodated in mainstream schools.
- Q56: I create a classroom environment that takes into consideration the diverse needs of all the learners in my class.
- Q57: Accommodations (concessions) for learners with barriers to learning are applied during tests and examinations in my subject/s.
- Q59: The SIAS policy considers the needs of learners with colour vision deficiency.
- Q60: I receive information, feedback and guidance from the School-Based Support Team (SBST) regarding the learners with barriers to learning that I teach.



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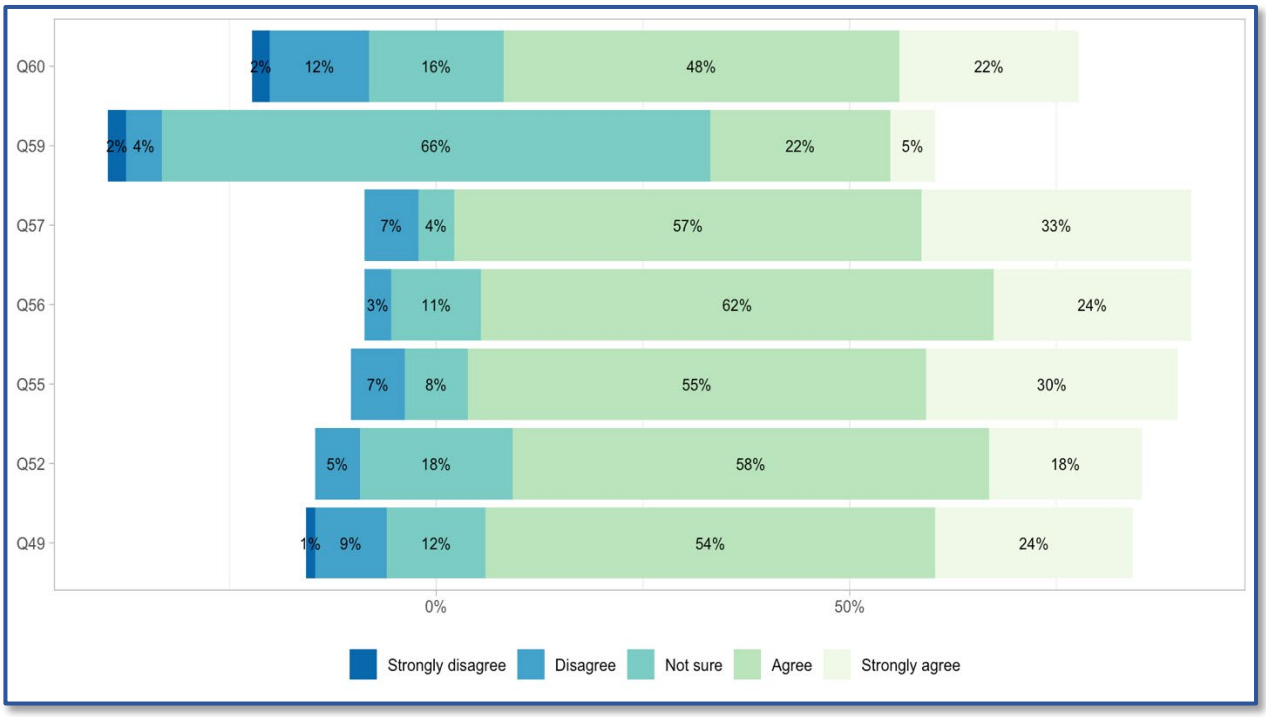
**Figure 4.14:**

*Teachers' willingness and attitudes to the accommodation of learners with special needs*




As indicated in Figure 4.14, the respondents' general attitudes and level of willingness to accommodate learners with special needs were primarily positive. To be more specific, 78% of the respondents (*Strongly agree* and *Agree* combined) indicated an awareness of the needs of the learners in their classrooms and considered these when planning lessons. In addition, a high percentage of respondents (76%) indicated that they accordingly used a variety of teaching methods and assessments to provide all learners in their classrooms with equal learning opportunities, with 85% of the respondents indicating the belief that learners with mild disabilities or learning challenges should be included in mainstream schools. Furthermore, 24% of the respondents *Strongly agreed* and 62% *Agreed* that they created a classroom environment that took into consideration the diverse needs of all the learners in their classrooms. Closely aligned, the majority of the respondents (89%) indicated that the accommodation of learners with barriers to learning was applied during tests and examinations in their subject.

However, with regard to policy, only 27% of the respondents indicated that the SIAS policy specifically considers the needs of learners with CVD, with a further 66% of the respondents noting uncertainty about this. While 70% of the respondents affirmed that they had received information, feedback and guidance from the school-based support teams concerning learners with barriers to learning, 16% expressed uncertainty about this, and 14% disagreed about the statement.



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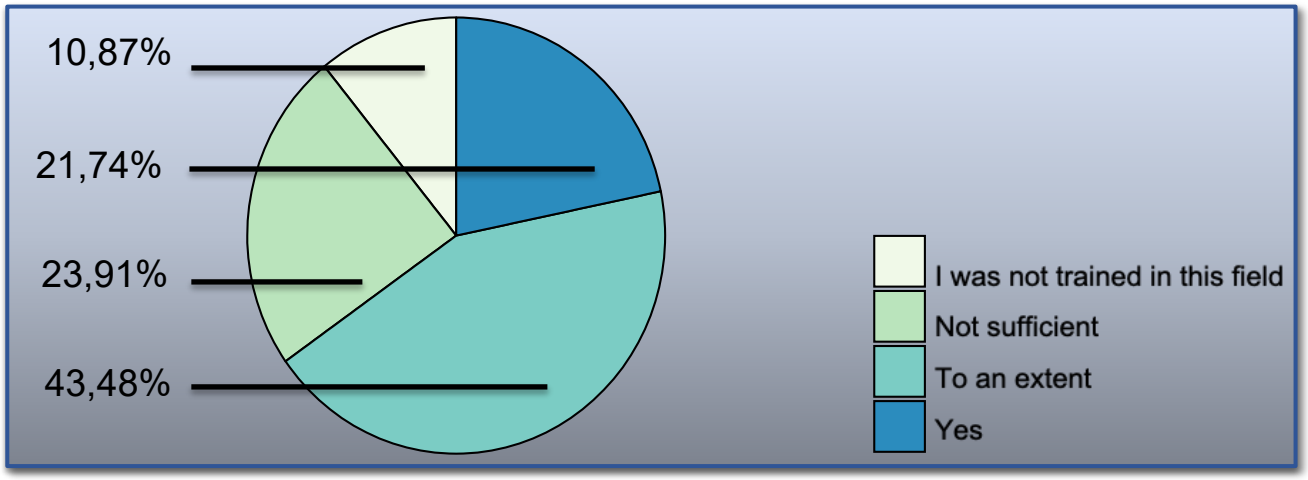
When asked about the training that they had received to accommodate and support learners with barriers to learning as part of their formal teacher training programme/s, only 21,74% of the respondents indicated that they had received sufficient training. As indicated in Figure 4.15, the majority of the respondents (43,48%) noted that they had received some training, with the remainder not having received sufficient training (23,91%) or not being trained at all (10,87%).

**Figure 4.15:**

*Training received to support learners with CVD*




Closely aligned, the respondents were asked whether they had received any additional training on how to accommodate and support learners with barriers to learning. In response, 53,26 % indicated that they had not received additional training on how to support learners with barriers to learning, with 46,74% reportedly having had additional training.

The respondents were also asked if they had been trained on how to implement the SIAS (Screening, Identification, Assessment and Support) policy in their classrooms. Only 29,35% of the respondents answered in the affirmative, with 38,04 % indicating that they had not been trained in this field, 30,43% noting that they had received some training and 2,17% being unsure.

Closely aligned, the respondents were asked whether they knew how to refer learners who experienced barriers to learning or who might need additional assessment opportunities/intervention. The respondents could choose between the options *Yes*, *Not sure* and *No,* with 81,52 % indicating that they knew how to refer such cases, as depicted in Figure 4.16.



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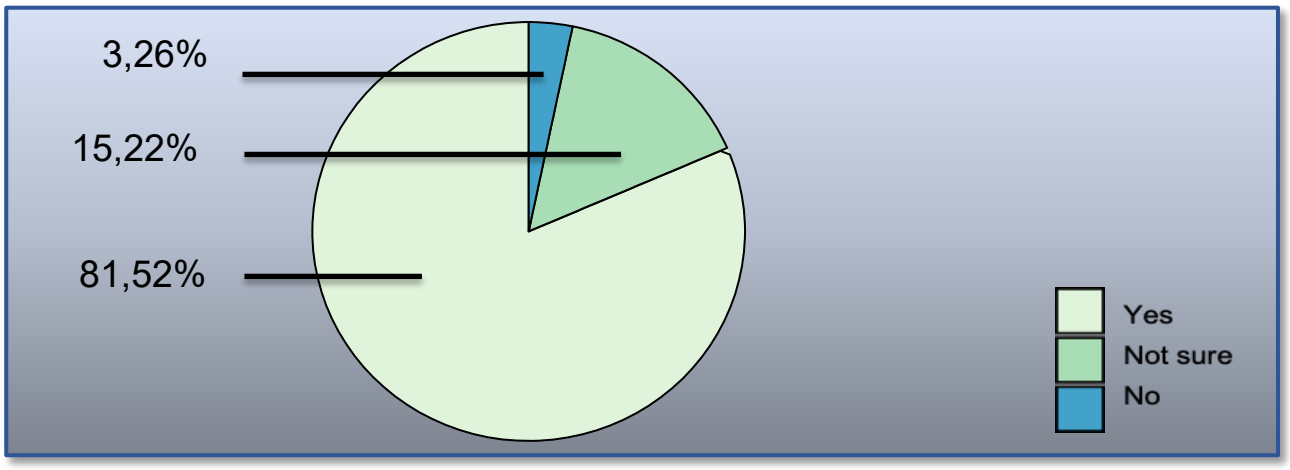
**Figure 4.16:**

*Knowledge about referring learners who experienced barriers to learning*




*4.2.9.2 Support and accommodation of learners with CVD*

Several questions related to the support and accommodation of learners with CVD, enquiring about the following, with the results presented in Figure 4.17:

- Q68: I received sufficient training to address the needs of learners with colour vision deficiency in the classroom effectively.
- Q69: In my view, learners with colour vision deficiency are at a disadvantage in the classroom.
- Q70: Learners with colour vision deficiency are supported in the school where I teach.
- Q71: Tests and assessments are adjusted in the case of learners with colour vision deficiency in the school where I teach.
- Q72: Learners who have CVD may be labelled as slow learners in subjects or grades where colour plays a role.
- Q73: It remains the responsibility of the learners who have CVD to adjust to school, as teachers cannot be expected to cater for their specific needs.



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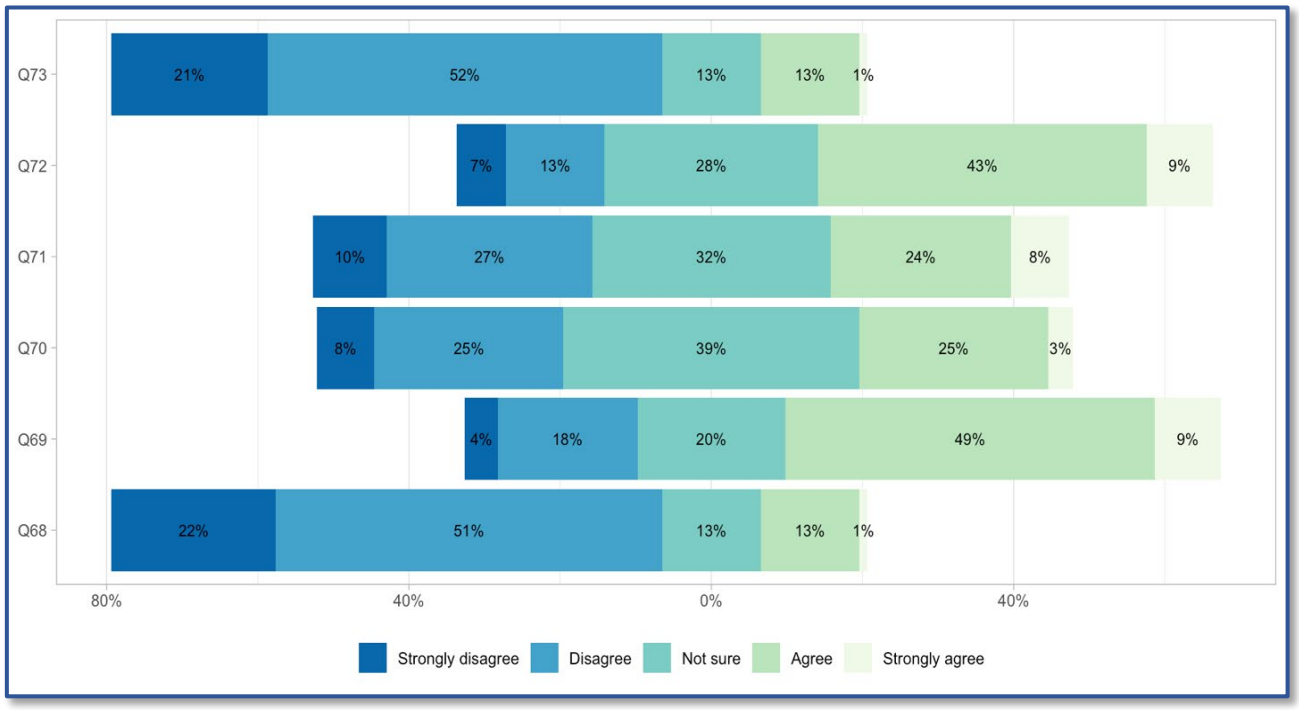
**Figure 4.17:**

*Accommodating learners with CVD*




With regard to the accommodation of learners with CVD, 73% of the respondents indicated that they had not received sufficient training to address the needs of learners with CVD in class effectively. More than half of the respondents (58%) were of the view that learners with CVD were at a disadvantage in the classroom. Although 28% of the respondents noted that learners with CVD were supported in the school where they taught, more of the respondents (33%) indicated that learners with CVD were not supported. The same trend is seen in terms of the accommodation of learners with CVD during assessment, with 32% of the respondents indicating that tests and assessment were adjusted in the case of learners with CVD in their schools, yet 37% of the respondents noting that tests were not adjusted. The majority of the respondents (52%) indicated that learners with CVD were occasionally labelled as slow learners in subjects or grades where colour played a role. Although 14% of the respondents indicated that it remained the responsibility of the learners with CVD to adjust to school, as teachers could not be expected to cater for their specific needs; 73% of the respondents disagreed (*Disagree* or *Strongly disagree*) on this view.

As a possible way of support, questions were included in the questionnaire that related to the screening of Foundation Phase learners who confused colours to determine the reason for their confusion. Results indicate that 53,26% of the respondents did not respond to this question, with a mere 7,61% indicating that this was not the case, 34,78% of the respondents



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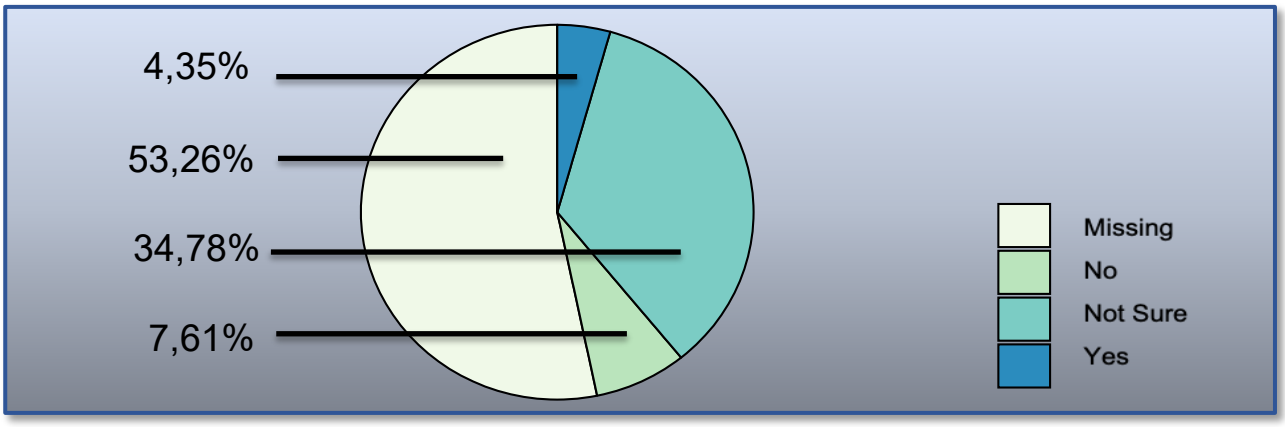
indicating that they were not sure and only 4,35% of the respondents responding positively, as captured in Figure 4.18.

**Figure 4.18:**

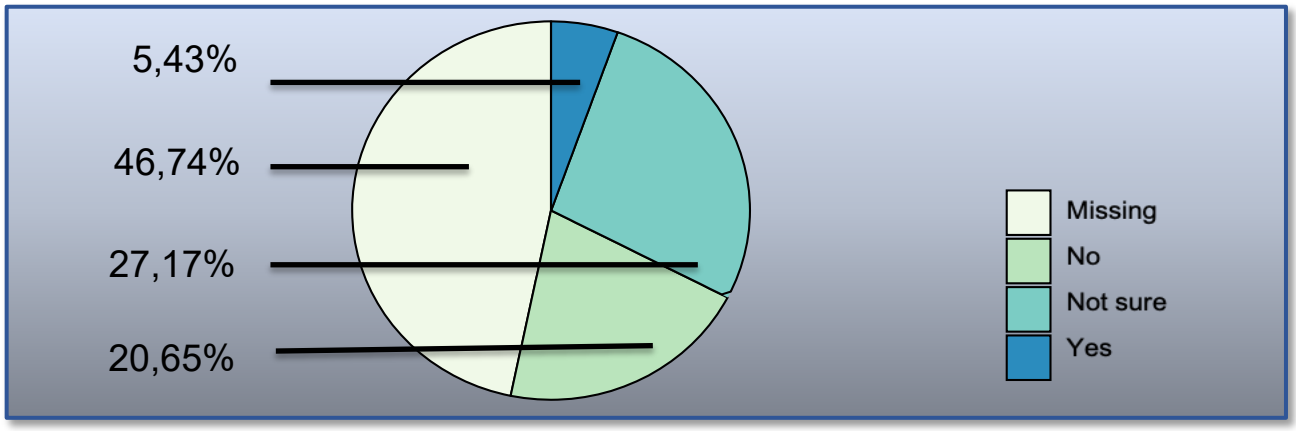
*Screening of Foundation Phase learners who confuse colours*




Finally, when asked about support to learners with CVD in the form of career guidance, the majority of the respondents (46,74%) did not respond to this question; 27,17% indicated uncertainty, and 20,65% of the respondents noted that this did not occur, and a mere 5,43% of the respondents responded positively. The responses to this question are recorded in Figure 4.19.

**Figure 4.19:**

*Career guidance for learners with CVD*




Respondents were similarly asked whether learners with CVD received support when choosing subjects in the school where they were teaching. In response to this question, 46,74% of the teachers did not provide a response, 22,83% indicated *No*, 25% *Not sure* and 5,43% indicated *Yes*.



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### 4.2.10 Inferential statistics

In this section I present the inferential statistics for the questionnaire completed by the teacher-respondents during Phase 1 of my study. I utilised the Fisher's Exact Test in an attempt to demonstrate how teachers' experiences of teaching learners with CVD might affect the support they offered to these learners. As stated in Chapter 3, the Fisher's Exact Test provides a statistical method to determine whether or not a significant association exists between two categorical variables. The Fisher's Exact Test therefore enabled me to determine whether the observed association between the two categorical variables is likely due to a real relationship or just the result of random chance.

To be more specific, in Chapter 1 I predicted a possible relation between teachers' experiences of teaching learner with CVD (independent variable) and their support provision to such learners (dependant variable). I accordingly utilised the Fisher's Exact Test to determine the relationship between the following questions from the questionnaire:

- Have you ever taught learners with colour vision deficiency (Question 64)?
- Learners with colour vision deficiency are supported in the school where I teach (Question 70).

As such, I used the Fisher's Exact Test to test the following hypotheses:

**$H_0$: The two variables have an independent relationship.**

There is no significant relationship between teachers' experiences of teaching learners with CVD and the support they offer to such learners.

**$H_1$: The two variables have a dependent relationship.**

There is a positive significant relationship between teachers' experiences of teaching learners with CVD and the support they offer to such learners.

In the case of the resultant p-value being less than 5%, I would reject the null hypothesis and conclude that the two variables have a significant dependent relationship with each other. In the case of the p-value being greater than 5%, I would not reject the null hypothesis and conclude that the two variables are independent and not related to each other.

Based on the Fisher's Exact Test p-value of 0.002, which is less than 0.05, I can conclude that there is a significant association between the two variables. This might imply that



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teachers who had experience in teaching learners with CVD were more likely to report that support for these learners was provided in their schools. Conversely, those who reported support for learners with CVD in their schools were more likely to have had experience in teaching such learners.

## 4.3 QUALITATIVE RESULTS OF THE STUDY

Nine teachers participated in the qualitative phase of the study – three male and six female participants. All nine participants were employed as teachers at public primary or secondary schools within the Ekurhuleni district at the time of my fieldwork. As an introduction to my presentation of the qualitative results, I provide an overview of the four themes and related subthemes I identified in Table 4.3.

**Table 4.3:**

*Overview of themes and subthemes*

| | |
|---|---|
| **Theme 1**<br>The use of colour in schools | |
| Subtheme 1.1 | The use of colour during classroom instruction |
| Subtheme 1.2 | The use of colour in school subjects |
| Subtheme 1.3 | The use of colour in teaching resources |
| Subtheme 1.4 | The use of colour during extra-curricular activities |
| **Theme 2**<br>Teacher perceptions and personal encounters with CVD | |
| Subtheme 2.1 | Teachers' understanding of CVD |
| Subtheme 2.2 | Teachers' awareness of learners with CVD |
| Subtheme 2.3 | Teachers' personal experiences of teaching learners with CVD |
| **Theme 3**<br>Challenges experienced by learners with CVD in the school context | |
| Subtheme 3.1 | Not being aware of or not diagnosed with CVD |
| Subtheme 3.2 | Colour-related challenges experienced in the classroom |
| Subtheme 3.3 | Colour-related challenges experienced in extra-curricular activities |
| Subtheme 3.4 | Psycho-social challenges experienced by learners with CVD |
| **Theme 4**<br>Supporting learners with CVD | |
| Subtheme 4.1 | Gaining knowledge and skills on how to support learners with CVD |
| Subtheme 4.2 | Making changes in teaching practices |
| Subtheme 4.3 | Providing individual support |



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### 4.3.1 Theme 1: The use of colour in schools

This theme captures the participants' perceptions of the use of colour in the school context. Four subthemes apply, related to the use of colour during instruction in different subjects, for educational media and during extra-curricular activities. In Table 4.4, I provide the inclusion and exclusion criteria I relied on in analysing the data related to Theme 1 and the related subthemes.

**Table 4.4:**

*Inclusion and exclusion criteria for Theme 1*

| **Theme 1**<br>The use of colour in schools | | |
|---|---|---|
| **Theme 1** | **Inclusion Criteria** | **Exclusion Criteria** |
| **Subtheme 1.1**<br>The use of colour during classroom instruction | Data that refers to the use of colour during teaching activities in the class. | Data that refers to the use of colour in the teaching of different subjects, in educational media or during extra-curricular activities. |
| **Subtheme 1.2**<br>The use of colour in school subjects | Data that refers to how colour is used in specific school subjects that learners are taught in school. | Data that refers to the use of colour during classroom instruction, in educational media or during extra-curricular activities. |
| **Category A**<br>Colour use in the Foundation Phase | Data that refers to how colour is used in Foundation Phase teaching. | Data that refers to the use of colour in specific subjects offered from Grades 4 to12. |
| **Category B**<br>Colour use during Grades 4 to 12 in specific subjects | Data that refers to the use of colour during Intermediate and Senior Phase teaching in the subjects offered in primary and secondary school. | Data that refers to the use of colour in Foundation Phase teaching. |
| **Subtheme 1.3**<br>The use of colour in teaching resources | Data that refers to the use of colour in educational media and resources such as textbooks, posters and other visual media. | Data that refers to the use of colour during classroom instruction, in different school subjects or during extra-curricular activities. |



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| Theme 1<br>The use of colour in schools | | |
|---|---|---|
| **Theme 1** | **Inclusion Criteria** | **Exclusion Criteria** |
| **Subtheme 1.4**<br>The use of colour during extra-curricular activities | Data that refers to the use of colour during extra-curricular activities. | Data that refers to the use of colour during classroom instruction, in school subjects or in educational media. |
| **Category A**<br>Prominent sport activities where colour is often used | Data that refers to specific sport activities where colour is commonly used. | Data that refers to the use of colour in sport equipment and clothing. |
| **Category B**<br>The use of colour in sport equipment and clothes | Data that refers to sport equipment and clothing that contain colour and are used during after-hours activities. | Data that refers to types of sport where colour is often used. |

#### *4.3.1.1 Subtheme 1.1: The use of colour during classroom instruction*

The participants indicated that they often used colour during teaching, for example, in organising or coding work, drawing attention or highlighting work, increasing memory, distinguishing between objects or concepts, or marking learners' work. While teacher perceptions regarding the value of colour in learning varied, the participants seemingly agreed that colour contributes positively to learning outcomes and academic performance. Furthermore, several of the participants indicated that the use of colour facilitates faster and deeper comprehension of learning content. One of the participants summarised her use of colour, stating, *When explaining on the board it is usually in colour* (IDT6; Pa7; p. 23)[8]. This report was supported by another teacher who explained her use of colour when teaching in the following words[9]:

> *So everything in our textbooks or on the walls or everything is with colour. And I will normally say okay, uhm so look at the … back poster… show me how many orange circles do you see in the poster or uhm what colour is the verb or the whatever circled in Afrikaans* (PII7; Pa9; p. 27).

In confirmation, another participant referred to her using colour to indicate the following: *The start of a new or different concept or start a new chapter or start of a new unit* (IDT1; Pa2; p. 2).

Several participants reported that they would use colour during classroom instruction to draw or keep the learners' attention. In this regard, a participant indicated, *We encourage*

[8] The following codes henceforth apply: IDT: Telephonic dyadic interview; IDP: In person dyadic interview; TII: Telephonic individual interview; PII: In person individual interview; Pa: Participant; p: page number.
[9] Responses are provided verbatim and have not been edited.



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*teachers to make use of colour mainly uhm because of uhm keeping learners' attention* (TII2; Pa3; p. 6). This was confirmed by another participant who stated, *You attract the learner's attention by making use of a different colour uhm to explain different things* (TII2; Pa3; p. 7). In further elaboration, another participant reported that colour is used to highlight work, and stated that *… highlighting the certain steps, we would use colour* (IDT1; Pa1; p. 2).

In addition, some of the participants said that they used colour to increase memory. A participant reported the following in this regard: *So, when I do my lesson, I normally ask my children, okay, think of something, and then we'll draw it or we'll colour it in or think of a colour that you like, and you got to remember that* (PII7; Pa9; p. 29). In confirmation, another participant mentioned, *with different colours you can actually remember things because you make it colour specific* (TII2; Pa3; p. 6). This report is supported by an excerpt taken from my field notes where I wrote *… often uses colour during instruction, uses it to help learners remember work* (Field notes, p. 2).

Some of the participants noted that they also used colour to distinguish between objects and/or concepts. One of the participants, for example, stated, *Geometry where you use different colours for your different angles and your different sides* (IDT1; Pa2; p. 2). This contribution was confirmed by another participant who stated, *With Maths as well and shapes, they tried to make it always different colours. So, it can also see, especially like maybe it's a circle and oval, it won't be the same colour. So that you can see the differences* (TII4; Pa5; p.13). In support, another participant stated: *Normal class test that we do on a Friday those words are in orange … That's our words for the week, remember everything was in orange* (PII7; Pa9; p. 29).

The participants seemed to agree that colour could facilitate a faster and deeper understanding of schoolwork amongst learners. In this regard, one of the participants noted the following:

> *That is hard because some children, they only, they learn better. Or they, they remember when I … do the colours. I learned very fast in colours. But if it's only plain uhm then it's boring. So that's a bit actually a tricky one … I'm a teacher who likes colour* (PII7; Pa9; p. 29).

This view was confirmed by another participant who stated the following:

> *I think the brightness … it brings a quicker understanding of uhm what is covered in the textbook… Is a lot of colour in textbooks were it uhm it helps the learner to*



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> *understand specifically when you refer to colour then you cannot work with black and white photos or pictures in textbooks* (TII2; Pa3; p. 6).

Lastly, some of the participants reported that they use colour to mark learners' schoolbooks. A participant noted, *Books we the teachers uhm mark with a red and green* (PII7; Pa9; p. 27). This view was confirmed by another participant who stated the following: *The student that I taught he was not able to see the colour red. So, when I marked his tests … in a different colour so he'll actually be able to see his test scores to see where he made mistakes* (IDT1; Pa2; p. 1). The view on the frequent use of colour during classroom instruction is supported by an extract taken from my research journal where I noted the following:

> *A learner in their classroom with CVD could not see red pen on his test. I wonder how many of his teachers were aware of this … It seems like CVD can even influence a learner's ability to see their marks and learn from their mistakes when teachers use red pen for marking and corrections. Teachers may not always realise how often they use colour* (Research journal, p. 5).

#### *4.3.1.2 Subtheme 1.2: The use of colour in school subjects*

The participants indicated several subjects where colour is commonly used in school. As they shared their personal experiences and therefore focused on the subjects they were teaching at the time, not all school subjects were referred to. For this subtheme, two categories are discussed, related to the use of colour during Foundation Phase teaching and the use of colour during the teaching of specific subjects offered in the remainder of the primary school and secondary school years.

##### 4.3.1.2.1 Category A: Colour use in the Foundation Phase

According to the Foundation Phase teachers who participated in my study, colour is widely used during teaching and in resources for teaching learners in this phase. One of the participants said, *As a Grade 1 teacher I use colour for everything especially when we even in the books when you write new phonic words* (PII4; Pa5; p. 12). In confirmation, another participant stated the following: *I have a Grade 3 class, so in my class I will use colour a lot of colour* (PII7; Pa9; p. 26).

Participants specifically emphasised the use of colour when teaching Language, Mathematics, and Life Skills that account for the three core teaching areas focused on in the Foundation Phase in South African schools. A participant, for example, explained her use of colour when teaching Language by saying, *So, let's say we write sentences today. Then we'll write the whole sentence in grey pencil and then the words that we use with a certain phonic like let's say it's the "th" or the "f" sound, then we write that in different colours*



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(PII4; Pa5; p. 12). This view was confirmed by another participant, who reported the following: *I would normally give them an Afrikaans … story. And then I will say … circle the … vocabulary words uhm in pink or in red so they have to go back to the script and do that in colour as well* (PII7; Pa9; p. 26). These reports are supported by an extract taken from my research journal where I noted the regular use of colour by Foundation Phase teachers, stating, *It seems as if Foundation Phase teachers often use colour. The educational media in the classroom are colourful and they use colour when writing on the board* (Research journal, p. 6).

In referring to the teaching of Mathematics in the Foundation Phase years, a participant stated the following: *In Mathematics, we use colours as well we will say … all the two-dimensional, colour that orange … we do use a lot of colour as well in tests … if a child get it wrong or right, it doesn't mean he can't do the maths. He just can't do the colour* (PII7; Pa9; p. 26). Another participant confirmed this experience by stating the following: *In math that you can say colour all the circles red and all the squares blue. And so, you can also see if the children understand what is squares and circles … colour especially for me in a grade one class is very important, we use it a lot* (PII4; Pa5; p. 12). Finally, another participant specifically noted the use of colour in Life Skills teaching in the Foundation Phase, saying, *Even if they go out for life skills, there's a lot of colours that those teachers use* (PII7; Pa9; p. 26).

#### 4.3.1.2.2 Category B: Colour use during Grades 4 to 12 in specific subjects

Participants who taught Mathematics indicated that they often used colour during instruction in class stating, *Geometry where you use different colours for your different angles and your different sides* (IDT1; Pa2; p. 2). In confirmation, another participant indicated the following: *I made notes on the board that they had to copy ... on congruency and similarity with geometry … And some of it I did in orange and some in green* (IDT6; Pa8; p. 20). In elaboration, another participant stated the following:

> *And for geometry … the different angles when you do the 'FUN' angles … you draw the picture in black, and then you show them the 'F' in a colour and also write that reason and statement in that colour, then you'll use a different colour, you show the 'U' …* (IDT6; Pa7, p. 20).

In addition to referring to the use of colour when explaining Geometry, colour was reportedly frequently used by the participants to highlight differences in Mathematics. One of the participants explained this as follows: *And especially with maths as well and shapes, they tried to make it always different colours … especially like maybe it's a circle and oval, it won't*



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*be the same colour, so that you can see the differences* (PII4; Pa5; p. 13). I captured similar reports in my field notes during an interview with two Mathematics teachers, stating, *A child struggled to see writing in different colours on the board* (Field notes, p. 2).

Another subject that was foregrounded by some of the participants as often relying on colour during teaching activities was History. For example, one of the participants referred to *… watching documentaries or videos* (TII3; Pa4; p. 9). In elaboration, she stated the following:

> *And then obviously with the senior History … all of the posters are in colour, so they can actually get … a better visual* (TII3; Pa4; P. 10) *… it's also nice to distinguish between different uniforms. If there's been a bad call, you know, sometimes you can see blood or violence or something because of the use of colour* (TII3; Pa4; p. 10).

Next, some of the participants reported on the use of colour in Science. Participant 3, a Science teacher, for example explained, *The colourful textbooks especially in my subject we work with Science and also cover topics like light uhm electromagnetic force, ultraviolet, infrared, etc.* (TII2; Pa3; p. 6), thereby indicating the use of colour in both teaching and educational media. He continued, adding, *Also, in Chemistry we have the different substances where uhm some properties of certain substances are related to them* (TII2; Pa3; p. 6).

As could have been expected, the participants also reported on the use of colour when teaching Art as a subject. One of the participants, for example, expressed the view that the use of colour in Art poses a challenge to a child with CVD. She shared a personal experience of a Grade 11 learner with CVD and stated the following:

> *And her biggest concern is that she was quite happy to just paint black and white pictures and we could never really understand why. But even when we assisted with the colour, she was still far more comfortable sticking to black and white painting* (TII3; Pa4; p. 10).

Finally, some of the participants referred to the use of colour in Geography, indicating that colour plays an important role when teaching this subject, especially when doing map work. A participant summarised this trend by saying, *That's very important to be able to distinguish colours there because of the maps* (TII3; Pa4; p. 9). In support of this view, another participant indicated the following:

> *Teaching Geography, we do a lot of map work, with the map work we often colour code, and we look at terrain maps so if it's brown or green, you know, and the dam and the rivers those are blue on the map. So, if a child cannot see that, it does get a bit more difficult for them* (TII5; Pa6; p. 16).



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#### *4.3.1.3 Subtheme 1.3: The use of colour in teaching resources*

The participants mentioned a variety of teaching resources that contain colour, with some of these examples already indicated in the previous section. In addition to mentioning the use of colour in textbooks and on posters and educational media, the participants reported that they often included colour when using electronic devices or when writing on the board. The participants referred to teaching resources containing colour, specifically those designed for Mathematics and reading activities.

The participants reported that colour is frequently used in textbooks. A participant, for example, shared the view that *A lot of colour in textbooks were it uhm it helps the learner to understand specifically when you refer to colour then you cannot work with black and white photos or pictures in textbooks* (TII2; Pa3; p. 6). In support, another participant stated: *Everything in our textbooks if we go through, it's in colour* (PII7; Pa9; p. 27). Another participant confirmed this view and noted that DBE (Department of Basic Education) textbooks specifically are printed in colour. She namely indicated that *DBE books that we have, like, they use a lot of colour* (PII4; Pa5; p. 13).

Some of the participants reported on the use of colour on posters in classrooms. The participants elaborated and shared the view that colour draws attention and can help learners see pictures clearly. In this regard, a participant stated, *Different colours as it tends to draw attention to the posters* (IDT1; Pa1; p. 2). This view was supported by another participant who noted, *With the senior History … all of the posters are in colour* (TII3; Pa4; p. 10). The participants furthermore reported on the use of colour by teachers when writing on the board. One of the participants, for example, stated, *I use a lot of colours on my board* (PII7; Pa9; p. 26). This was confirmed by another participant who said, *When explaining on the board is usually in colour* (IDT6; Pa7; p. 23).

As indicated, the participants reported that they often included colour when using electronic devices for teaching, such as in PowerPoint presentations on data projectors or when utilising electronic boards. One of the participants stated, *I also use colour in uhm doing slideshows* (IDT1; Pa2; p. 2). This was confirmed by another participant who noted, *Even with a projector, projecting images on a whiteboard we can use colour* (TII2; Pa3; p. 6).

Several participants reported on the use of colour in other teaching resources for Mathematics and reading. One of the participants, for example, noted the following, with specific reference to Foundation Phase teaching:



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> *So the counters … I think the first ten is in yellow, and the rest is in blue … No, it's the first five sorry and the next five is another colour … the big number chart that's usually on the wall. We use colours for that as well. If we count in two's, usually then we give them one they say okay, so like let's say red, and go colour all the red, and count in two's all the even numbers. And then you can do the same with different colours of all the fives and then for the tens. So, if the colours looks the same, then they're going to struggle to count in two's and in fives and tens* (PII4; Pa5; p. 13).

In addition to teachers reportedly using colour during explanations and when teaching Mathematics, the participants indicated that Mathematics resources often include colour. To give an example, a participant indicated the following:

> *We have 3D shapes … all of that is in colour, different colours … when we show the volume, you obviously add a coloured liquid to show them the volume of the whatever the triangular prism or the cylinder and … you add water with a little bit of colour in it, for them to see, you don't just put water because then they won't be able to see. So yes, you use colour in all your resources* (IDT6; Pa7, p. 23).

This was confirmed by another teacher who mentioned that *3D shapes. And all of that is in colour, different colours* (IDT6; Pa7; p. 23). In addition, I wrote in my field notes that *Maths counters are colour-coded* (Field notes, p. 2), pointing to yet another use of colour when teaching Mathematics.

Closely aligned, a participant indicated that the reading resources in her class were colour-coded. She gave to following explanation:

> *A reading activity … we call it like a window activity. So there's a, you have a script, and then the window can show you where you go to read … those are also in colour. So we will say, okay, uhm this is a grade 1 sentence. Go get the window that that's yellow, so it's a window that they put in the page and then for the learners that uhm gets to the next step it's red. So we say XXX let's read, you are now at the red level so that they know for the next time, there's levels and that's also to differentiate* (PII7; Pa9; p. 27).

#### *4.3.1.4 Subtheme 1.4: The use of colour during extra-curricular activities*

The participants reported that colour is often used during extra-curricular activities, referring to prominent sport where colour is often used, and the use of colour in sport equipment and sport clothing.

##### 4.3.1.4.1 Category A: Prominent sport activities where colour is often used

According to the participants, colour was often used in certain sport activities. As only nine teachers were interviewed for this study, it is possible that additional sport activities may also apply that go beyond the scope of the answers recorded from the participants in my



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study. I summarised the participants' views on this in the following way in my research journal:

> *It seems as if colour is often used in extra-curricular activities. Several of the teachers I interviewed coached hockey, netball and cricket. None of them reported on the use of colour in other sports such as rugby, soccer and swimming. I do recall that cones and coloured clothing or bibs to identify teammates, were used in these sports when I was still teaching* (Research journal, p. 6).

In addition, the participants reported on the use of colour during warm-up exercises for sport activities. One of the participants explained this as follows: *When I was coaching hockey ... to the red cones we'll be jogging and the cones next to it will be green cones that we're going to be running or sprinting … also for long distances … different colours do play a big role in sport* (IDT1; Pa2; p. 2). Another participant reported on the use colour in archery and tennis along with other sport, stating the following: *We got archery at school, the targets different colours. Uhm and then well most other sports making use of like cricket got the red ball and hockey's got a white ball uhm with tennis we work with yellow balls but that's more sports specific* (TII2; Pa3; p. 6).

Besides the reported use of colour in sport activities, one of the participants referred to the use of colour in cultural activities such as revues. She stated the following:

> *Culture like … revues and stuff they like to have colours … they will put stickers on the floor so that they know where to go stand. So maybe if my dot is blue and I can't see the blue then I'm not going to know where to stand* (PII4; Pa5; p. 12).

#### 4.3.1.4.2 Category B: The use of colour in sport equipment and clothes

The participants noted that sport equipment often contains colour, mentioning the examples of cones and balls used in sport activities. To be more specific, the participants reported that coloured cones were often used during practice to colour-code activities. An example of such a contribution is captured in the following excerpt taken from the interview data:

> *For long distances you'll have different colour where we have to do different like the dynamic warm up … we'll do high knees to this cone and to the blue cone, for example and then like high kicks to the red cone so it's just different cones will represent different exercises that they will have to do next. … in the hockey … the first cone we'll have to hit the ball and the next cone you'll have to set the ball* (IDT1; Pa2; p. 2).

This explanation was supported by another participant who stated, *Use different colour cones and at each cone they have to do a different thing* (PII4; Pa5; p. 12). In confirmation, I wrote in my research journal that *Participants shared thoughts on the use of colour in sport,*



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*specifically netball where bibs, cones, balls and field markings are coloured* (Research journal, p. 6).

With regard to the use of different coloured balls, one of the participants indicated the following: *Sometimes especially with the astro we have at school now they'll make the ball a bright green colour, it's a bright colour because it's easier to be seen on the field. And I think for learners with colour-blindness that could be difficult* (IDT1; Pa1; p. 2). Another participant concurred that coloured balls are often used in sport activities and said, *Currently with the hockey they always need to know we have different kinds of balls for practice. And then match balls are generally just white* (TII3; Pa4; p. 9). In confirmation, another participant referred to the use of coloured balls in cricket, stating that *Colour in cricket is extremely important for either you play with the red ball, or you play with a white ball* (TII5; Pa6; p. 16). Finally, one of the participants reported on the use of colour for field markings. The participant namely said the following:

> *Sometimes the field markings, you know, use different colours with field markings. And also, maybe to distinguish between a fellow teammate and an opponent because if they're not seeing different coloured uniforms they're not always going to distinguish who's on their team* (TII3; Pa4; p. 9).

Several other participants also indicated that different coloured clothing was generally used to indicate teams in sports. One of the participants elaborated as follows:

> *Everyone in your team would wear a certain colour. Even during practices when playing many games, all the learners from a certain team would wear uhm certain colour bib so that it's easy to identify who's in your team* (IDT1; Pa1; p. 2).

This contribution was supported by another participant who indicated that juveniles are divided into teams based on colour, and stated that *you divide them up in teams like the green team and the orange team. So if they can't see that they are the green team then maybe they're going to play for the other team* (PII4; Pa5; p. 12). In confirmation, I noted the following in my research journal:

> *Often in individual sports such cross country, learners from the same school would wear the same colour clothing whereas in team sports the learners often wore the same colour clothing as well as bibs that were colour-coded to indicate the position they played. I wonder how this may impact learners with CVD when participating in sport, especially team sport where colour may be used to identify teammates and positions* (Research journal, p. 7).



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### 4.3.2 Theme 2: Teacher perceptions and personal encounters with CVD

I identified three subthemes that apply to teachers' perceptions and personal encounters with CVD, relating to their understanding of CVD, their views on the value of colour for learning and their experiences of teaching learners with CVD. The inclusion and exclusion criteria for these subthemes are presented in Table 4.5.

**Table 4.5:**

*Inclusion and exclusion criteria for Theme 2*

| **Theme 2**<br>Teacher perceptions and personal encounters with CVD | | |
|---|---|---|
| **Theme 2** | **Inclusion Criteria** | **Exclusion Criteria** |
| **Subtheme 2.1**<br>Teachers' understanding of CVD | Data that refers to teachers' general understanding and views of CVD and what it entails. | Data that refers to teachers' awareness of learners with CVD or their experiences of teaching learners with CVD. |
| **Subtheme 2.2**<br>Teachers' awareness of learners with CVD | Data that refers to teachers' awareness of learners with CVD in their schools. | Data that refers to teachers' understanding of CVD or their personal experiences of teaching learners with CVD. |
| **Category A**<br>Challenge of not being aware of learners with CVD | Data related to the challenges of not being aware of learners with CVD in class. | Data expressing the importance and value of being aware of learners with the condition. |
| **Category B**<br>Importance of being informed about learners' CVD | Data that refers to the importance of being aware of learners with CVD in class. | Data that refers to the challenge of not being aware of learners with CVD in class. |
| **Subtheme 2.3**<br>Teachers' personal experiences of teaching learners with CVD | Data that refers to teachers' personal experiences of teaching learners with CVD, either in the past or at the time of the study. | Data that refers to teachers' understanding of CVD or their awareness of learners with the condition in their schools. |

#### *4.3.2.1 Subtheme 2.1: Teachers' understanding of CVD*

The participants' levels of understanding of CVD varied. When asked about their understanding of CVD, they provided different responses. Several of the participants indicated that learners with CVD experienced challenges to distinguish between certain colours and colour combinations. Another participant noted that different colours may look like different shades of the same colour to people with CVD, whilst some other participants held the view that people with CVD are not able to see certain colours or any colours.



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One of the participants, for example, noted that certain colours might look different to a learner with CVD and that they will experience challenges to distinguish between certain colours. In this regard, the participant stated, *Children struggle with certain colours they can't see … maybe blue looks different to them … they can't distinguish between the certain colours* (PII4; Pa5; p. 12). Several other participants shared this view and noted that people with CVD may experience challenges when distinguishing between certain colour combinations. A participant, for example, referred to the following colour combinations that people with CVD may struggle with: *… mainly the blue-green and orange-red combinations* (TII2; Pa3; p. 6). In support of this view, another participant stated, *Basically, the people can't distinguish between colours like red and green* (TII3; Pa4; p. 9). In further confirmation, another participant noted the following: *My understanding is that while the person or in this case the learner will have difficulties differentiating between different colours that can be seen if you don't have any sight impairment* (TII5; Pa6; p. 16). All these contributions attest to the participants' view that people with CVD perceive colour in a different way and may experience problems to differentiate between certain colours.

Closely related, a participant referred to the possibility of different colours looking like different shades of the same colour to a person with CVD. She stated the following:

> *There's a specific group of colours that they can't see the same way they see it in a different shade. So, at a robot, they would maybe see the same colour for all three red, green and orange but the brightness would differ. So, they do see a colour but it's different to what the normal side that people can see. But it's not the orange, for example, that we know is orange it's a different shade* (IDT6; Pa8; p. 19).

In confirmation, I reflected on the participants' understanding of CVD in my research journal and wrote the following: *The teachers' responses varied … Some noted that people with CVD cannot see certain colours at all while others noted that certain colours may look like shades of the same colour for people with the condition* (Research journal, p. 8).

Some participants, however, held the view that people with CVD may not be able to see certain colours at all. One of the participants, for example, stated, *I noticed on the board, for example, some learners would not see orange, for example, at all* (IDT6; Pa8; p. 19). In support, another participant noted the following: *Then you can only see specific colours and some colours you can't see at all* (IDT6; Pa7; p. 19), while another participant made reference to both the challenges of struggling to differentiate between certain colours and not being able to see any colour. She stated, *If a child can't see colour, meaning red or green, or any colour to do his work* (PII7; Pa9; p. 26).



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Two of the participants shared the view that certain people with CVD may not be able to see colour at all and see grey scale only. In this regard, one of the participants said, *A lot of the time they often just see grey when it's supposed to be colour …* (TII3; Pa4; p. 9). This was supported by another participant holding this view, stating the following: *You can't see colours or specific colours so you see everything in a grey-white-black manner* (IDT6; Pa7; p. 19). Reflecting on this view, I wrote the following in my research journal: *Some of the participants are of the opinion that people with CVD cannot see colour at all. I wonder how teachers' understanding of CVD may impact the support they offer to learners with the condition* (Research journal, p. 8).

Most of the participants seemed uncertain about the different types of CVD and how they might impact learners with CVD. In this regard, I wrote the following in my research journal: *He referred to a concept 'straight blind' but when I asked him what this meant he could not define it. It seemed as if he was uncertain about the different types of CVD and associated challenges* (Research journal, p. 6).

In terms of the prevalence of CVD, one of the participants noted that she thought it was a rare condition, stating, *I think it's a very rare thing … It's rare they don't see the same red I see they see a different shade* (IDT1; Pa8; p. 22). Some of the participants noted that CVD is more common amongst males than females. One of them, for example, said, *My understanding of colour-blindness uhm normally or more often seen with men than with women ...* (TII2; Pa3; p. 6). In support, another participant noted, *I think what I've read is it's more common amongst men* (IDT6; Pa8; p. 19).

#### *4.3.2.2 Subtheme 2.2: Teachers' awareness of learners with CVD*

In discussing this subtheme, I refer to two categories that I identified. These relate to the challenge of not being aware of a learner with CVD in class, and to the importance of being informed.

##### 4.3.2.2.1 Category A: The challenge of not being aware of learners with CVD

A general lack of awareness seemingly existed amongst teachers of identifying learners with CVD or what the condition implied. One of the participants, for example, indicated that he could not remember teaching children with CVD but then noted the following: *Maybe they were there but never mentioned that they are colour-blind and then I never knew that I taught learners with colour-blindness* (TII2; Pa3; p. 6). He elaborated as follows:



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> *They must be aware of the fact that we have a number of children that normally have that problem … at the moment I don't know what is the tendency, what is percentages you know … So if you make them aware that this problem uhm appears more often than what we thought then they will be more alert* (TII2; Pa3; p. 8).

In support I wrote the following in my research journal: *Certain participants reported that they had not taught learners with CVD. Due to the prevalence of CVD, I wonder if they really had not taught any learners with CVD or if they were just unaware* (Research journal, p. 7).

Some of the participants noted that learners with CVD might experience challenges due to not informing teachers about their condition. In this regard, one of the participants stated, *If they never have the courage to go and tell the teacher or their educator that I can't see this colour or the teacher isn't accommodating of them then it can also be very difficult to see what the teacher is talking about if she is using the colour that they can't identify* (TII1; Pa1; p. 3).

Several participants shared some experiences regarding the challenges associated with the reporting of CVD and making teachers aware of a learner with CVD. A participant, for instance, mentioned an example of not being aware of a learner's challenges with differentiating colours until she was in Grade 11, saying, *By the time we actually figured it out, she was in Grade 11* (TII3; Pa4; p. 10). Another participant similarly noted that it may be hard for learners to inform their teachers if they have CVD. The participant stated the following: *I think one of the biggest challenges is … basically being bold enough to come out and say … I cannot see this colour … I think that's a very big step where they have to have a lot of courage* (IDT1; Pa2; p. 2). Closely aligned, another participant noted that it may be difficult for learners to make teachers aware of their CVD due to the possible reactions of other learners in the class. The participant explained this view as follows:

> *It would be very difficult for them to just come forward and say that they have colour-blindness. So, the teachers are aware so that they can work around that and accommodate them when necessary if possible. I feel in all high schools uhm teenagers tend to be quite cool. So as soon as learners find out about that they would tease them* (IDT1; Pa1; p. 2).

#### 4.3.2.2.2 Category B: Importance of being informed about learners' CVD

Several participants expressed the importance of increased awareness of CVD amongst both teachers and learners, including peers. One of the participants summarised this view in the following way:

> *Maybe if the school can make everybody the students more aware of colour-blindness so that students can, don't feel as shy and as intimidated to say hey, I*



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> *cannot see this colour … the school to be more aware of colour-blindness to maybe have like someone to come in and to speak about colour-blindness and … how to accommodate someone who has colour-blindness just to make people more aware of it. And also, for the students to feel more safe … a safer environment for them to come out with boldness and say … I cannot see this colour or, hey, please don't use this colour because I cannot see it. So just to be more to make the students and the teachers even more aware of colour-blindness … that would be the first step for the school to take to improve* (IDT1; Pa2; p. 4).

This need for awareness was similarly emphasised by another participant, who stated, *The extra support that would be most important is awareness … either having like someone coming in with a slideshow making the teachers more aware. Then the teachers can maybe take that information and make the students more aware* (IDT1; Pa2; p. 4). In confirmation, the need for teacher awareness was reciprocated by several other participants in the following words:

- *I think training or maybe just like awareness, because I think they tend to forget about, like colour-blindness, or they think it's not that not that bad, or it's not a serious problem like ADHD … Because we can see colour, we don't usually think, oh okay what if I couldn't see this is red … we forget sometimes about, like colour-blindness … I think like awareness and training … will be nice* (PII4; Pa5; p. 15).
- *I think people need to educate themselves more or they must create awareness with this barrier to learning … colour-blindness can cost them a lot, marks and friends* (IDT6; Pa7; p. 25).
- *I think awareness. I don't think people are aware of it … If you educate people especially educators, because not everyone is aware of it. I am because I had one learner and I had barriers to learning as one of my major subjects, so I know about the different barriers. But not everyone does. So, I think educate the educators on this* (IDT6; Pa8; p. 25).

Contributions such as these point to the participants' view that awareness of a learner's CVD is important for the learner, teacher as well as peers. Furthermore, these contributions highlight the participants' view that teachers could be more aware of and be informed about CVD through training opportunities or self-driven initiatives. In this regard I noted the following: *… expressed a need for awareness and practical ways on how to accommodate such learners* (Field notes, p. 3). It was interesting to note that the participants' awareness seemingly followed their participation in the research process, as captured in my research journal in the following words:



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> *She* [a participant] *noted that she had several conversations with older teachers who taught with her in the Foundation Phase. She explained that several of them had taught learners with CVD and shared their experiences with each other after the completion of the questionnaire … It seems as if the completion of the questionnaire itself generated conversation and brought awareness of CVD* (Research journal, p. 5).

Several participants reported that once they had become aware of CVD and the associated challenges, they became more inclusive of learners with the condition in their teaching. To this end, a participant noted that she had changed her approach after becoming more aware, stating, *I think out of my experience with the girl, I I'm forcing myself to use … more basic colours then highlighters. So I'll focus on the black, the blue and then the red. More primary colours …* (IDT6; Pa7; p. 21). The participant elaborated on her changed teaching practice, stating, *I must say my way of teaching has changed because of that girl* (IDT6; Pa7; p. 21). Another participant noted that, although she did not stop using colour, she made other changes. She noted the following:

> *I'm also more aware of colour-blindness after this boy. I do ask the learners if they can see the specific colours. I do make a point of asking, Can you all see this? It's not that I really changed my methods … but I do pay attention to asking them can you see the colour* (IDT6; Pa7; p. 21).

Contributions such as these emphasise the importance of teachers and others being informed in the case of a learner experiencing CVD. In this regard, I reflected as follows:

> *When I was a teacher, I taught a learner with CVD. I recall how I limited the use of red due to the learner's challenges to see when I wrote in red on the board. Similarly, it seems as if the participants' experiences of teaching learners with CVD changed their teaching in a way that is more supportive of learners with the condition* (Research journal, p. 8).

#### *4.3.2.3 Subtheme 2.3: Teachers' personal experiences of teaching learners with CVD*

Even though the participants' experience of teaching learners with CVD in the school context varied, six of the nine teacher-participants reported that they had worked with learners with CVD in the past. Additionally, another teacher specified that colleagues in her department had reported some challenges while instructing learners with CVD.

With regard to the way in which the teachers became aware of the learners with CVD in their classes, two participants indicated that they were informed by the learners with CVD themselves. Another participant reported, *I have experienced one of my students being colour-blind in one of my maths classes* (IDT1; Pa2; p.1), indicating the following adjustments required of her in class: *He was not able to see the colour red … I had to rewrite*



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*his scores … in a different colour … when doing examples on the board I could not use the colour red* (IDT1; Pa2; p. 1). Another participant similarly stated, *A learner kept on asking me specifically not to write in orange hum because she can't see that colour on the board* (IDT1; Pa1; p. 1). In support, I captured these reports in my field notes, noting that *Learners with CVD came to them and told them they could not see certain colours* (Field notes, p. 1).

In addition to learners informing their teachers of the CVD, some participants explained how they themselves identified such learners based on the learners struggling to see what the teachers were writing on the board when certain colours were used. One of the participants explained her experience as follows:

> *So that's how I realised that the kid in my class is colour-blind … whenever I did a calculation in orange, yellow or on a cloudy day, red, she could not see what I was doing on the board. And I could see on her face that she's squinting and usually she'll interact … I picked up when I use those colours, she only stared at the board* (IDT6; Pa7; p. 19).

Another participant shared a similar experience, stating the following:

> *I've had one boy … he asked me what must he write down and I said what I wrote on the board. And he said but there's nothing. The green he could kind of see but very faint, the orange he couldn't see at all. And that's when he also only realised that he's colour-blind* (IDT6; Pa8; p. 20).

Closely related, a secondary school Geography teacher who participated reported that he had taught a learner who experienced challenges doing map work and subsequently realised that she was colour vision deficient. He stated the following:

> *I had a case this year with a girl I taught. We will look at the map on the board … and she couldn't tell a difference between the green one and the orange country. So that was the first time I have actually teaching a child that has colour-blindness* (TII5; Pa6; p. 16).

Three of the participants indicated that they had not been aware of any learners with CVD in their classes in the past. One namely stated, *I cannot remember teaching any person with colour-blindness … Maybe they were there but never mentioned that they are colour-blind and then I never knew that I taught learners with colour-blindness* (TII2; Pa3; p. 6); and another said, *Personally, I have never had a learner that was colour-blind … But I have heard about a lot of teachers … and what they have done to help the children* (PII4; Pa5; p. 12).



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### 4.3.3 Theme 3: Challenges experienced by learners with CVD in the school context

This theme relates to possible challenges that learners with CVD may experience, as perceived by the participating teachers, based on their experience in the past. Four subthemes apply, related to the challenge of not being aware of their condition, challenges experienced in the classroom with teaching, colour-related challenges in extra-curricular activities, and psycho-social challenges often experienced by learners with CVD. Table 4.6 provides an overview of the inclusion and exclusion criteria I relied on for Theme 3.

**Table 4.6:**

*Inclusion and exclusion criteria for Theme 3*

| **Theme 3**<br>Challenges experienced by learners with CVD in the school context | | |
|---|---|---|
| **Theme 3** | **Inclusion Criteria** | **Exclusion Criteria** |
| **Subtheme 3.1**<br>Not being aware of or not diagnosed with CVD | Data that refers to learners with CVD who are not aware of their condition or have not been diagnosed with the condition. | Data that refers to colour-related challenges experienced in the classroom, during extra-curricular activities, or on a psycho-social level as a result of CVD. |
| **Subtheme 3.2**<br>Colour-related challenges experienced in the classroom | Data that refers to possible colour-related challenges learners with CVD may experience in the classroom. | Data that refers to possible colour-related challenges learners with CVD may experience during extra-curricular activities, on a psycho-social level or as a result of them not being aware of their condition or not having been diagnosed with CVD. |
| **Category A**<br>Challenges to benefit fully from teaching in class | Data that refers to the possible challenges learners with CVD may experience due to the use of colour during teaching. | Data that refers to challenges related to accessing learning content and educational media where colour is used, or successfully completing assessment tasks as a result of CVD. |



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| Theme 3<br>Challenges experienced by learners with CVD in the school context | | |
|---|---|---|
| **Theme 3** | **Inclusion Criteria** | **Exclusion Criteria** |
| **Category B**<br>Challenges to access learning content | Data that refers to challenges to access learning content that learners with CVD may experience due to the use of colour in learning content and educational media. | Data that refers to the challenges learners with CVD may experience due to the use of colour during teaching or for assessment tasks and activities. |
| **Category C**<br>Challenges with assessment tasks and activities | Data that refers to challenges during tasks and assessment activities experienced by learners with CVD. | Data that refers to how the use of colour during teaching, in learning content and in educational media may negatively impact learners with CVD. |
| **Subtheme 3.3**<br>Colour-related challenges experienced during extra-curricular activities | Data that refers to possible colour-related challenges learners may experience during extra-curricular activities based on their CVD. | Data that refers to possible colour-related challenges learners with CVD may experience during teaching in the classroom, on a psycho-social level or due to them not being aware of or not having been diagnosed with CVD. |
| **Subtheme 3.4**<br>Psycho-social challenges experienced by learners with CVD | Data that refers to possible psycho-social challenges learners may experience as a result of CVD. | Data that refers to possible colour-related challenges learners with CVD may experience in the classroom context, during extra-curricular activities or as a result of them not being aware of or having been diagnosed with CVD. |

#### *4.3.3.1 Subtheme 3.1: Not being aware of or not diagnosed with CVD*

Learners' awareness of their condition seemingly varied, according to the teacher-participants. However, when not aware of the condition, a learner may experience the challenge of not being supported, in the view of the participants. Even though certain learners may recognise their CVD and communicate this to teachers, others may thus not be aware of the CVD, resulting in them facing certain challenges. In the latter case, it is possible that teachers can identify these learners based on the challenges they observe in their schoolwork and/or in class, such as when a learner indicates to the teacher that they



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cannot differentiate between certain colours. One of the participants mentioned such an example, saying the following:

> *He actually told me and I think like it was a bit awkward for him in class because all the students were like ah he doesn't know. And I think because of the way they reacted as well, he had like a no care uhm attitude towards it. But he was the one who told me there were no other teachers or anybody else that made me aware of it* (IDT1; Pa2; p. 1).

The participant elaborated and, in this process, highlighted some associated potential challenges in the following way:

> *It was more of like a teasing manner as some people they do not understand of not being able to see a different colour. So, when he was like he cannot see his test scores all the other students wanted to see his test score … And that kind of sometimes leads to teasing from the other students. Some students do understand but others they don't, there not actually quite aware of colour-blindness. So, they receive the teasing manner* (IDT1; Pa2; p. 1).

Closely related, another report on how a learner indicated her challenges to a teacher in private after class confirms the possibility of these learners feeling ashamed of their condition. The participant namely said: *A Grade 8 learner… she actually came to me and she asked me at the end of the period to please not use orange when doing examples on the board that she could not see the colour* (IDT1; Pa1; p. 1). Several other participants shared their experiences in becoming aware of learners' challenges to distinguish colour as captured in the following contributions, all pointing to challenges implied by learners not being aware of the condition:

- *She said she knew something was wrong. She just didn't think it was anything too serious. So I assumed she was probably colour-blind most of her life and nobody picked it up* (TII5; Pa6; p. 16).
- *She didn't know there was a problem. She only realised that when I asked her okay, what colours can I use? Because why are you pulling your face like somebody is thinking … And then she said I'm struggling to see. And then we realised … it's the colour* (IDT6; Pa7; p. 19).
- *I've had one boy … I made notes on the board that they had to copy … I did in orange and some in green. And he asked me what must he write down and I said what I wrote on the board. And he said but there's nothing. The green he could kind of see but very faint, the orange he couldn't see at all. And that's when he also only realised that he's colour-blind* (IDT6; Pa8; p. 20).



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I reflected on how teachers became aware of learners with CVD in their classrooms and learners not being aware of their condition, noting the following in my research journal:

> *The participants' ways of becoming aware of learners with CVD in their classrooms varied. Some of the participants reported that the learners came to them and told them. Some noted that they became aware of the learners' challenges with not seeing or differentiating between colours in class and that the learners were not aware that they had CVD. Several of these participants noted that the learners with CVD lost marks due to their challenges; for example, one teacher noted that when he looked at the learner with CVD's test, he could see that she lost marks on the map work section. I wonder how many learners with CVD are underperforming at school due to associated challenges* (Research journal, p. 8).

#### *4.3.3.2 Subtheme 3.2: Colour-related challenges experienced in the classroom*

I identified three categories for this subtheme related to challenges experienced by learners with CVD to benefit fully from teaching in class, challenges to access learning content, and challenges with assessment tasks and activities.

##### 4.3.3.2.1 Category A: Challenges to benefit fully from teaching in class

The teacher-participants referred to several possible challenges related to the use of colour during teaching that may impact learners with CVD, indicating that the frequent use of colour in the school context may present some challenges. The participants referred to the use of colour during instruction and the fact that work is often colour-coded, yet noted that colour was typically used to attract the attention of learners and make lessons more interesting. In explaining the frequent use of colour in the classroom, one of the participants said the following: *I suppose there's quite a lot. I guess number one would affect their education, because maybe they're not going to interpret things in the correct way* (TII3; Pa4; p. 10).

This view was supported by another participant who emphasised the following: *I think like we use colour without even knowing we use colour* (TII4; Pa5; p. 12). In confirmation, I wrote the following in my research journal:

> *She noted we do not always realise the challenges learners with CVD experience. She noted that sometimes children with CVD may seem to struggle with schoolwork not because of not understanding the concept but because of struggling to differentiate colours* (Research journal, p. 6).

In the participants' view, learners with CVD could specifically experience challenges to follow instructions and understand teaching when colour is used during learning activities. One of the participants explained this view in the following way:



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> *I think there's a lot of challenges that we don't realise as people who can see colour, like for example, if the instructions in a certain colour…like you say, colour all the squares blue, and he sees maybe green as blue and go colour, and then it's wrong. So I think they can lose a lot of marks … it's unnecessary because … they try to the best of their ability to do the instructions … it's not their fault that they can't see this* (PII4; Pa5; p. 13).

In support of this perception, another participant referred to an example of a learner in his class with CVD who was not able to follow the explanations, as the teacher used colour while explaining and included a map on the board that was colour-coded. The participant stated the following: *We will look at the map … I will simply ask her to find a country a green one … That does make it quite a bit more difficult, especially when we do use colour quite a bit in education* (TII5; Pa6; p. 16).

Against the background of the participants indicating that they used colour during teaching to brighten up lessons and attract or keep the learners' attention, the challenge of lessons not being so interesting to learners with CVD is implied. In this regard, a participant stated, *A lot of the time you want to keep the kid's attention span going, and colours can often do that* (TII5; Pa6; p. 16), with another participant adding the following:

> *Even with PowerPoint presentations and then of course when I do whiteboard, whiteboard markers they use different colours … only blue or only black uhm gets boring. So you attract the learners' attention by making use of a different colour uhm to explain different things* (TII2; Pa3; p. 7).

Closely related, some participants referred to the value of colour for learning when wanting to remember content, indicating, *A lot of kids they learn from using different colours and they, the colours help them to basically remember certain definitions* (IDT1; Pa2; p. 2).

#### 4.3.3.2.2 Category B: Challenges to access learning content

The participants indicated that learners with CVD may experience challenges in accessing learning content that is printed or presented in colour, such as learning content written in colour on the board, captured in textbooks that are printed in colour, presented in colourful PowerPoint presentations, videos or documentaries, when doing experiments, or when taking the form of colour pictures or posters where colour is used, with these educational media being colour-coded. A participant emphasised this possibility by stating the following:

> *Scholastically a problem would be in textbooks … I know for the languages uhm a lot of the time the textbooks is in colour and some of the stuff would be in colour or even if you take Science, the experiments that they do requires you to be able to identify certain colours. In experiments if the reactions took place or something like that. And*



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> *that will be very difficult for them to identify if that is the colour they are having difficulty seeing …* (TII1; Pa1; p. 3).

In support, another participant added the following examples: *With my teaching I think it relates to watching documentaries or videos. Another subject that falls under me is the Geography. That's very important to be able to distinguish colours there because of the maps* (TII3; Pa4; p. 9). One of the participants specifically referred to the frequent use of colour in the DBE prescribed school books, with words often being printed in colour, thereby potentially creating an obstacle for learners with CVD. This view is captured in the following contribution:

> *The DBE books that we have, like, they use a lot of colour in it to make it more interesting for the children to draw their attention with the pretty pictures and stuff, or they will, especially in the DBE books, they try to put words in different colours. So it's easier for the children to go write it like let's say the other day I did a lesson on was different animals. So the words were there, but the words are a bit still difficult for them to read. So then I would read them for them and said okay, lion is the pink word. So go look where's the pink word … So if they can't see the colour, then maybe they're not going to know what word I'm talking about* (PII4; Pa5; p. 13).

In support, I compiled the following field notes: *She notes that her class is colourful; colour is used in textbooks especially the DBE books* (Field notes, p. 2). This was further confirmed by another participant, who shared the following experience:

> *Yeah with colour it makes it, does help quite a lot especially with map work and that's how I picked it up with the child and I thought about the whole year we've been teaching about terrains and all of that. And not once did she come to me to say she didn't pick it up on the map. But when I went back to her map work marks I saw that she couldn't find the river or dam because she was looking for the blue, in turn she just couldn't pick it up where the blue was* (TII5; Pa6; p. 16).

I similarly captured this in my field notes, stating*, He teaches Geography and only after a while realised that a learner in his class could not find features that were colour-coded such as rivers on maps* (Field notes, p. 2).

Several of the participants thus noted that learners with CVD may not be able to access important content when it is colour-coded; for example, when colour is used to highlight or emphasise content. Despite this awareness, the participants seemingly relied on colour to emphasise important work, as captured in the following words: *If there's important words then I'll write it in colour so they can see it, so it can stand out* (PII4; Pa5; p. 13), and further:

> *When I do my lesson, I normally ask my children, okay, think of something, and then we'll draw it or we'll colour it in or think of a colour that you like, and you got to remember that. So every Mathematics … we get something new have to get*



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> *something new in our heads, we will start with green … So my children know in Mathematics we'll do a hard Mathematics sum we will do in green… I'll say, Okay, let's do our green, green sums … our normal, normal class test that we do on a Friday those words are in orange … That's our words for the week, remember everything was in orange … I love colour in my class* (PII7; Pa9; p. 27).

The participants specifically indicated that learners with CVD may experience challenges based on educational media being colour-coded. One of the participants mentioned the following example:

> *I think it will influence … let's say they had to count in two's, and now they can't, because they can't see the colours. So maybe they're going to count, colour ahg count two, four, five, because the five is also coloured in, but in a different colour. So I think that will also affect them* (PII4; Pa5; p. 14).

4.3.3.2.3 Category C: Challenges with assessment tasks and activities

The participants were of the view that learners with CVD will experience challenges with assessment tasks and activities where colour is used. Some of the participants, for example, reported that learners with CVD may not be able to identify colours in tests, school projects and/or experiments. In this regard, a participant expressed the following view: *If you take Science, the experiments that they do requires you to be able to identify certain colours. In experiments if the reactions took place … that will be very difficult for them to identify if that is the colour they are having difficulty seeing* (IDT1; Pa1; p. 3). This view was supported by another participant who noted the following: *It was an Art student from this year that they discovered is actually colour blind. So it made their practical a little bit more challenging* (TII3; Pa4; p. 9). The participant elaborated by referring to other possible challenges as follows:

> *With the posters because they need to see certain things are written in bold or written in a different colour to create affect, like if they don't, you know, distinguish between colour, it's going to be a problem* (TII3; Pa4; p. 9).

In addition, a participant indicated that work is often colour-coded in terms of time frames. The participant stated the following:

> *There is a lot of colour. Also, the term work is colour-coded. So, first term is red, second term is green third term is blue is and forth term is yellow … that would obviously make it easier when you study for your final year exam to look at each term* (TII5; Pa6; p. 17).

A Foundation Phase teacher-participant similarly noted that Art projects that contain colour may present a challenge to learners with CVD. She stated, *… life skills as well. Especially the Art section of life skills we use a lot of colours* (PII4; Pa5; p. 13). In capturing the content



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of the interviews, I compiled the following field notes: *He realised she lost marks in map work because of this* (Field notes, p. 2). I further reflected on the use of colour in assessment activities in the following way:

> *Teachers noted that they often used colour during assessment activities; for example, in lower grades learners are asked to colour certain shapes or write certain words in a different colour. In higher grades colour is used in assessment activities as well; for example, in map work certain features are colour-coded and in History and Art colour may convey important information; for example, blood stains on clothing in a picture. It seems as if learners with CVD may lose marks in assessment activities due to challenges distinguishing colour* (Research journal, p. 7).

#### *4.3.3.3 Subtheme 3.3: Colour-related challenges experienced during extra-curricular activities*

The participants indicated that colour is often used in sport activities and that this may present challenges to learners with CVD. One of the participants for example said:

> *For Netball, we will pack cones and then the first cone is for example where you do lunges and then from the orange to the pink cone you do high knees and from the pink to the green you'll do burpees and so I colour code my activities and my warm ups and my drills in netball for example. So if you are colour-blind that's going to be an issue because you will just see grey grey grey grey so then you must focus so much harder to remember what to do where because you can't see the colour so I think it's more tiring for you that's a colour-blind netball player then what it is for the colour seeing netball players* (IDT6; Pa7; p. 21).

In support of this view another participant stated the following: *I guess going back to sports it's also going to hinder them, are they going to be successful in seeing a yellow ball coming at them or a white ball? Because there are different colours for every sport … I think it's a big challenge* (TII3; Pa4; p. 10). In confirmation, I summarised the challenges learners with CVD may experience when participating in sport in the following way:

> *The teachers identified several challenges associated with the use of colour in sport; for example, challenges in seeing the ball or field markings and challenges in identifying teammates where colour-coded clothing or bibs are used to differentiate between teams* (Research journal, p. 7).

Another participant noted that learners with CVD may experience challenges when participating in cultural activities as colour is often used in such activities. The participant explained this view in the following manner: *Culture like in especially in like revues … they will put stickers on the floor so that they know where to go stand. So maybe if my dot is blue and I can't see the blue then I'm not going to know where to stand* (PII4; Pa5; p. 12).



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#### *4.3.3.4 Subtheme 3.4: Psycho-social challenges experienced by learners with CVD*

In addition to CVD effecting the academic performance of learners, the participants reported that these learners may experience emotional challenges. A participant, for example, stated the following view: *I think it's quite challenging … the emotional … that's going to cost you because you are colour-blind* (IDT6; Pa7; p. 23). Others elaborated, arguing that learners with CVD may feel marginalised. In this regard, one of the participants pointed out the following: *I think they're scared of being different and being bullied and being looked at differently. Maybe stop doing sport completely, because they can't see what's going on. Or they don't want to participate, because there're scared to ask for help* (IDT6; Pa7; p. 23).

This view was supported by the contribution of another participant who stated, *The emotional part is the bullying and the not want to be different. And just keeping quiet because you don't want to be the weird one* (IDT6; Pa8; p. 23). In confirmation, another participant commented on the possible emotional challenges and said, *A lot of kids are ashamed. They don't want to say that they see it differently than what others do. Because of bullying and everything they're scared they're going to be mocked … colour-blindness can cost them … friends* (IDT6; Pa7; P. 25).

I reflected on the possible psycho-social impact of CVD on learners in my research journal, stating the following:

> *Several teachers noted how learners with CVD may be impacted emotionally due to the challenges they may experience in the school context. One participant noted that all the learners in class knew of a learner with CVD in the class, that they made remarks in an almost teasing manner and how this may have been difficult for him. Other participants noted that learners with CVD may be perceived as different or marginalised or even teased. I recall how when I was a teacher a learner in my class would ask me not to write with red on the board as he could not see. He raised his hand in front of the whole class asking me to use a different colour, while his peers looked at him strangely* (Research journal, p. 7).

In support, an extract from my field notes indicates, *The participant noted the possible emotional impact for learners with CVD noting that they may at times be excluded or teased due to being different and the challenges they experience* (Field notes, p. 3). In addition to the challenges discussed in the preceding sections, the participants made mention of challenges associated with daily living, such as driving and choosing clothes. These brief references are however not included in my discussion.



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### 4.3.4 Theme 4: Supporting learners with CVD

In Theme 4 I discuss the participants' personal experiences in supporting learners with CVD in the school context, as indicated during the individual interviews. The subthemes relate to teachers gaining knowledge and skills on how to support learners with CVD, making changes in teaching practice in support of learners with CVD, and providing individual support for learners with CVD. I present the inclusion and exclusion criteria I relied on for Theme 4 in Table 4.7.

**Table 4.7:**

*Inclusion and exclusion criteria for Theme 4*

| **Theme 4**<br>Supporting learners with CVD | | |
|---|---|---|
| **Theme 4** | **Inclusion Criteria** | **Exclusion Criteria** |
| **Subtheme 4.1**<br>Gaining knowledge and skills on how to support learners with CVD | Data that refers to teachers gaining knowledge and acquiring skills on how to support learners with CVD. | Data that refers to changes in teaching practice or the provision of individual support for learners with CVD. |
| **Subtheme 4.2**<br>Making changes in teaching practice | Data that refers to possible changes in teaching practice that may support learners with CVD. | Data that refers to teachers gaining knowledge and skills to support learners with CVD, or to recommendations for the individual support of these learners. |
| **Subtheme 4.3:**<br>Providing individual support | Data that refers to individual support provision for learners with CVD. | Data that refers to teachers gaining knowledge and skills on how to support learners with CVD, or to changes in teaching practice in support of learners with CVD. |

#### *4.3.4.1 Subtheme 4.1: Gaining knowledge and skills on how to support learners with CVD*

The participants seemed to agree that a need exists for an increased awareness amongst teachers and other role players to be able to support these learners. The participants specifically expressed a need for training to feel empowered to support and accommodate the needs of learners with CVD. In this regard, the participants made suggestions such as the following in support of teachers becoming more aware of and informed about CVD:



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- *I think training or maybe just like awareness, because I think they tend to forget … or they think it's not that not that bad, or it's not a serious problem like ADHD … Because we can see colour, we don't usually think, oh okay what if I couldn't see this is red … we forget … awareness and training … will be nice* (PII4; Pa5; p. 15).
- *Courses I suppose. Most of us have not actually been trained … courses available if you were faced with a situation in your class, can tell you this is how you can maybe go about assisting the children or something like that but you as a teacher don't feel useless because there's nothing more annoying than you trying to help, but you actually probably making the situation worse because you don't know where to start* (TII3; Pa4; p. 11).

This need is confirmed in the following extract from my field notes: *Express a need for awareness and practical ways on how to accommodate such learners* (Field notes, p. 1).

According to the participants, an increased awareness of CVD, not only amongst teachers but also amongst learners could strengthen the support offered to learners with CVD. In this regard, a participant argued the following:

> *Maybe if the school can make everybody the students more aware of colour-blindness so that students can, don't feel as shy and as intimidated to say hey, I cannot see this colour … rest of the school to be more aware of colour-blindness to maybe have like someone to come in and to speak about colour-blindness and about, like, how to accommodate someone who has colour-blindness just to make people more aware of it. And also for the students to feel more safe … where they can come forth and say, okay, I have colour-blindness to have like a more safer environment for them to come out with boldness and say okay, hey, I cannot see this colour or, hey, please don't use this colour because I cannot see it. So just to be more to make the students and the teachers even more aware of colour-blindness in the school. I think that would be the first step for the school to take to improve* (IDT1; Pa2; p. 4).

This contribution underscores the value of teachers being informed on how to support learners with CVD, yet also foregrounds the possibility of awareness efforts for learners with CVD potentially becoming more willing to access help. It furthermore indicates the value of other learners becoming aware of and reacting in a sensitive and supportive way to learners with CVD. One of the participants made a supportive contribution, emphasising the value of peers being informed. The participant said the following:

> *The learners should also be more aware of it so that the teasing doesn't take place or even when they are doing projects that they hum are more aware of the learners in their class … not just uhm are insensitive to the fact that they can't see certain colours* (IDT1; Pa1; p. 5).



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In this regard, the participants seemingly realised that timely identification of CVD could enhance the support provided to them within the school context. A participant accordingly noted the following:

> *I think in the first place they must be identified … then when that learner is in class I would then like to in the first place know it and then maybe get some training on how to help them because I think most teachers, even myself, when I did my teacher training, there was no specific training for teaching colour-blind children … I think we have to identify the type of colour-blindness of how severe it is so that you know not to make an issue where there is no issue* (TII2; Pa3; p. 7).

Another participant confirmed this view by stating, *You definitely have to know if they are colour-blind … just to know what their capabilities* (TII5; Pa6; p. 18). In confirmation, I noted the following in my research journal:

> *Some of the participants noted that learners with CVD need to be identified so that they can provide support to these learners … wanted to offer individual support to specific learners with CVD. I wonder to what extent this would be possible in the South African context where there are resource constraints with regard to professionals screening for CVD and teachers teaching large classes* (Research journal, p. 8).

In addition to referring to the importance of teachers and other role players being better informed, the participants made some recommendations for school policies and formal documents being in place on how to support learners with CVD. The participants suggested that learners with CVD may, for example, benefit from accommodation such as additional time for tests and examinations, as they may take longer than their peers to find items in pictures or access content when colour is important. In this regard, a participant stated the following: *You should have a structure in place that … as soon as you become aware of it you have this plan that you going to follow* (IDT6; Pa7; p. 24).

When discussing the possibility of accommodation in support of learners with CVD, another participant said, *Colour-blindness is terminal sign that the child should definitely be given a bit of help, maybe with extra time within the exam, because it is going to be a lot more difficult* (TII5; Pa6; p. 18). Closely related, another participant noted, *Then also with additional time maybe if there's a student that is colour-blind in class to have a little bit more time to prepare beforehand in classes uhm to say okay I'm not going to using these colours or let's change this in the book* (IDT1; Pa2; p. 4).

One of the participants shared the view that concessions need to be granted by the Department of Education, thereby implying the importance of the Department to take into consideration the challenges that learners with CVD may face. The participant stated, *With*



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*children with any kind of concessions, we need to be given the approval to actually do that. And were not always given those types of concessions* (TII3; Pa4; p. 11). In reflecting on these contributions, I noted the following:

> *Teachers recommended accommodation such as extra time for tests and examinations to support these learners; this may be an example of support in resource constrained areas. However, here once again these learners need to be identified* (Research journal, p. 8).

#### *4.3.4.2 Subtheme 4.2: Making changes in teaching practices*

The participants seemingly agreed that changes in teaching practice, specifically related to the use of colour, may support learners with CVD. They referred to the strategies of modifying colour usage in class, and adapting instructional methods. When discussing strategies to adjust the use of colour in class, the participants suggested the use of shapes, symbols and numbers, and different fonts or line thickness. Alternatively, it was suggested that steps can be written out in cases where colour is used. Examples of the participants' suggestions for alternatives to colour differentiation are captured in the following excerpts:

- *Instead of using different colours, you can use different shapes, because it's just something different that students can relate to and say okay, this is now a different step* (IDT1; Pa2; p. 3).
- *I think maybe just incorporate the symbol with the colour … the rest of the class can still see colours* (PII4; Pa5; p. 14).
- *I would also use more shapes rather than colours to make notes or different shapes between the steps or so* (IDT6; Pa8; p. 8).
- *Instead of colour then you know use thicker and thinner lines* (TII2; Pa3; p. 7).
- *I would rather use then different handwriting styles. So I'll write something in bold something with a thinner black pen, then maybe put a twirly wirily underlining thing. I'll add more symbols I don't know how to say more symbols or graphic. More graphic in black then use colours. That Italic bold underline from Word. Yes, put it in a block* (IDT6; Pa7; p. 24).

One of the participants explained that colour is often used to show different steps in the programme used to teach Engineering Graphics and Design (EGD). In this regard, the participant suggested that the steps could be written down so that a learner who cannot differentiate between colour-coded steps may still have access to the content. The participant stated the following:



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> *You can write down the steps next to the question. So for example, step one, for EGD for example draw the base of the line or bisect the line, step two we did this so you can write down your steps afterwards … just writing the steps out in words would also already uhm accommodate the learners and not just drawing the lines or such in a different colour so that you can see which one you're doing and how to do that* (IDT1; Pa1; p. 4).

I reflected on these suggestions for changes in teaching strategies in the following way in my research journal:

> *The participants made several recommendations on adjusting teaching in support of learners with CVD, such as using shapes or symbols and writing in different fonts and line thickness and writing down steps to accommodate learners with CVD. These challenges in teaching can be used in resource constrained areas as well as in situations where screening for learners with CVD may not be possible* (Research journal, p. 8).

The participants proposed less use of colour in general instruction and educational media as a strategy that could support learners with CVD. For example, the participants suggested prints in black and white, and using only primary colours or the colours that learners with CVD can see when having to use colour. In this regard a participant stated, *More support will also be able to reprint some of the notes in not in a specific colour … maybe just black and white reprinting parts of the textbook for the learners that are colour-blind in a specific colour* (IDT1; Pa1; p. 4). Another participant shared a similar experience, stating, *You adjust your way of teaching because all of a sudden now I'm using more black where I never used to use black. I incorporate … more primary colours, the black, the blue* (IDT6; Pa7; p. 24), whilst another suggested the use of more basic colours, recommending the following: *I think out of my experience with the girl, I I'm forcing myself to use … basic colours to use more basic colours then highlighters … I'll focus on … primary colours* (IDT6; Pa7; p. 21).

As indicated, the participants also suggested the use of only the colours that learners with CVD can see. A participant explained this idea by stating the following:

> *I feel like it depends on which colours the students cannot see, if it is a lot of colours the students cannot see … get them a textbook printed in colour so that they can see. Making sure that the test paper or the examples on the board are for that specific student or the class that the student is in* (IDT2; Pa2; p. 3).

In support of this suggestion, another participant noted the following:

> *Use other colours that that that person doesn't have a problem with because if I know it's blue-green then I will maybe in class try and revert from blue-green … So that they doesn't have to distinguish between the blue and the green. So just block out*



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> *one colour if you can and use less colours to accommodate that person then* (TII2; Pa3; p. 7).

In confirmation, I noted the following in my field notes: *… mark his work in another colour* (Field notes, p. 1).

As an alternative option, the participants suggested that the learners be asked which colours they can see or whether they can see a specific colour before using it for teaching purposes. In this regard a participant noted, *After being made aware of the colour-blindness through the learner that came to me last year … I just ask if everyone is able to see the colour. If they don't want to tell me in class they can come to me after the class and just tell me* (IDT1; Pa1; p. 5). In support, another participant indicated that she also used to ask a learner with CVD who was in her class if he could see the colour before she used it. She said, *Instead of those specific colours I use colours that he could see. I would ask him which colours do you prefer* (IDT6; Pa8; p. 44). Following the interviews with these participants, I reflected as follows: *The participants who had taught learners with CVD seemed to limit their use of colour in general or to use only colours that the learners with CVD could see when writing on the board* (Research journal, p. 8).

When discussing possible support in the Science class, one of the participants suggested that a learner with CVD be exposed to situations where colour is used for the learner to know what to expect in future. The participant explained this suggestion as follows:

> *If you asked to identify substances uhm when you do uhm chemical Chemistry in chemistry experiments. We have to use sulphur for instance. Sulphur is bright yellow. Uhm but if you want to identify it as a colour-blind person I think it won't be a problem in future to identify the same because they have seen it. Although it doesn't seem yellow to you, you know exactly know what to expect* (TII2; Pa3; p. 7).

Overall, the participants recommended that learners with CVD be kept in mind during all teaching activities. A participant explained this as follows:

> *Keeping them in mind with everything because I know you tend to forget not on purpose but you tend to forget about the one child that has one specific challenge … just make a note in your back of your head and tend to just ask them, are you fine? Did you see this? Or is there something I can help you with or make it easier* (PII4; Pa5; p. 14).

In addition, the participants made some suggestions for support during extra-curricular activities, saying that, *I will not colour code my cones anymore. I would say we work from line to line on the netball court. I won't really add cones and stuff like that and luckily for us the bibs is black with white on* (IDT6; Pa7; p. 24). In support of this view, I wrote the following



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in my research journal: *The participants, for example, made suggestions on how to support learners with CVD on the sport field by limiting the use of colour during training and making sure positions are readable by printing bibs in black and white* (Research journal, p. 8).

#### *4.3.4.3 Subtheme 4.3: Providing individual support*

Participants recommended individual support for learners with CVD when needed, or when wanting to know how best to support these learners. One of the participants shared a personal experience and explained this approach as follows: *I would ask him which colours you prefer so those would be the colours and then I would also use more shapes rather than colours to make notes or different shapes between the steps or so* (IDT6; Pa8; p. 24). Another participant similarly recommended the following:

> *You can even ask them what will work for them what do they prefer. Because I know also if you have one child now and you make just for that child, the symbols then the rest of the class always find a way to explain or treat them different or tease them or something* (PII4; Pa5; p. 14).

A few participants referred to individualised support through placement of learners with CVD in class to accommodate their specific needs. They, for example, provided the following reports:

- *I will put that person in front in the class so that I can remember this person and that I can give extra attention and speak to that person uhm with a softer voice so that that it's not necessary to disturb the whole class when I speak to that specific person. That's why I want the learner close to me. And then just to make sure that he understands he's got an alternative way of explaining the same thing not using colour* (TII2; Pa3; p. 7).
- *I also moved the boy a bit closer* (IDT6; Pa8; p. 24).

The participants further noted that individual assistance with colour identification could support learners with CVD in the school context. One of the participants shared the following anecdote as an example:

> *Well, if she's busy with practical then she can always say, I've decided to do this section over here red. And you know, then we would actually then just have to show her that this is the red paint. And you need to put it in this section here. It's almost like you're prompting them. But anything you can really do, because our school is not really equipped for children or I suppose those kinds of needs* (TII3; Pa4; p. 11).



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In confirmation, I wrote in my field notes *… give a lot of practical examples on how to change teaching and instruction for learners with CVD … ask them … expose* (Field notes, p. 1). In further elaboration of this strategy, another participant recommended the following:

> *Personally, I have never had a learner that was colour-blind in my class. But I have heard about a lot of teachers that have taught for many years and what they have done to help the children. Like the one teacher, I know the little boy was very shy about having colour- blindness. So she told him no that he mustn't be shy and no one needs to know. So on the back of his pencils, she wrote the colours for him, so to help him so that he can doesn't have to be shy about it* (P114; Pa5; p. 12).

Overall, the participants emphasised the importance of learners with CVD experiencing understanding by their teachers. A participant explained this as follows:

> *The problem we face today is that people don't have the time and people don't care enough anymore to actually change their way of teaching because a lot of people will say there's 30 kids in my class, so why must I change my whole way of teaching for one kid. And then make it more difficult for 29. Because people are weird like that. So the problem is … the lack of passion in teachers ... I think people need to educate themselves more or they must create awareness with this barrier to learning, it's not just dyscalculia or dyslexia or all of that but colour-blindness can cost them a lot, marks and friends* (IDT6; Pa7; p. 25).

Another participant added the following insight: *You can't really pretend to know what that child's going through. So they need to feel like they can trust you and tell you when things are a problem. And you have to do your best to try and meet them halfway so that they feel comfortable* (TII3; Pa4; P. 11). In confirmation, I summarised such support offered to learners by the participants in my research journal in the following way:

> *Several of the participants reported that they had taught learners with CVD. Some of the teachers and schools put in much effort to support these learners. In some cases, the schools sent learners for eye tests. The participants made several changes to support these learners in their classrooms; for example, they used colour less frequently and asked learners if they could see when they wrote in colour on the board. It seemed that once teachers had become aware of the challenges learners with CVD faced in the classroom, they were eager to assist them* (Research journal, p. 7) .

## 4.4 INTEGRATION OF QUANTITATIVE AND QUALITATIVE RESULTS

In this section I integrate the quantitative and qualitative results. A comparison of the results I obtained is included in Table 4.8, followed by a brief discussion.



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**Table 4.8:**

*Integration of quantitative and qualitative results*

| QUANTITATIVE | QUALITATIVE |
|---|---|
| **The use of colour in schools** | |
| ❖ Colour is often used on notice boards and signs around the school. | ❖ Colour is frequently used in the school context. |
| **The use of colour during extra-curricular activities** | |
| ❖ Colour is used during extra-curricular activities, such as netball, rugby, chess, drama, soccer, swimming and athletics.<br>❖ Sport teams tend to wear different colour clothing.<br>❖ Colour is used for field markings, flags, house colours, uniforms and bibs, cones, coloured balls, videos, images, cue cards and worksheets. | ❖ Colour is used during extra-curricular activities such as netball, hockey, cricket, archery, tennis and revue.<br>❖ Colour is used during extra-curricular activities for cones, balls, bibs/clothing, field markings and décor.<br>❖ Learners with CVD may experience challenges during extra-curricular activities as colour is often used in sport and cultural activities. |
| **The use of colour during classroom activities** | |
| ❖ Colour is used on a daily basis in the classroom by most teachers.<br>❖ Colour is used for activities such as writing on the board, class activities, homework, teaching and when using PowerPoint presentations. | ❖ Colour is frequently used by most teachers in their classrooms for numerous purposes. |
| **The use of colour during classroom instruction** | |
| ❖ Colour is used on a daily basis during teaching by most teachers.<br>❖ Colour is used to structure and organise classrooms, code information, explain differences between objects/concepts and to make the work more interesting. | ❖ Colour is used during teaching.<br>❖ Colour is used to organise or code work, draw attention, emphasise or highlight work, distinguish between objects/concepts, increase memory and for marking. |
| **The use of colour in educational media** | |
| ❖ Many resources used in class such as books, posters, worksheets and images contain colour.<br>❖ Teachers use different coloured chalk or whiteboard markers when writing on the board.<br>❖ Most textbooks use black print on white paper; however, textbooks may also contain images in colour.<br>❖ The DBE workbooks and readers used in the Foundation Phase often contain colour. | ❖ Textbooks, educational media such as posters, counters, 3D shapes and reading windows often contain colour.<br>❖ Teachers use different colours when writing on the board.<br>❖ Images in textbooks in higher grades are colourful to facilitate better understanding of the content.<br>❖ The DBE workbooks contain many colours. |



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| QUANTITATIVE | QUALITATIVE |
|---|---|
| **Colour and the use of technology in the classroom** | |
| ❖ The use of technology has increased the use of colour in the classroom.<br>❖ Technology is used for coloured images, movies, PowerPoint presentations and smartboards.<br>❖ Possible challenges with differentiating colours are considered when designing PowerPoint presentations or when choosing images or YouTube videos. | ❖ Teachers use colour when using technological devices, such as PowerPoint presentations, projecting images, when watching documentaries or videos on data projectors, or when utilising electronic boards and visualisers. |
| **The use of colour in school subjects** | |
| ❖ Learners with CVD may struggle in the Foundation Phase where colour is often used for assessment.<br>❖ The use of colour in the classroom may negatively affect learners with CVD due to colourful content such as diagrams and pictures, and them not being able to follow instructions, taking longer, or getting confused when colour is used during teaching or when struggling to see colourful work. | ❖ Colour is widely used in the Foundation Phase for numerous purposes, when teaching Languages, Mathematics and Life Skills.<br>❖ DBE workbooks and readers are colourful.<br>❖ When teaching Languages, colour is used to emphasise certain words or phonics.<br>❖ When teaching Mathematics, colour is used to distinguish between shapes.<br>❖ Different colours are used in Mathematics for different angles and sides in geometry to highlight differences such as 3D shapes, counters and number charts, or when using educational media.<br>❖ Colour is used in History when watching documentaries or videos, on posters and when viewing images.<br>❖ In Science, colour is used in textbooks for certain topics, such as electromagnetic force, ultraviolet and infrared as well as in chemistry for the properties of different substances.<br>❖ Art works contain colour; however, learners with CVD may prefer painting in black and white.<br>❖ Colour is used in Geography for map work. |
| **Teachers' perception regarding the importance of colour** | |
| ❖ Colour plays an important role in learning.<br>❖ Good performance at school can be linked to the ability to differentiate between colours.<br>❖ Colour is valuable when wanting to highlight important concepts in school work. | ❖ Colour contributes positively to learners' academic performance as it may facilitate their understanding of the content.<br>❖ Colour can be an important teaching tool as it can be used to highlight work, emphasise ideas and important concepts, distinguish between objects and concepts, enhance memory, draw and keep learners' attention, and make work more enjoyable. |



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| QUANTITATIVE | QUALITATIVE |
|---|---|
| **Teachers' understanding of CVD** | |
| ❖ Different levels of understanding of CVD amongst teachers.<br>❖ General view that learners with CVD cannot see certain colours or shades of colour.<br>❖ View that learners with CVD see colour less saturated, have a lack of photoreceptors in the eyes that perceive different colours, are colour blind, or are affected by depth perception and Irlen syndrome. | ❖ Varying views on and understanding of CVD.<br>❖ General awareness that CVD is more common amongst men than women.<br>❖ General view that people with CVD experience challenges to distinguish between certain colours and colour combinations, and are not able to see certain or all colours. |
| **Teachers' personal experiences of teaching learners with CVD** | |
| ❖ Fewer than 40% of the respondents had taught learners with CVD in the past.<br>❖ On average, these respondents had taught three learners with CVD. | ❖ More than half of the participants had taught learners with CVD. |
| **Not being aware of or not diagnosed with CVD** | |
| ❖ Limited quantitative data indicating teachers' awareness of CVD, with one respondent not being aware of the condition at all.<br>❖ Teachers' awareness of learners with CVD often depended on them being informed by learners, or to a lesser extent the parents or other teachers, or on their own observation of learners experiencing the condition. | ❖ Limited awareness amongst participants of how to identify learners with CVD and what the condition implies.<br>❖ Varying levels of awareness amongst learners with CVD themselves, resulting in teachers not being informed, or in teachers identifying the challenge.<br>❖ Awareness of learners with CVD can result in positive change in teaching practice.<br>❖ Teachers' awareness of learners with CVD often depended on them being informed by the learners themselves or on them realising that the learners struggled to see certain colours. |
| **Colour-related challenges experienced in the classroom** | |
| ❖ CVD may affect learners' scholastic performance as it can affect their marks when they struggle with schoolwork or to identify colours.<br>❖ Teachers who are unaware of learners' CVD cannot accommodate them, with them possibly being negatively affected by this.<br>❖ CVD may affect learners with CVD's learning, as they may struggle to see work, see on the board or analyse images/charts when colour is used. | ❖ Learners with CVD may face several challenges in the school context.<br>❖ Some challenges relate to them not being aware of or not being formally diagnosed with CVD.<br>❖ Learners with CVD may experience challenges to benefit fully from teaching when colour is used, to access learning content that contains colour, to benefit from educational media, or during assessment activities and tasks that contain colour. |



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| QUANTITATIVE | QUALITATIVE |
|---|---|
| **Psycho-social challenges experienced by learners with CVD** | |
| ❖ CVD can affect a learner's emotional functioning, due to, for example, lack of enthusiasm and confidence, heightened frustration, being insecure and self-conscious, being treated differently or being ridiculed if they do not perform well.<br>❖ Peers may make remarks about learners with CVD.<br>❖ CVD may have an effect on social functioning as these learners may be teased or excluded.<br>❖ Learners with CVD may be labelled as slow in subjects where colour plays a role. | ❖ Learners with CVD may experience emotional challenges as they may feel as if they do not fit in or are different, may feel ashamed, be marginalised or be bullied.<br>❖ Learners with CVD's social economical background may have an influence on the support they receive. |
| **Colour-related challenges experienced in extra-curricular activities** | |
| ❖ No quantitative results obtained. | ❖ Learners with CVD may experience challenges when participating in extra-curricular activities. |
| **Supporting learners with special needs** | |
| ❖ Learners with mild disabilities and barriers to learning should be accommodated in mainstream education.<br>❖ Teachers should create a classroom environment that considers the diverse needs of all learners in class.<br>❖ Teachers are aware of the different needs of learners in their classrooms and consider these when planning and presenting lessons.<br>❖ Teachers use a variety of teaching methods and assessments to give all learners equal opportunities.<br>❖ Accommodation of learners with barriers to learning is applied during tests and examinations.<br>❖ Teachers receive feedback from the SBST on how to support learners with barriers to learning.<br>❖ The minority of the respondents received sufficient training on how to support learners with special needs.<br>❖ The majority of the respondents knew how to refer learners with special needs.<br>❖ The majority of the respondents had not received training on how to implement the SIAS policy.<br>❖ The majority of the respondents were unsure whether the SIAS policy considers the needs of learners with CVD. | ❖ Little information provided on the overall support for learners with special needs in the school context.<br>❖ Teachers received little to no training on how to support learners with CVD.<br>❖ Learners with CVD were reported to specific teachers, and support staff and structures had been put in place to refer learners with CVD or other special needs for appropriate support.<br>❖ No qualitative results obtained on SIAS training. |



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| QUANTITATIVE | QUALITATIVE |
|---|---|
| **Support for and accommodations of learners with CVD** | |
| ❖ CVD may affect a learner's scholastic performance.<br>❖ CVD may specifically impact learners with the condition when teachers do not play their part.<br>❖ It is not the responsibility of a learner with CVD to adjust to the school system.<br>❖ Teachers are uncertain whether learners with CVD are supported in school.<br>❖ The respondents were uncertain whether tests and assessments were adjusted for learners with CVD.<br>❖ No quantitative results obtained on teachers' awareness and training on how to support learners with CVD.<br>❖ No quantitative results obtained on policies and formal structures that were in place to support learners with CVD. | ❖ Teachers need to be supportive and understand learners with CVD.<br>❖ Learners with CVD should be supported in school through, for example, changes in teaching.<br>❖ Examples of such changes include using shapes, symbols and numbers, using different fonts or line thickness, writing down the steps of a process, limiting the use of colour, asking learners if they can see a colour, exposing learners with CVD to different situations, keeping learners with CVD in mind, and offering personal assistance with colour identification.<br>❖ Increased awareness and training on CVD and how to support learners with CVD may enhance the support offered to learners with CVD in school.<br>❖ Policies and structures in support of learners with CVD may assist in providing them with the needed support.<br>❖ Learners with CVD may need specific accommodation during tests and examinations. |
| **Career and subject choices** | |
| ❖ The minority of the respondents indicated that learners with CVD are guided in terms of subject choices and future career choices. | ❖ No qualitative results obtained regarding guidance for career choices for learners with CVD.<br>❖ Colour-related challenges were noted in specific subjects but not when learners with CVD were guided in terms of subject choice. |
| **Screening for CVD** | |
| ❖ Learners who confuse colour in the Foundation Phase are seldom screened to determine reasons for their confusion. | ❖ Learners are not always aware that they have CVD.<br>❖ Identifying learners with CVD may assist in providing them with specific support in the school context. |
| **Relationship between teachers' experiences with learners with CVD and their awareness of CVD and the support they offer to such learners** | |
| ❖ Teachers who have experience in teaching learners with CVD are more likely to report that support for these learners is provided in their schools.<br>❖ Teachers who report support for learners with CVD in their schools are more likely to have had experience in teaching such learners. | ❖ Learners with CVD should be supported in the school context.<br>❖ Teachers who have experience in teaching learners with CVD tend to make changes in their teaching in support of these learners. |



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### 4.4.1 The use of colour in the school context

The results of both phases of the study indicate that colour is often used in the school context, both for classroom and extra-curricular activities. The quantitative results indicate that teachers often use colour in the classroom for class activities, during homework, instruction, as part of PowerPoint presentations, when writing on the board, during extra lessons and when displaying YouTube video clips. The teachers make use of a variety of colours in class, with blue, green and red most frequently used. During the qualitative phase, the participants elaborated on the use of colour for posters. Similarly, colour is often used on notice boards and signs around school.

The majority of the respondents indicated that they used colour in their classroom on a daily basis, with the rest of the respondents using colour in class on a weekly basis. To be more specific, both the quantitative and qualitative results refer to the use of colour during teaching practice, either on a daily or a weekly basis by all the respondents. Teachers namely relied on colour to explain important concepts, explain the differences between objects, code and organise work, draw learners' attention, emphasise or highlight specific content and assist with learners memorising the content. In addition, the participants reported that they used colour when marking, for worksheets, to make the work more interesting, for structure and organisation in the classrooms or to code information.

In a similar way, both the quantitative and qualitative results indicate that colour is often used in educational media such as textbooks, posters and worksheets. The same applies to other manipulatives and media used in class, such as blocks, puzzles and other objects used for teaching, such as counters, shapes and reading resources. Closely related, the results of the study indicate that colour is often used by teachers when writing on the board.

In terms of the use of colour in various subject areas, the results from both the quantitative and qualitative phases of my study indicate that colour is used across school phases and subjects. A summary of the prominent use of colour in different subjects is presented in Table 4.9.



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**Table 4.9:**

*The use of colour in different subjects*

| SUBJECT | RESULTS |
|---|---|
| Foundation Phase teaching | Colour is widely used in the following core learning areas:<br>❖ Languages: new words and phonics, writing sentences<br>❖ Mathematics: different shapes<br>❖ Life skills |
| Mathematics | ❖ During instruction to show different angles or sides<br>❖ To highlight differences<br>❖ Using different colours for different shapes and to indicate volume<br>❖ Different coloured counters |
| History | ❖ Watching videos or documentaries<br>❖ Posters and images |
| Science | ❖ Colour in textbooks especially for topics such as electromagnetic force, ultraviolet and infrared<br>❖ Chemistry, the properties of different substances |
| Art | ❖ The use of colour in artworks |
| Geography | ❖ Map work |

The results of both phases of the study further indicate that the use of technology has increased the use of colour in the classroom in terms of the use of, for example, coloured images, videos, PowerPoint presentations, smartboards and visualisers. Just more than half of the respondents indicated that they considered the challenges that learners may experience to see different colours when choosing colours for PowerPoint presentations and choosing images or YouTube videos that will be used during a lesson presentation.

In addition to confirming the wide use of colour in the class by teachers, the results of my study indicate the use of colour in extra-curricular activities. The results namely indicate that colour is used in sport activities such as netball, hockey, rugby, cricket, soccer, athletics, mini soccer, swimming and tennis during coaching, for the identification of the clothes of different teams, and for equipment such as cones and field markers as well as balls. Other extra-curricular activities where colour is reportedly used include archery, chess, drama and revue.

### 4.4.2 Teachers' understanding and experience of learners with CVD

Almost all the respondents who took part in the quantitative phase of the study agreed that colour plays an important role in learning and performance in school. Although the



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participant responses in the qualitative phase of the study varied, the participants seemingly agreed that colour contributes to learning and performance in a positive manner. In addition, the results of my study indicate that the use of colour can make work more enjoyable to learners and may draw learners' attention, support memory and assist with the underscoring of ideas and important concepts.

Teachers' understanding of CVD and what the condition implies was found to be limited. Both the quantitative and qualitative results indicate teachers' views that CVD implies that one cannot see certain colours or shades of colours, resulting in learners experiencing challenges to distinguish between certain colours. The results of the qualitative phase of the study elaborate on teachers' understanding of CVD, indicating that teachers lack sufficient understanding of the different types of CVD, the prevalence of CVD and what the condition implies. The teachers, however, demonstrated some understanding of the challenges that learners with CVD may experience in school, despite the general limited awareness amongst teachers and other role players about the condition.

The quantitative and qualitative results on teachers' experience with learners with CVD in the school context varied, indicating that a number of teachers had taught learners with CVD in the past. Teachers reportedly became aware of these learners either when the learners with CVD informed them about their condition, or when they themselves realised that a learner was struggling to see certain colours in class. Some participants indicated that they were informed by the learners' parents or by other teachers. In elaboration, teachers who participated in the qualitative phase of the study shared examples of how learners with CVD can be identified in the school context by sharing their personal experiences of identifying learners with the condition.

### 4.4.3 Teacher perceptions of the challenges that learners with CVD may experience in school

According to the results of the study, learners with CVD are at a disadvantage in the classroom, as they may not be able to see colourful diagrams and pictures, struggle to grasp concepts and explanations when teachers use colour and experience difficulty with tasks and assignments when colour is used. Teachers further noted that these learners may struggle to access content, and experience challenges when educational media or work is colour-coded or when teachers use colour during teaching. As colour is often used to draw attention, underscore concepts and assist learners to learn, teachers were of the view that learners with CVD may be disadvantaged as they often do not benefit from this.



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Despite such possible challenges experienced by learners with CVD, a number of respondents indicated that tests and assessments were not adjusted in the case of learners with CVD. This result was confirmed by participants in the qualitative phase who gave examples of how learners with CVD had lost marks in assessments in the past where colour was used. Overall, the teachers who participated thus indicated that CVD does affect a learner's scholastic performance, often due to teachers not being aware of and not accommodating these learners.

Additional challenges that were identified during the qualitative phase of the study relate to teachers not being equipped to support learners with CVD, a lack of accommodations to support these learners, a need for support and understanding by teachers and in some cases, learners not being aware of the CVD themselves. In addition to the challenges often experienced in class, the participants of the qualitative phase of the study mentioned that learners with CVD may struggle with sport and cultural activities where colour is used. They specifically referred to challenges associated with the use of coloured cones during training, seeing colourful balls or field markings, and identifying teammates or positions when uniforms and bibs are colour-coded.

Finally, the teacher-participants also noted that learners with CVD may experience psycho-social challenges as a result of CVD. They noted possibilities of these learners being bullied or perceived as different. Even though a large number of respondents in the quantitative phase of my study indicated that learners with CVD were not singled out in class, some indicated that these learners were singled out by other learners in school. During the qualitative phase the participants provided examples of how learners with CVD had been singled out and treated by their peers in the past due to the challenges they experienced with seeing and differentiating between colours. According to the majority of the respondents, the social functioning of these learners was not affected by their condition, which points to the possibility of them not being well-informed about the possible effects of CVD.

### 4.4.4 Supporting learners with CVD

The questionnaire determined whether learners with CVD were supported in terms of subject choices and future career options by teachers in school. In addition, participants in the qualitative phase of the study provided several practical examples of how learners with CVD can be supported in the school context besides support with subject and career choices. Teacher-participants, for example, suggested changes in teaching practices, such



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as using shapes, symbols and numbers instead of or with colour during teaching, using different fonts or line thickness instead of or with colour during teaching, writing down the steps of a process that is colour-coded and limiting the use of colour in class. Other suggestions relate to asking learners with CVD whether they can see a colour before using it, exposing learners with CVD to different situations and keeping learners with CVD in mind when planning and presenting a lesson or conducting an assessment task. Participants further recommended individual support for learners with CVD as and when required, offering personal support to assist these learners in the classroom with colour identification.

The teacher-participants underscored a need for training and raising awareness of CVD amongst teachers. In this regard the results of my study indicate that the majority of teachers who participated did not receive sufficient training to address the needs of learners with CVD in class effectively. According to the participants, increased awareness and training of teachers on how to accommodate learners with CVD may contribute to better understanding these learners in school. The majority of the respondents furthermore indicated that they knew how to refer learners who experienced barriers to learning to obtain support and permission of accommodations. Some of the teachers suggested having policies and structures in place within the school context in support of learners with CVD.

Even though varied responses were provided regarding learners with CVD being supported by schools, more respondents indicated that learners with CVD were not supported by their schools than those confirming support provision in their schools during the quantitative phase of my study. In confirmation, the results of the qualitative phase indicate a need for the accommodation of learners with CVD by teachers. Less than a third of the respondents indicated that the SIAS policy considered the needs of learners with CVD, with a similar number of respondents indicating that they had received sufficient training on the SIAS policy.

When asked about inclusive education, the majority of the respondents indicated that they created a classroom environment that took into consideration the diverse needs of all the learners when planning lessons, and when choosing teaching methods and assessment strategies. Even though the majority of the respondents noted that they were able to identify learners who experienced barriers to learning during the quantitative phase of the study, participants in the qualitative phase seemed challenged when not aware of learners with CVD due to the learners not reporting this.



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Several participants expressed the need for awareness of CVD amongst both teachers and learners. The results of the qualitative phase of the study further predicted that such an awareness of learners with CVD in class can bring about change in teaching practice. This result is supported by the inferential statistics indicating a significant relation between teachers who have experience in teaching learners with CVD and the likelihood of support provision for such learners in the specific school. Or conversely, those teachers who reported support for learners with CVD in their school are more likely to have had experience in teaching such learners. Only a small number of the teachers who participated reported that they had been trained on how to accommodate and support learners with barriers to learning such as CVD.

## 4.5 CONCLUSION

In Chapter 4, I provided the results of the study. I first presented the quantitative results I obtained after which I reported on the results of the qualitative phase of my study. Lastly, I triangulated the results stemming from the quantitative and qualitative phases I conducted.

In Chapter 5 I interpret the results of the study by relating them to existing literature on the topic under investigation. In my discussion, I refer to both correlations and contradictions between the results of the current study and those of other scholars who work in the field. I also identify silences in the data of my study and foreground new insights based on the research I completed.

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# CHAPTER 5 - FINDINGS OF THE STUDY

## 5.1 INTRODUCTION

In Chapter 4, I discussed the results of my study. I first presented the quantitative data that was analysed through the assistance of the Department of Statistics at the University of Pretoria in the form of graphic presentations. I then discussed the qualitative results in terms of the themes and subthemes I identified during the inductive thematic analysis I completed. Finally, I presented an integrated discussion of the quantitative and qualitative results I obtained.

In this chapter I relate the results of the current study to the existing body of knowledge as presented in Chapter 2. I discuss correlations and contradictions between the results I obtained and those captured in the existing literature, highlight silences in the data that may require further research, and identify new insights stemming from the current study.

## 5.2 FINDINGS IN SUPPORT OF EXISTING LITERATURE

In this section I highlight the findings of my study that correlate with and confirm research reported in existing literature. To this end, I discuss the findings I obtained on how colour is frequently used for various purposes in the school context, and on teachers' understanding of and experiences with learners with CVD.

### 5.2.1 Areas where colour is used in the school context

In this section I highlight correlations between the results of the current study and those captured in the existing literature regarding the use of colour in the school context. As an introduction, I provide an overview of the correlating findings related to this topic in Table 5.1.



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**Table 5.1:**

*Correlating findings regarding the use of colour in the school context*

| FINDINGS OF THE CURRENT STUDY | CORRESPONDING LITERATURE |
|---|---|
| Colour is often used by teachers in the school context. | ❖ Chen et al., 2014<br>❖ Collins, 2015<br>❖ Kvitle, 2018<br>❖ Maule and Featonby, 2016<br>❖ Wu et al., 2019 |
| Teachers often use technological devices and include colour when using such devices. | ❖ Chen et al., 2014<br>❖ CUDO, 2006<br>❖ Kvitle, 2018<br>❖ Wu et al., 2019 |
| Colour is used in teaching resources such as textbooks, posters and other teaching resources. There is a scarcity of teaching resources that cater for the needs of learners with CVD. | ❖ CUDO, 2006<br>❖ Frane, 2015<br>❖ Jenny and Kelso, 2007<br>❖ Klooster, 2016<br>❖ Maule and Featonby, 2016<br>❖ Nuñez et al., 2018<br>❖ Tanuwidjaja et al., 2014<br>❖ Torrents et al., 2011 |
| Coloured maps are regularly used in teaching. | ❖ Jenny and Kelso, 2007<br>❖ Nuñez et al., 2018 |
| Teachers write in different colours on the board when teaching. | ❖ Kvitle, 2018<br>❖ Olurinola and Tayo, 2015 |
| Teachers often use colour during classroom instruction. | ❖ Collins, 2015<br>❖ Kvitle, 2018<br>❖ Olurinola and Tayo, 2015 |
| Colour is commonly used during extra-curricular activities. | ❖ Chan et al., 2014 |

As indicated in Table 5.1, the findings of the current study confirm existing literature indicating that colour is often used within the school context for a variety of purposes. These findings are discussed in more detail in the following subsections.

#### *5.2.1.1 Colour is widely used during Foundation Phase teaching*

The results of the current study indicate that colour is used across the learning areas covered in the Foundation Phase; in other words during the teaching of Languages, Mathematics and Life Skills. According to the findings I obtained, colour is used for a variety of reasons by Foundation Phase teachers, such as during classroom instruction, explanations and as part of teaching resources. In support of this finding, existing literature



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indicates that visual stimuli and colour are commonly used in early learning activities and as a form of communication with young learners, resulting in numerous tasks relying on colour and colour differentiation (Collins, 2015; Hui, 2021, Torrents et al., 2011). Existing literature furthermore emphasises that colour is often used to assimilate new information or as part of various activities in early learning phases requiring developed colour perception, for learners to be able to complete these activities and understand the work (Chan et al., 2014; Klooster, 2016; Suero et al., 2005; Torrents et al., 2011). In support of existing literature, the findings of my study indicate that colour is also often used for assessment activities in the Foundation Phase.

In line with the findings I obtained, existing literature emphasises the role of colour in educational and recreational activities, with objects often being colour-coded for identification to explain concepts and to sort items (Woldeamanuel & Geta, 2018). Learners with CVD may, as a result, experience difficulty during educational tasks and recreational activities that rely on colour recognition (Birch, 2012). The work of Hui (2021) elaborates on early childhood as a critical period for foundational learning, indicating that such colour-related challenges may have a negative impact on the ability of a child with CVD to fully engage in learning activities and comprehend certain aspects of the work.

The participants in the current study noted that colour is commonly used when teaching Languages during the Foundation Phase, as new words, phonics or different parts of sentences are often written in different colours. This finding is confirmed by the existing literature (Al-Ayash et al., 2016; Chan et al., 2014), indicating that reading media in the early reading years regularly includes colour or is colour-coded, with different phonetic sounds or word groups being differentiated through the use of different colours to assist learners with the differentiation of sounds.

In addition to colour being central when teaching Languages in the Foundation Phase, the findings of my study indicate that colour is widely used when teaching Mathematics during this phase; for example, to assist learners with the differentiation of shapes, or when using number charts where learners are required to count in multiples of, for example, two or five. This finding is once again supported by the existing literature (Geddes et al., 2022; Suero et al., 2005) indicating that colour is often used in the teaching of early Mathematics, both as a visual resource or support mechanism and also in teaching resources.



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#### *5.2.1.2 Colour is used in a range of subjects in both primary and secondary schools*

According to the findings of the current study, learners with CVD may experience challenges in a number of school subjects due to the use of colour. This finding comfirms the work of Sullivan (2011) who similarly found that learners with CVD will typically lag behind in certain school subjects where colour is widely used. Correlations between the findings of my study and those of related studies on the possible challenges commonly experienced in specific school subjects by learners with CVD due to the use of colour are summarised in Table 5.2 below.

**Table 5.2:**

*Correlating findings on the challenges learners with CVD may experience in specific school subjects*

| SUBJECT | FINDINGS OF THE CURRENT STUDY | EXISTING LITERATURE |
|---|---|---|
| Mathematics | ❖ Colour is used to highlight differences. | Colour is often used to differentiate between elements or to represent different numerical operations or categories in Mathematics (Kvitle,2018; Suero et al., 2005). |
| Science | ❖ Colour is used in textbooks, especially for topics on electromagnetic force, ultraviolet and infrared.<br>❖ In Chemistry, colour is associated with the properties of different substances. | Learners may experience challenges in Science where colour indicates the outcome of an experiment. For example, a learner with CVD may struggle to determine the outcome of a scientific litmus test where results are displayed in shades of greens and purples (Bailey, 2013). Learners with CVD may also experience challenges to describe the colours of different chemical solutions or to identify metals from the colour of the flames they produce when burning. These learners may furthermore experience difficulty with prisms and coloured wiring (Kvitle, 2018). |



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| SUBJECT | FINDINGS OF THE CURRENT STUDY | EXISTING LITERATURE |
|---|---|---|
| Art | ❖ Colour is used in pictures on art history.<br>❖ Colour is widely used in art works.<br>❖ Learners with CVD may prefer to use only black and white when doing Art. | Learners with CVD may struggle to appreciate the use of colour or use the wrong colours when painting. Learners with CVD may prefer the use of black and white rather than colour (Hui, 2021). |
| Geography | ❖ As maps are in colour and colour is used to indicate important information on maps, learners with CVD may struggle with map work.<br>❖ Posters and images are typically in colour, with colours conveying important information. | Learners with CVD typically experience challenges with reading and the decoding of maps (Al-Ayash et al., 2016; Nuñez et al., 2018). |

In addition to the findings of the current study confirming existing literature on the possible challenges experienced by learners with CVD in Mathematics due to the use of colour, some new insight is added with regard to the specific ways in which colour may be used in Mathematics teaching. This finding is discussed in more detail in Section 5.5.

#### *5.2.1.3 Colour is prominent in teaching resources*

The challenges that learners with CVD may experience are often not taken into consideration when designing teaching resources, as indicated by both existing literature (CUDO, 2006; Frane, 2015; Maule & Featonby, 2016; Torrents et al., 2011) and the findings of the current study. To be more specific, the findings of my study indicate that colour is widely used in a range of teaching resources such as textbooks, posters, manipulatives, worksheets, reading windows and 3D objects used during teaching. This finding corresponds with the work of Frane (2015), Klooster (2016), Maule and Featonby (2016), Nuñez et al. (2018) as well as Torrents et al. (2011) who all report on the scarcity of teaching resources that consider the restrictions of colour perception possibly experienced by learners with CVD.

The participants in the current study specifically referred to the extensive use of colour in the prescribed DBE workbooks and readers used during the Foundation Phase, adding to the challenges already experienced by learners with CVD during classroom instruction. In support of this finding, existing literature indicates that coloured printing in textbooks has



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increased in recent years (CUDO, 2006), and that the needs of learners with CVD are seldom taken into account when designing textbooks (Torrents et al., 2011; Frane 2015; Maule & Featonby, 2016).

#### *5.2.1.4 Colour is strongly relied on during teaching and instruction activities in class*

All the teachers who participated in the current study indicated that they use colour during classroom instruction. This finding corresponds with the work of Collins (2015), Kvitle (2018), Olurinola and Tayo (2015) as well as Suero et al. (2005) who report that colour is an important tool in education with various uses, such as drawing the attention of learners, highlighting important concepts, establishing a code, and identifying and labelling objects and characters. The findings of the current study confirm these reported trends, pointing to the use of colour to explain important concepts and for numerous other purposes during classroom instruction, such as the processes of organising and coding work to draw attention and highlight work, to increase memory, or to distinguish between objects and concepts. Existing literature further elaborates, with Gegenfurtner and Rieger (2000) stating that colour can assist learners in recognising and remembering learning media and highlighting important concepts (Olurinola & Tayo, 2015).

These findings I obtained are supported by authors such as Collins (2015), Chen et al. (2014), Wu et al. (2019), Kvitle (2018), Klooster (2016) as well as Gegenfurther and Rieger (2000) who all note that colour is used for various purposes during teaching and instruction. According to Prieto et al. (2021), teachers are generally of the view that a black and white colour scheme will draw less attention than when using colour during lesson presentations. In confirmation, both Kvitle (2018) and Klooster (2016) state that colour is considered to be an important tool in the school setting to highlight certain aspects of the work, emphasise meaning, or identify and explain concepts.

Teachers who participated in the current study emphasised that they often use colour when writing on the board. This finding supports the work of Olurinola and Tayo (2015), who posit that an increase of whiteboards in the classroom has led to the increased use of colour. In addition, the findings of the current study indicate that colour is generally used when marking learners' schoolwork. This finding is supported by existing research by Olurinola and Tayo (2015) as well as Klooster (2016) who similarly report on the challenges that learners with CVD may experience when colour is used for marking.



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#### *5.2.1.5 Increased use of colour due to technological advances*

The findings of the current study indicate that teachers increasingly use technological devices in the classroom and will typically use colour when utilising such devices. This finding corresponds with existing literature indicating that people with CVD are currently encountering coloured stimuli on coloured screens more frequently due to technological advances (Cole, 2004; Chen et al., 2014; CUDO, 2006; Lin et al., 2019). This trend has distinct implications for the possible challenges that learners with CVD may experience when technology is used as part of teaching and learning activities.

To elaborate on the use of colour in technology, the findings of my study indicate that teachers tend to include colour when using technological devices in class; for example, when displaying movies or YouTube videos, when using PowerPoint presentations, or when displaying learning content on smartboards or through visualisers. My findings on the use of technology leading to an increased use of colour support the existing body of research. To be more specific, Cole (2004), Kvitle (2018) as well as Lin et al. (2019) similarly indicate that the increased use of technology has led to an increased use of colour in schools in recent years.

In line with the findings highlighted in the previous sections, I further found that the teachers, however, do not consider the challenges that learners may experience in seeing different colours when, for example, choosing images or video media to use in class when relying on technology. This finding corresponds with existing knowledge that indicates that colour displays seldom consider the challenges that people with CVD may experience (Al-Ayash et al., 2016; Cole, 2004; Kvitle, 2018; Lin et al., 2019).

#### *5.2.1.6 Colour is used in extra-curricular activities*

The findings of the current study indicate that colour is often used in extra-curricular activities. Although limited research has been undertaken on the use of colour in these actvities, Chan et al. (2014) as well as Simunovic (2010) refer to some challenges that learners with CVD may face when playing games due to not being able to differentiate between colours. The findings of the current study confirm the findings of these scholars.

To elaborate on the findings I obtained, the teachers who participated indicated that colour is used in various types of sport and other extra-curricular activities, such as netball, hockey, cricket, rugby, chess, drama, soccer, swimming, athletics, archery, tennis and revue. I furthermore found that sport equipment and clothing such as cones, balls, field markings,



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bibs and other clothing items are often colour-coded, posing challenges to learners with CVD when participating in such activities. In support of these findings, Simunovic (2010) provides examples of how different team sports rely on colour to distinguish players that may pose challenges to learners with CVD to distinguish between the players of the various teams and track a game. Furthermore, the incorporation of colour-coded elements in these activities may lead to confusion and require additional effort to participate for learners with CVD (Chan et al., 2014; Simunovic, 2010). In this regard, Chan et al. (2014) note that the associated challenges may affect the enjoyment and inclusivity of learners with CVD in sport activities.

In confirmation of existing literature, the findings of my study indicate that teachers hold the view that learners with CVD may struggle to participate in sport training where colour-coded cones are used for different warm up and training activities. The findings of the current study further indicate that when coloured balls and field markings are used in sport, learners with CVD may struggle to see the ball and field markings due to the reliance on colour.

### 5.2.2 Teachers' perceptions and understanding of CVD

In Table 5.3 I provide an overview of the findings I obtained regarding teachers' perceptions and understanding of CVD, including their perceptions on the challenges that learners with CVD may face within the school context and the importance of being aware of these learners. I also indicate the corresponding literature.

**Table 5.3:**

*Correlating findings regarding teachers' perception and understanding of CVD*

| FINDINGS OF THE CURRENT STUDY | CORRESPONDING LITERATURE |
|---|---|
| **Teachers' perceptions of the value of colour for learning** | |
| Colour plays an important role in learning and is widely used as a teaching tool. | ❖ Collins, 2015<br>❖ Torrents et al., 2011<br>❖ Woldeamanuel and Geta, 2018 |
| Colour makes work more enjoyable and draws learners' attention. | ❖ Collins, 2015 |
| Colour is used by teachers to assist learners in recognising and remembering learning content. | ❖ Gegenfurtner and Rieger, 2000 |



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| FINDINGS OF THE CURRENT STUDY | CORRESPONDING LITERATURE |
|---|---|
| **Teachers' understanding of CVD** | |
| Learners with CVD face challenges to see or distinguish between certain colours. | ❖ Collins, 2015<br>❖ Maule and Featonby, 2016<br>❖ Woldeamanuel and Geta, 2018 |
| CVD is more common amongst men than women. | ❖ Gupta et al., 2017<br>❖ Mashige and Van Staden, 2019 |
| There are different types of CVD that may influence one's ability to see colours. | ❖ Fentahun, 2014<br>❖ Moreira et al., 2017<br>❖ Simunovic, 2010 |
| Teachers are aware of CVD but do not understand the implications or ways of identifying learners with CVD. | ❖ Collins, 2015<br>❖ Maule and Featonby, 2016<br>❖ Tofts, 2007 |
| **Teachers' perceptions of the challenges that learners with CVD may experience in the school context** | |
| Learners with CVD may experience various challenges during classroom activities due to the use of colour. | ❖ Bailey, 2013<br>❖ Chan et al., 2014<br>❖ Espinda, 1973<br>❖ Frane, 2015<br>❖ Hui, 2021<br>❖ Klooster, 2016<br>❖ Kvitle, 2018<br>❖ Nuñez et al., 2018<br>❖ Sato and Inoue, 2016<br>❖ Simunovic, 2010<br>❖ Torrents et al., 2011 |
| Learners with CVD may experience challenges during extra-curricular activities such as sport and cultural activities. | ❖ Chan et al., 2014<br>❖ Simunovic, 2010 |
| Learners with CVD may experience challenges on a psycho-social level. | ❖ Barry et al., 2017<br>❖ Bailey, 2013<br>❖ Birch, 20o1<br>❖ Hui, 2021<br>❖ Klooster, 2016<br>❖ Thomas et al., 2018 |



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| FINDINGS OF THE CURRENT STUDY | CORRESPONDING LITERATURE |
|---|---|
| **Importance of being aware of learners with CVD** | |
| Teachers hold limited knowledge of the prevalence and implications of CVD. | ❖ Collins, 2015<br>❖ Maule and Featonby, 2016<br>❖ Tofts, 2007 |
| There is a need for greater awareness of CVD amongst various role players. | ❖ Berisso, 2018<br>❖ Maule and Featonby, 2016<br>❖ Mpu et al., 2021 |
| Teachers' awareness of learners with CVD in their class can facilitate positive change in teaching, with teachers being more inclusive of learners with CVD. | ❖ Bailey 2013<br>❖ Chan et al., 2014<br>❖ Klooster, 2016<br>❖ Kvitle, 2018<br>❖ Woldeamanuel and Geta, 2018 |

#### *5.2.2.1 Teachers' view that colour is important for learning*

The findings of the current study indicate that teachers value colour as important for learning. To be more specific, according to the teachers who participated, colour contribute to learning and performance in addition to assisting learners to better understand the content they need to master in a quicker way than when colour is not used. This finding supports the work of Collins (2015), Reppa et al. (2020), Torrents et al. (2011) as well as Woldeamanuel et al. (2018) who similarly note that colour can be used successfully as a teaching tool and plays an important role in understanding the visual world.

The findings of my study furthermore indicate that teachers hold the view that colour can make learning more enjoyable and maintain learners' attention in addition to colour assisting teachers to emphasise important ideas and concepts. This finding confirms the work of Collins (2015) who argues that colour can be utilised to draw attention to something in class or to the learning content that is discussed. In further correlation, research by Prieto et al. (2021) indicates that teachers consider black and white learning media as less attention grabbing than when colour is included.

Even though the cited studies suggest a positive effect of colour on memory, other research indicates opposing findings. A study by Finn et al. (2011), for example, indicates that colour will not influence short- or long-term retention of knowledge. This finding correlates with a study by Hall and Hanna (2004) that examined the effect of text and background colour combinations on factors such as readability and retention, indicating that high contrast colours increase the readability of text but that colour combinations do not necessarily affect retention. In the current study, the findings underscore the perception of teachers that the



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use of colour will enhance memory and the retention of learning content by learners, thereby aligning with the work of Pan (2010), Reppa et al. (2020) as well as Dzulkifli and Mustafar (2013).

#### *5.2.2.2 Teachers' understanding of CVD*

Although I found that the level of teachers' understanding of CVD varies among individuals, the insight that the participants demonstrated to some extent corresponds to the definitions of CVD as presented in existing literature. To be more specific, the majority of the participants in the current study indicated that people with CVD are not able to see or distinguish between certain colours, with some teachers referring to certain colour combinations that people with CVD may struggle with, such as red and green. These descriptions correspond to the existing literature on CVD, defining the condition as the decreased or inability to distinguish between certain colours (Collins, 2015; Maule & Featonby, 2016; Woldeamanuel & Geta, 2018). Even though existing literature refers to different types of CVD with red-green CVD being used as an umbrella term, refering to protanomaly, deuteranomaly, protanopia and deuteranomia (Mitiku et al., 2020; Simunovic, 2010), the teachers in the current study did not indicate such detailed knowledge. As such, the findings I obtained confirm that the participants of the current study had a broad idea of what CVD entails, but did not possess detailed knowledge.

It was also noted by some teachers who participated in the current study that some people with CVD may see a grey scale only and see no colour at all. Although existing literature does refer to monochromia, a severe form of CVD characterised by the inability to discriminate between colour (Fentahun 2014; NIH, 2023; Simunovic 2010), other types of CVD are more prominently discussed and distinguished, where people struggle to differentiate between specific colours depending on the cones affected, yet this was not highlighted by the findings of the current study. Finally, my finding on teachers' awareness that CVD is more common amongst men than women corresponds with existing literature, indicating that CVD is prevalent amongst 8% of males and only 0,5% of females (Simunovic, 2010).

#### *5.2.2.3 Teachers' understanding of the challenges experienced by learners with CVD*

The findings of the current study indicate that teachers possess some understanding of the challenges generally experienced by learners with CVD within the school context. According to the findings I obtained, learners with CVD may experience challenges in the classroom as well as during extra-curricular activities due to the use of colour in addition to experiencing



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challenges on a psycho-social level. Overall, these findings correspond to the existing literature that even links CVD with learning challenges in some cases (Chan et al., 2014; Simunovic, 2010).

To be more specific, the findings of the current study indicate that teachers are of the view that learners with CVD are at a disadvantage in the classroom. This finding supports the work of Simunovic (2010) who argues that learners with CVD are at a disadvantage when having to perform certain visual tasks. Although conflicting findings can be found in existing literature on the impact of CVD on scholastic development, many studies emphasise differences between the scholastic performance of learners with CVD when compared to those with normal vision (Chan et al., 2014; Espinda, 1973). Correlating findings between the current and previously conducted studies on how learners with CVD may be negatively impacted in the classroom are summarised in Table 5.4 below.

**Table 5.4:**

*Correlating findings on the challenges that learners with CVD may face in the classroom*

| CHALLENGES | THE CURRENT STUDY | EXISTING LITERATURE |
|---|---|---|
| Challenges to benefit fully from teaching and classroom instruction | ❖ Learners with CVD may struggle to follow instructions when colour is used, which may negatively impact their understanding of the learning content presented to them.<br>❖ Learners with CVD may struggle to see writing and content presented in colour on the board.<br>❖ Colour may not draw the attention of learners with CVD or make lessons more appealing and enjoyable to them. | ❖ Learners with CVD may struggle when instructions include colour (Collins, 2015; Hui, 2021).<br>❖ Learners with CVD may struggle to see certain colours used for writing on the board (Klooster, 2016).<br>❖ Learners with CVD may struggle to see certain colours on a smartboard or screen (Cole, 2004; Kvitle, 2018; Lin et al., 2019).<br>❖ Colour can draw the attention of learners (Collins, 2015; Terry, 2017), support their memory of learning content and assist learners with later retrieval of information (Dzulkifli & Mustafar, 2013; Olurinola & Tayo, 2015; Reppa et al., 2020). |



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| CHALLENGES | THE CURRENT STUDY | EXISTING LITERATURE |
|---|---|---|
| Challenges to access learning content | ❖ Learners with CVD may struggle to see text/work presented in certain colours. | ❖ Learners with CVD may struggle to read coloured words against a coloured background (Hui, 2021).<br>❖ Learners with CVD often take longer and are less successful when working with colour-coded information (Klooster, 2016).<br>❖ Colour-coding used to assist learners in making sense of information may have limited benefits for learners with CVD (Collins, 2015; Kvitle, 2018; Reppa et al., 2020). |
| Challenges related to educational resources | ❖ Learners with CVD may experience difficulty in analysing images, diagrams, charts and pictures where information is presented in colour. | ❖ Learners with CVD may struggle to understand coloured charts and diagrams (Bailey, 2013; Chan et al., 2014; Frane, 2015; Hui, 2021; Kvitle, 2018; Nuñez et al., 2018). |
| Challenges with assessment tasks and activities | ❖ The challenges that learners with CVD experience may negatively impact their marks.<br>❖ Learners with CVD may use the wrong colours during tasks and assessment activities.<br>❖ In the Foundation Phase, colour is often used for assessment activities. | ❖ Learners with CVD may experience challenges in completing tasks that involve colour and reading tests written in colour (Helvacıog & Olguntürk, 2011; Maule & Featonby, 2016; Torrents et al., 2011).<br>❖ When colour is frequently used in the classroom it may influence learners' scholastic performance, with these learners potentially being mistaken as having a learning disability, being inattentive, or being lazy (Chan et al., 2014; Klooster, 2016; Torrents et al., 2011).<br>❖ Learners with CVD may experience challenges to differentiate between colours |



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| CHALLENGES | THE CURRENT STUDY | EXISTING LITERATURE |
|---|---|---|
| | | when used in assessment tasks (Bailey, 2013; Chan et al., 2014; Frane, 2015; Hui, 2021; Kvitle, 2018; Nuñez et al., 2018; Sato & Inoue, 2016; Torrents et al., 2011).<br>❖ In early education, colour is generally used as an educational resource and forms part of the learning content, which may lead to challenges for learners with CVD in the school context (Collins, 2015; Suero et al., 2005). |

In addition to the correlating findings obtained on the challenges that learners with CVD may experience in the classroom, the findings of the current study indicate that learners with CVD may also struggle when involved in extra-curricular activities where colour is used. They may, for example, be challenged when participating in sport activities where colour is used for balls, cones, field markings, uniforms and bibs. This finding corresponds to the work of both Chan et al. (2014) and Simunovic (2010), who similarly found that learners with CVD often experience challenges with distinguishing teammates from opponents, and recognising targets when participating in sport and games.

Finally, the findings of the current study point to the perception of teachers that CVD can affect a learner's emotional and social functioning. To be more specific, the participating teachers reported the belief that learners with CVD may experience psycho-social challenges as a result of, for example, limited enthusiasm and confidence, heightened levels of frustration or them being insecure, ashamed and self-conscious when feeling that they do not fit in or are different from others. The findings of the current study additionally indicate that learners with CVD may be ridiculed if they do not perform well and that they may be treated differently, be singled out by teachers and/or peers, or even be teased or excluded from groups or activities because of their condition. These learners with CVD may also be labelled as slow in subjects where colour plays a role. This finding corresponds with and supports existing literature on the potential negative psychological effects of CVD (Barry et al., 2017; Bailey 2013; Birch, 2001; Hui, 2021; Klooster, 2016; Thomas et al., 2018).



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#### *5.2.2.4 Teachers' realisation of the importance of being aware of learners with CVD in school*

Even though the findings of my study indicate some awareness of CVD amongst the participating teachers, they lacked sufficient knowledge on the exact prevalence and implications of CVD and how to identify such learners in school. These findings support several existing studies presenting teachers as often being unaware of how CVD may affect learning in school (Collins, 2015; Maule & Featonby, 2016; Tofts, 2007).

In addition to my finding that teachers are often unaware of learners with CVD in their class, I found that such learners themselves may not be aware of their condition, based on the experiences of teachers who participated. Closely related, my findings indicate that the participating teachers in most cases became aware of learners' colour-related challenges only when observing them experiencing challenges with the use of colour when, for example, doing Art or when working with colour-coded maps. The work of Maule and Featonby (2016) emphasises the importance of teachers' understanding of the possible challenges that learners with CVD may experience and of being aware of common mistakes that may be made by these learners to avoid misdiagnosing them and to assist teachers in the identification of such learners.

A related finding of the current study emphasises the need for awareness of a learner's condition of CVD amongst the various role players, such as teachers, learners with CVD themselves as well as peers in the case of a learner with CVD. The results of the current study highlight the need for increased awareness and training of teachers and other role players in CVD and what it entails to be able to understand the challenges that these learners may face and to provide the necessary support to the learners. In support of this finding, existing literature such as the work of Mpu et al. (2021), Berisso, (2018), as well as Maule and Featonby (2016) stresses the importance of an increased awareness and training of teachers to equip them with the necessary skills to support learners with barriers to learning and specifically those with CVD. In further confirmation of the findings I obtained, the work of Phasha et al. (2017) as well as Louw et al. (2020) indicates that teachers generally feel unprepared and may lack the necessary training to support learners with barriers to learning. This finding further corresponds to existing literature where teacher awareness and understanding are emphasised as prerequisite for effectively accommodating learners with CVD in school (Berisso, 2018; Collins, 2015; Maule & Featonby, 2016).



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According to the findings of the current study, an awareness of CVD amongst other learners in school may contribute to a more supportive learning environment for learners with CVD. This finding confirms the work of Mpu et al. (2021) who found that collaborative learning structures and associated peer support may support learners with barriers to learning in the school context. Furthermore, the work of Birch (2012) confirms the importance of promoting an awareness and understanding amongst the peers of learners with CVD to create a more inclusive and supportive environment for these learners.

In the current study, the teachers who had taught learners with CVD in the past noted that their awareness of these learners and the condition changed their way of teaching. To be more specific, my findings indicate that these teacher-participants started limiting their use of colour to colours that learners with CVD could more easily discriminate once they became aware of learners with CVD in their class. This finding corresponds with existing literature that advocates an increased awareness of CVD amongst teachers to increase their understanding of the condition and how to support and be inclusive of learners with CVD (Bailey, 2013; Chan et al., 2014; Klooster, 2016; Kvitle, 2018; Woldeamanuel & Geta, 2018).

The findings of my study therefore point to the importance of teacher awareness of CVD to facilitate positive change in support of learners with CVD. In this regard, I found that the changed teaching practices of the participants reportedly resulted in better support of learners with CVD. This finding is supported by existing literature, with Chan et al. (2014) indicating that an increased awareness of CVD amongst teachers can strengthen the supportive strategies offered to such learners.

### 5.2.3 Teachers' experiences of teaching and supporting learners with CVD

Several findings of the current study relate to the experiences of the participants in teaching and supporting learners with CVD in the past, with these findings confirming existing literature. The findings of the current study and the confirming literature are summarised in Table 5.5.



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**Table 5.5:**

*Correlating findings on teacher experiences in teaching and supporting learners with CVD in the school context*

| FINDINGS OF THE CURRENT STUDY | CORRESPONDING LITERATURE |
|---|---|
| Teachers reported encounters with a small number of learners with CVD. | ❖ Kvitle, 2018<br>❖ Mashige and Van Staden, 2019<br>❖ Prieto et al., 2021 |
| Teachers shared the view that learners with CVD are not always aware of their condition. | ❖ Kvitle, 2018<br>❖ Mashige and Van Staden, 2019<br>❖ Prieto et al., 2021 |
| Teachers became aware of learners with CVD in various ways. | ❖ Maule and Featonby (2016) |
| A need exists for increased awareness of CVD and the associated challenges amongst teachers and other important role players. | ❖ Bailey, 2013<br>❖ Berisso, 2018<br>❖ Wu et al., 2019; |
| The inclusion of and support for learners with CVD align with South African school policies. | ❖ Department of Education, 2001<br>❖ Department of Basic Education, 2011<br>❖ Republic of South Africa, 1996b<br>❖ South African Schools Act, 1996 |
| Recommendations were made by the teachers for supportive changes in teaching and instruction. | ❖ Berisso, 2018<br>❖ Collins, 2015:<br>❖ Colour Blind Awareness, 2022<br>❖ CUDO, 2006<br>❖ Meeks et al., 2016<br>❖ Mpu et al., 2021<br>❖ Sakr et al., 2024<br>❖ Torrents et al., 2011 |

#### *5.2.3.1 Teachers' experiences of teaching learners with CVD*

A few participating teachers shared their personal experiences on teaching learners with CVD. This finding that only a limited number of teachers had taught learners with CVD in the past does not, however, align with existing literature reporting on the prevalence of people with CVD and the associated prediction of the presence of such learners in school as further discussed in Section 5.3; yet the finding may be linked to existing literature emphasising that a large number of people with CVD remain undiagnosed and may not be aware of their condition (Kvitle, 2018; Mashige & Van Staden, 2019; Prieto et al., 2021). In support of such existing research, I found that learners with CVD are often not aware of their



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condition, resulting in teachers occasionally identifying these learners based on the teachers' observation during tasks involving differentiation between colours.

In addition to relying on observation to identify learners with CVD, I found that some teachers became aware of learners with CVD when being informed by the learners with CVD themselves, or to a lesser extent by their parents or other teachers. This finding supports the work of Maule and Featonby (2016) who underscore the importance of teachers being aware of the possible challenges that learners with CVD may experience and the mistakes that learners with CVD may make, as these can assist teachers to identify such learners and avoid a misdiagnosis and the possibility of unjust labelling of a child as having, for example, behaviour or learning problems.

Even though the findings of my study indicate that most teachers are of the view that learners with CVD are negatively affected in class, I found that some teachers do not realise the possibility of CVD negatively affecting learners in class. The latter view aligns with the work of Ramachandran et al. (2014) who argue that learners with CVD are still able to achieve academically as research suggests no association between CVD and the level of educational achievement by learners with the condition. In further support of this view, Suero et al. (2005) found no difference between learners with CVD and those with normal colour vision in the performance on memory tasks when colour is not involved. This confirms the view that learners with CVD may be able to perform well when colour differentiation is not important, even though their performance may be negatively affected when colour is used in assessment tasks.

#### *5.2.3.2 Support offered by teachers to learners with CVD*

As indicated earlier, the findings of the current study emphasise that learners with CVD are at a disadvantage when colour is used in the classroom, necessitating accommodation of these learners, such as additional time or personal assistance with colour identification. In support of this finding, existing literature (Kvitle, 2018; Meeks et al., 2016; Tofts, 2007) proposes that CVD should be considered as a learning challenge or hidden disability so that the specialised support required by learners with CVD can be acknowledged.

The findings of the current study indicate that teachers are generally of the view that learners with barriers to learning and specifically those with CVD can be supported and accommodated in mainstream education. This view corresponds with existing policies on inclusive education (Department of Education, 2001; Department of Basic Education, 2011;



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Republic of South Africa, 1996a; Republic of South Africa, 1996b; UNESCO, 1994). To be more specific, The South African White Paper 6 (Department of Education, 2001) stipulates that all children of school-going age are to have access to all schools regardless of the challenges they may experience. In support, the national CAPS documents (Department of Basic Education, 2011) form a foundational guide that aims to cater for the diverse needs of all learners by following an inclusive education approach that recognises the importance of adapting teaching and assessment practices to address the needs of all learners (Department of Basic Education, 2011). In this way, existing South African school-related policies support the view of the teachers in my study by emphasising inclusive strategies that cater for the unique learning requirements of learners with conditions such as CVD. The findings I obtained further align with my conceptual framework, more specifically with Vygotsky`s theory of dysontogenesis (Vygotsky et al., 1993) that forms a theoretical basis for inclusive education and also with Vygotsky's (1987) theory of socio-constructivism that highlights how teachers' communicative practices can support learners with CVD.

In addition, the findings of the current study indicate that teachers are of the view that they can play a prominent role to support learners with CVD in the school context and that they need to acknowledge their role and play their part in supporting these learners. This finding is supported by existing literature, with Adelm an and Taylor (2017) emphasising the role of teachers in modelling respect and understanding, thereby contributing to the creation of a positive learning space for learners with CVD. In addition, the work of Klooster (2016), Chan et al. (2014) as well as Kvitle (2018) emphasises the important role of teachers in attending to aspects such as seating arrangements, classroom displays, and avoiding the use of colour-coded teaching resources to ensure an organised and accessible learning environment for all learners. According to existing literature (Berisso, 2018; Meeks et al., 2016 Rose & Meyer, 2002; Rubin et al., 2009), learners with CVD can also be supported by using various ways of instruction and presenting information, such as written text, verbal explanations and visual media with distinct patterns or textures rather than colour to acknowledge the diverse learning styles and visual abilities of all learners, including those with CVD.

In terms of the accommodation of learners with CVD in the general classroom, the findings I obtained indicate that changes in the use of colour and the incorporation of other strategies rather than colour (consult Table 5.6 below) may support learners with CVD during classroom activities. This finding corresponds to existing literature on creating an inclusive, flexible learning environment by presenting information in multiple ways instead of



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depending on colour only, thereby increasing access to information without hampering learning opportunities for learners with normal colour vision (Collins, 2015; Zhong, 2012). In support of this finding, Kvitle (2018) recommends the use of colour schemes that can be identified by learners with CVD and the combination of shapes, positions or patterns in addition to using labels with colours. In Table 5.6, I provide an overview of the correlations between the findings of my study and those captured in existing literature on supportive strategies that can be implemented for learners with CVD.

**Table 5.6:**

*Correlating findings on supportive strategies for learners with CVD*

| TEACHING AND INSTRUCTION PRACTICES | FINDINGS OF THE CURRENT STUDY | EXISTING LITERATURE |
|---|---|---|
| Use shapes, symbols and numbers rather than different colours | The use of shapes, symbols and numbers instead of or with colour during teaching and instruction can increase the accessibility of learning content and make it easier for learners with CVD to follow classroom activities. | The use of a symbolic element, arrows and numbers in black rather than relying on colour alone is suggested as supportive strategy (Berisso, 2018; Meeks et al., 2016; Prieto et al., 2021). |
| Use different fonts and line thickness | The use of different fonts or line thickness instead of or with colour may support learners with CVD during classroom activities. | Line width, bold and underlined text can be used rather than colour to emphasise and differentiate between aspects (Jenny & Kelso, 2007; Prieto et al., 2021). |
| Write down steps when colour is used for different steps in a process | Writing down the steps when colour is used to explain different steps can assist learners with CVD to follow the various steps. | Although existing literature does not specifically refer to writing down steps it refers to adding labels rather than using colour only to indicate content (Jenny et al., 2007; Berisso, 2018). |
| Limit the use of colour in general classroom teaching | Limiting the use of colour during classroom activities can support learners with CVD. | Several authors recommend avoiding or limited use of colour when teaching learners with CVD (Berisso, 2018; Meeks et al., 2016). |



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| TEACHING AND INSTRUCTION PRACTICES | FINDINGS OF THE CURRENT STUDY | EXISTING LITERATURE |
|---|---|---|
| Determine the colours that learners with CVD can see | Asking learners with CVD if they can see a colour before using it can strengthen the chances of success. | Teachers are encouraged to ask someone with CVD to review work that contains colour before using it (Frane, 2015). |
| Provide individual support | Offering personal support to assist learners with CVD in the classroom can assist them with colour identifi-cation and tasks involving colour. | Individualised learning or a support plan that includes specific accommodation to address a learner with CVD's specific needs is recommended when teaching such a learner (Adelman & Taylor, 2017). |

The findings of the current study furthermore suggest that accommodations such as additional time during tests and examinations may support learners with CVD within the school context as they may take longer than their peers to find items in pictures or access content where colour is included. This finding is supported by the work of Berisso (2018) and Simunovic (2010) who recommend the allowance of additional time for tasks that involve colour interpretation for learners with CVD as accommodating strategy.

In addition to these specific strategies that may support learners with CVD in class, the findings of my study indicate that teachers are of the view that they are responsible to create a classroom environment that considers the diverse needs of all the learners in their class, and that they should consider these needs when planning lessons in addition to being responsible to provide equal opportunities by implementing a variety of teaching methods and assessments. The findings, however, indicate that teachers may not have received sufficient training on how to accommodate and support learners with CVD in class. Closely related, the findings of the current study emphasise the need for awareness of CVD amongst learners with CVD themselves, their peers as well as their teachers. These findings correlate with the work of Bailey (2013), Berisso (2018), Collins (2015) and Wu et al. (2019) who all emphasise the need for awareness of, training and support for learners with CVD.

In this regard, the findings of the current study furthermore underscore the view of teachers that increased awareness and teacher training on how to accommodate learners with CVD may contribute to the support provided to learners with CVD. This finding is supported by existing literature (Bailey, 2013; Berisso, 2018; Klooster, 2016; Maule & Featonby, 2016;



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Wu et al., 2019), arguing that increased awareness of CVD and the challenges associated with the condition is important, especially amongst teachers who are responsible to facilitate positive change and create a supportive environment for learners with CVD.

Closely related, my findings emphasise the need for teachers to know when learners have CVD to be able to support these learners in the school context. In support of this view, Kvitle (2018) notes that a CVD diagnosis may increase the understanding of the condition amongst role players such as teachers. In further confirmation, the work of Bailey (2013), Mashige and Van Staden (2019) as well as Woldeamanuel and Geta (2018) posits that learners with CVD need to be identified in order to facilitate an understanding amongst important role players and to provide learners with CVD with the appropriate support not only in the school context, but also for aspects such as future career choices.

Having said this, the findings of my study also indicate that learners are seldom screened when demonstrating colour confusion. This finding aligns with existing literature indicating that the screening of learners for CVD has been phased out in contemporary schools (Kvitle, 2018; Maule & Featonby, 2016). In further support, existing research emphasises that CVD is often under-diagnosed due to limited structured screening, and that people with CVD are often unaware of their condition (Kvitle, 2018; Prieto et al., 2021; Suero et al., 2005; Torrents et al., 2011).

In terms of the broader school system, the findings of the current study indicate that school policies and structures on how to support learners with CVD may assist such learners within the school context. In support of this finding, Meeks et al. (2016) developed a supportive policy for medical students with CVD. Closely aligned, the work of Collins (2015) as well as Prieto et al. (2021) argues that a universal design can cause teachers to become proactive and create a more welcoming environment for learners with CVD.

## 5.3 FINDINGS THAT CONTRADICT EXISTING LITERATURE

In this section I discuss the findings I obtained that contradict existing knowledge. The contradictions discussed in this section relate to the use of colour in teaching resources, teachers' understanding of what CVD exactly entails and implies, and career guidance support provision to learners with CVD, as well as the impact of CVD on scholastic performance.



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### 5.3.1 Findings on the use of colour in teaching media and resources

The findings of the current study indicate that the teachers who participated tend to consider the possible challenges that learners with CVD may face to differentiate between colours when designing PowerPoint presentations. However, this finding is not supported by existing literature, according to which colour display designs do not consider the challenges that people with CVD may experience (Cole, 2004; Kvitle, 2018; Lin et al., 2019). These apparent contradictory findings may perhaps be ascribed to the general lack of sufficient awareness of CVD in society, despite the participating teachers having some knowledge of CVD and what the condition entails. This is, however, a mere hypothesis that requires further investigation.

Next, the findings of my study indicate that some textbooks are black and white with others containing coloured images, except for the prescribed DBE books that contain many colours. On the contrary, existing literature reports that CVD is seldom considered when textbooks are designed (Frane, 2015; Maule & Featonby, 2016), implying the potential of textbooks being colourful or containing colours that may be confused by learners with CVD. Yet Torrents et al. (2011) found that a mere 10% of the work in Mathematics textbooks may be challenging for learners with CVD, thereby implying a fairly low use of colour in this subject's resources. These seemingly contradicting findings emphasise the need for additional research before coming to final conclusions about the use of colour in school textbooks.

### 5.3.2 Limited detailed understanding of CVD by teachers

Even though the findings of the current study indicate that the teachers had some insight into what CVD entails, I found that they lacked detailed knowledge and insight in terms of what exactly the condition implies. In addition, as opposed to the findings of the current study indicating that teachers are aware of and consider learners with CVD's needs when planning lessons, Berisso (2018), Kvitle (2018) as well as Maule and Featonby (2016) argue that teachers do not necessarily consider the needs of learners with CVD in the classroom. Possible reasons for this apparent contradiction relate to teachers' limited knowledge of what the condition entails and a lack of teacher training on inclusive education practices, specifically regarding support for learners with CVD. This is a mere hypothesis that requires additional research before drawing conclusions.

Based on available research on the prevalence of CVD it is statistically likely that two learners in every classroom in South Africa will have CVD (Albany-Ward, 2011; Collins, 2015). This prediction, however, does not align with the findings of the current study, as the



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current study indicates that only a few teachers reportedly had experience of such learners, with not all teachers even being aware of learners with CVD in their schools. As discussed in Section 5.2.3.1, this apparent contradiction might support existing literature indicating that a large number of people with CVD remain undiagnosed and that there may be learners with CVD in schools that teachers are simply not aware of.

Closely aligned, some limitations may as a result exist with regard to teachers' awareness of the impact of CVD on learners. Even though the findings of the current study indicate split views on learners with CVD not being singled out yet with some of them experiencing emotional challenges as discussed in Section 5.2.2.3, related literature posits that learners with CVD may attempt to hide the challenges they experience due to a fear of being labelled as being different from their peers (Gupta et al., 2017). In this regard, Hui (2021), Klooster (2016) and Thomas et al. (2018) argue that learners with CVD may indeed experience negative psycho-social effects due to the challenges associated with CVD. Based on these discrepancies in findings, it seems clear that the potential effect of CVD on the emotional functioning of learners requires additional research before drawing final conclusions.

### 5.3.3 Career guidance to learners with CVD

In terms of support provision to learners with CVD who are known to teachers, Simunovic (2010) notes that the current management of CVD is often primarily focused on counselling, which includes career counselling. The findings of the current study, however, contradict this claim, as I found that the learners with CVD whom the participating teachers are aware of have received little to no support with subject and future career choices thus far. These contradictory findings may perhaps be linked to resource contraints in the South African context and to many schools not being able to offer counselling services nor career guidance, regardless of whether or not a learner experiences a special needs condition. This is a mere hypothesis that requires further exploration.

### 5.3.4 CVD's impact on scholastic performance

The findings of the current study indicate that most teachers are of the view that learners with CVD are at a disadvantage and are negatively affected when colour is used in the classroom. My findings also indicate that teachers believe that good performance in school can be linked to the ability to differentiate between different colours. These findings contradict the work of Cumberland et al. (2004), Mandola (1969) as well as Ramachandran et al. (2014) who all found that no significant link exists between education performance and



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colour vision status. The Cumberland et al. (2004) study further found no significantly lower scores in reading and Mathematics for learners with CVD, when compared to learners with normal vision.

In further support, studies by Finn et al. (2011) as well as Hall and Hanna (2004) indicate that colour and colour combinations do not influence the retention of knowledge. However, contradictory findings by Chan et al. (2014) and Simunovic (2010) indicate that CVD may be associated with learning and psycho-social challenges. Due to the findings I obtained and those captured in the existing literature being contradictory, additional research is required to draw a conclusion on the impact of CVD on the scholastic performance of learners.

## 5.4 SILENCES IN THE DATA THAT WAS COLLECTED/GENERATED

I identified three silences in the data of the current study that may be explored further in follow-up studies. These silences relate to teachers' limited knowledge on CVD as condition, the impact of CVD based on the use of colour in schools, and ways in which to support learners with CVD.

### 5.4.1 Detailed understanding of the types and causes of CVD

Even though the teachers in the current study demonstrated some understanding of what CVD implies, they remained silent about the causes of CVD as well as the different types or diagnosis processes of these. To be more specific, the findings do not refer to how the cones within the eye are affected when a person has CVD, or how CVD is caused by abnormal or absent cones that may lead to narrow colour vision and impact the specific colours that people are able to see (Maule & Featonby, 2016; Wu et al., 2019). The findings of the current study simply indicate some awareness amongst teachers of people with CVD struggling to distinguish between certain colours or colour combinations such as the red-green combination and the prevalence and specific challenges associated with certain types of CVD. Even though existing literature foregrounds different types of CVD that may vary in prevalence and severity and will affect how a person perceives colour (Maule & Featonby, 2016; Wu et al., 2019), no mention was made of this by the participants in the current study, except for the reference to people with CVD experiencing difficulty to distinguish between red-green colour combinations.

The findings of the current study therefore indicate that teachers are aware that CVD exists and may impact learners; however, the extent of such impact was not mentioned, nor an



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understanding of the fact that different types of CVD can be distinguished that will influence daily living differently, ranging from a minor influence to a person experiencing daily frustrations, or to a person being exposed to frequent dangerous situations as a result of the CVD condition. The findings of the current study do not reflect teachers' knowledge on the possible causes of CVD, despite existing literature clearly indicating that CVD can be congenital or acquired (Berisso, 2018). To be more specific, the participants of the current study did not refer to the causes of CVD in relation to inheritance through a gender-linked recessive gene (Frane, 2015; Mitiku et al., 2020; Simunovic, 2010). Closely related, no mention was made of possible comorbidities associated with CVD, as captured in the work of Berger et al. (2016), indicating that enuresis, irritable bowel syndrome and somatoform disorders are associated with CVD in various degrees.

Even though the findings of the current study indicate a need for screening for CVD to identify learners with CVD so that support can be provided within the school context, no mention was made by the participants of the types of screening material that is currently available. As such, the teachers did not indicate insight into the Ishihara Test, the Colour Vision Testing Made East (CVTME) instrument or the Farnsworth-Munsell 100 Hue Test that are available and in use to diagnose CVD (Klooster, 2016; De Fez et al., 2018).

Possible reasons for the participants' silence about the detail underlying CVD in terms of the causes, different types, levels of severity, associated conditions or screening procedures include a limited knowledge of the condition amongst teachers and the general public. In addition, the lack of sufficient formal training on inclusive education practices, specifically in terms of the accommodation of CVD in teacher training programmes as well as continuous training programmes may explain these silences in the data. This is a mere hypothesis that requires additional research before drawing conclusions.

### 5.4.2 Detailed understanding of the impact of CVD in school due to the use of colour

Although the findings of the current study indicate teachers' insight that colour is used for various purposes when teaching the Foundation Phase subjects as well as Mathematics, Science, Art and Geography as discussed in Section 5.2.1.2, the findings do not reflect detailed insight in terms of the colour-coded elements often used in graphs and charts, nor how broadly colour is used across all the various subjects offered in school. In existing literature Geddes et al. (2022) and Birch (2012), for example, emphasise the challenges that learners with CVD may experience when interpreting graphs or charts. In addition, when



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referring to the use of colour in specific subjects, no participants of the current study mentioned Biology, Computer Science and Programming, or Home Economics where learners may be challenged, as indicated in existing literature (Al-Ayash et al., 2016; Chan et al., 2014; Kvitle, 2018). Furthermore, even though the findings of my study refer to the challenges experienced by these learners in Art, detailed knowledge of, for example, the reproducing of specific colour combinations and associated challenges is not mentioned, as stipulated by Hui (2021).

In terms of advancements in technology and how this has affected the use of colour in school and in daily living, existing literature indicates that in contemporary life people with CVD encounter coloured stimuli more frequently due to, for example, coloured printing and coloured screens occurring more frequently (Chen et al., 2014; CUDO, 2006; Kvitle, 2018; Lin et al., 2019). Although the findings of the current study indicate that teachers make use of technology in the classroom and that technology has led to an increase in teachers' use of colour in the classroom as discussed in Section 5.2.1.5, the participants did not refer to the effect of technology on coloured printing, specifically in terms of workbooks and an increase in coloured textbooks due to technological advances. Furthermore, no reference was made by the participants to the increase in whiteboards or an increase in the use of colour on whiteboards in the modern classroom.

The participants' silence about the specific use of colour across school subjects in resources and as part of technology that is commonly used can possibly be ascribed to the teacher-participants only sharing their experiences in the specific subjects they were teaching, and to resource constraints in the South African context, possibly limiting the impact of technology and the use of teaching resources that contain colour in some school settings. This is, however, a mere hypothesis and further investigation is needed prior to drawing conclusions.

### 5.4.3 Strategies to support learners with CVD

Although several recommendations on how to accommodate learners with CVD in the classroom were indicated by the participants of the current study that corresponded with existing literature as discussed in Section 5.2.3.2, a number of strategies were not noted with reference to the following:

- Utilising differences in lightness rather than only relying on differences in hues to differentiate between colours (Frane, 2015).



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- Avoiding the use of red on a dark background; for example, using dark backgrounds with a red foreground or using a red laser pointer during presentations (Frane, 2015; Prieto et al., 2021).
- Attending to the learning environment and classroom lighting, emphasising sufficiently bright light with no glare or shadows projected on the board (Cole, 2004; Collins, 2015; Helvacıog & Olguntürk, 2011; Nagy et al., 2014; Sato & Inoue, 2016).

In addition, the participants in the current study were silent about the possible use of assistive devices in support of learners with CVD. Even though existing literature captures several ideas on assistive devices and software that can support people with CVD (Tanuwidjaja et al., 2014; Wu et al., 2019; Simunovic, 2010; Hui, 2021; Wu et al., 2019) such as software that filter images (Wu et al., 2019), tinted lenses (Simunovic, 2010), Daltonizing algorithms, colour transparency overlays, specialised glasses (Serrantino et al., 2015) and applications for smartphones that can assist with daily activities such as reporting colour (Tanuwidjaja et al., 2014), no mention was made of any of these options or possibilities in the current study.

The participants' silence about specific teaching strategies and the use of assistive devices to support learners with CVD in the classroom can possibly be ascribed to a lack of detailed knowledge on supportive strategies for CVD due to limited exposure to such learners in the past or to insufficient awareness and understanding of the condition. In addition, limited training on inclusive education practices in the South African context may explain these silences, as well as teachers not being aware of assistive devices due to limited exposure and possible resource constraints associated with the South African context. However, these are mere hypotheses that require further research before drawing conclusions.

## 5.5 NEW INSIGHT STEMMING FROM THE STUDY

The findings of the current study contribute to the existing knowledge base on the use of colour in the school context, more specifically in terms of its use in classrooms, in specific school subjects and in extra-curricular activities in the South African context. In addition, my conceptualisation of a teacher guidance intervention was informed by the teacher-participants' indications of the knowledge they held yet also the areas in which they required further guidance. The framework for a teacher guidance intervention (consult Section 6.5 in the next chapter) in itself represents new insight stemming from the study.



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Firstly, even though existing research underscores the use of colour in the classroom, the extent to which colour is used is not clearly indicated. The findings of the current study indicate that colour is used in the classroom by most teachers on a daily basis and that all teachers use it for teaching and classroom instruction. In addition, existing research (Cole, 2004; Kvitle, 2018) indicates an increase in the use of colour in classrooms due to the increased use of whiteboards and technology; however, little reference is made to traditional green boards, whereas the findings of the current study confirm that teachers often use different coloured chalk to write on the board when teaching. In addition to the use of colour on the chalkboard, the findings of the current study point to the frequent use of colour during classroom instruction, in school subjects, in teaching resources and during extra-curricular activities.

The current study furthermore adds insight in terms of the use of colour in some specific subjects on which limited research is available. To be specific, detail is added to the use of colour in Mathematics and History, and how this may impact learners with CVD, as summarised in Table 5.7.

**Table 5.7:**

*New insight on the use of colour in Mathematics and History*

| SUBJECT | CURRENT STUDY |
|---|---|
| Mathematics | ❖ Colour is often used in Mathematics to indicate different angles or sides in geometry.<br>❖ Colour is often used to indicate different shapes and volume.<br>❖ Coloured counters are widely used to teach Mathematics in the lower grades. |
| History | ❖ Videos or documentaries that are commonly used often contain colour and may indicate important information; for example, a soldier's uniform or blood on their clothing.<br>❖ Colour is often used to convey important information on posters and images used in History. |

Although literature exists on the use of colour in sport and how this may impact people with CVD, the available research on this topic is scarce, specifically related to sport and extra-curricular activities in the school context. The findings of the current study add new insight in this field, indicating that colour is frequently used in extra-curricular activities such as chess, drama, revue, netball, hockey, soccer, swimming, athletics, cricket and rugby in South African schools. Colour is specifically used for flags, house colours, uniforms and



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bibs, cones, field markings, coloured balls, videos, images, cue cards and worksheets, thereby posing challenges to learners with CVD who would like to participate in such activities.

## 5.6 CONCLUSION

In this chapter I interpreted the results I presented in Chapter 4 against the existing body of knowledge on CVD. To this end, I related my findings to the literature discussed in Chapter 2, highlighting correlations and contradictions between the findings of the current study and those captured in existing literature, and indicating silences and new insight based on the findings of the current study.

In the next chapter, I provide an overview of the chapters of this thesis. I then draw conclusions by addressing the research questions in terms of the findings discussed in this chapter and subsequently propose a framework for a teacher guidance intervention that may be developed and implemented in a follow-up study. I present the contributions of my study and reflect on the challenges and potential limitations I identified. I conclude the thesis by formulating recommendations for future training, practice and research.



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# CHAPTER 6 - CONCLUSION AND RECOMMENDATIONS

## 6.1 INTRODUCTION

In Chapter 5, I discussed the findings of my study in relation to existing literature on the phenomenon I researched. I focused on both correlations and contradictions I identified when comparing the results of my study with those captured in the existing body of knowledge. I further identified silences in the data and highlighted new insights stemming from the study.

In this final chapter of my thesis, I provide an overview of the previous chapters. I then draw conclusions in terms of the research questions I formulated in Chapter 1. Stemming from these conclusions, I conceptualise a teacher guidance intervention that may be developed and implemented in a follow-up study in support of learners with CVD. Thereafter, I present the contributions of the study and discuss the potential limitations I identified. I conclude with recommendations for future training, practice and research.

## 6.2 OVERVIEW OF PREVIOUS CHAPTERS

In **Chapter 1** I introduced my study by providing relevant background and justifying the focus of this enquiry. The purpose of the study was to explore and describe teachers' perceptions and understanding of CVD and the extent to which these are taken into consideration during classroom instruction, with the aim of conceptualising a teacher guidance intervention in support of learners with CVD. I also formulated research questions and hypotheses, declared my initial assumptions and introduced the research methodology of the empirical part of my study.

In **Chapter 2** I discussed existing literature on the phenomenon that formed the basis for my study, being CVD. More specifically, I explored existing literature on the use of colour in schools, specifically focusing on the use of colour during teaching and classroom instruction, and the use of colour in teaching resources. I furthermore explored existing literature on how children with CVD may be affected within the school context. Next, I discussed literature on how children with CVD can be supported and referred to policies related to the inclusion of learners with different abilities in mainstream schools. In the final section of the chapter, I explained the conceptual framework that guided me in undertaking this research.



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**Chapter 3** focused on my discussion of the research process. To this end, I explained and justified the selected paradigmatic perspectives, research design and selection of the participants. Next, I explained the data collection/generation, capturing/documentation and analysis procedures, throughout relating my choices to the research questions and purpose of the study. Lastly, I presented the applicable standards of rigour and discussed the ethical considerations I aimed to adhere to.

In **Chapter 4** I presented the results of both the quantitative and qualitative components of my study. First, I presented the quantitative results by means of both descriptive and inferential statistics. Thereafter, I discussed the qualitative results in terms of the themes and related subthemes I identified. I concluded the chapter by integrating the quantitative and qualitative results.

**Chapter 5** focused on the findings of the study. To this end, I discussed the results I obtained against the background of the existing literature explored in Chapter 2, thereby presenting the findings. I specifically foregrounded correlations, contradictions, silences in the data and new insights stemming from the current study.

## 6.3 CONCLUSIONS IN TERMS OF THE FORMULATED HYPOTHESES

Based on the findings I obtained, I draw conclusions in this section in terms of the following hypotheses formulated in Chapter 1:

- $H_0$: There is no significant relationship between teachers' experiences of teaching learners with CVD and the support they offer to such learners.
- $H_1$: There is a positive significant relationship between teachers' experiences of teaching learners with CVD, and the support they offer to such learners.

In determining the relationship between teachers' experiences of teaching learners with CVD and the support offered to these learners in school, the results of the Fisher's Exact Test indicate a p-value of 0.002, which is less than 0.05. These results confirm a positive and significant relationship between the two variables. This implies that teachers who have experience of teaching learners with CVD are more likely to report on support provision for these learners in their schools. Conversely, teachers who report support for learners with CVD in their schools are more likely to have had experience in teaching such learners.

Based on the results I obtained, I reject the null hypothesis. As such, I conclude that there is a positive relationship between teachers' experiences of teaching learners with CVD and



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the support they offer to such learners within the school context. The qualitative results of my study confirm this conclusion, as the teachers who became aware of and had taught learners with CVD reportedly made positive changes in support of these learners. To be more specific, the teachers who shared experiences on teaching learners with CVD indicated that they changed their teaching practices in response and in support of these learners.

## 6.4 ADDRESSING THE FORMULATED RESEARCH QUESTIONS

In this section I draw conclusions based on the findings of the study put forward in the previous chapter. I first address the secondary research questions, and then answer the primary research question that guided my study.

### 6.4.1 Secondary research question 1: What is teachers' understanding of CVD and what this condition implies for learners?

Based on the findings of the current study, I can conclude that most teachers have some understanding of what CVD is, yet that this understanding of CVD and what the condition entails seemed to be limited. In my study, the participating teachers' understanding of CVD varied, with the most popular explanation of CVD by the participants relating to the idea of one not being able to see certain colours or shades of colours, and experiencing challenges to distinguish between certain colours. Some of the teachers were of the view that people with CVD are not able to see any colour, seeing only a grey scale. This belief, even though voiced by selected participants only, attests to the fact that CVD is not well-known in society or even by teachers, specifically in terms of what the condition entails and implies.

As stated, some teachers are seemingly aware of certain colour combinations that people with CVD may struggle to distinguish, such as colours on the red-green spectrum. Despite this awareness, most teachers lack insight into the specific types and severity of CVD and how these can affect a learner's ability to perform during colour-coded visual tasks. Even though some teachers are apparently aware of the fact that CVD is more common amongst men than amongst women, teachers generally lack the necessary detailed understanding of the prevalence of CVD and what this implies. I can subsequently conclude that teachers may be aware of CVD to an extent but at the same time lack the necessary knowledge of the exact implications of CVD and how to identify learners with CVD.

In terms of the challenges experienced by learners with CVD, the participating teachers demonstrated some understanding of the scholastic challenges typically associated with



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CVD, sharing their experiences and views on how the use of colour in the school context can have a negative impact on learners with CVD in the classroom, during extra-curricular activities as well as on a psycho-social level. During classroom activities when colour is used, learners with CVD will, for example, experience challenges with benefitting from teaching and instruction, and accessing all the learning content. Furthermore, learners with CVD will typically be challenged when educational resources are colour-coded or when colour is used during assessment tasks and activities. Learners with CVD may also struggle with extra-curricular activities due to the frequent use of colour, for example, in balls, cones, field markings, uniforms and bibs. This may lead to these learners finding it hard to distinguish between teammates and positions on the field in addition to the challenges they may experience to see balls and field markings on a field with a similar colour.

With regard to the psycho-social challenges that learners with CVD may experience, the teachers who participated in the current study indicated that CVD affects learners in terms of their emotional functioning, with them experiencing feelings such as a lack of enthusiasm and confidence, increased levels of frustration, or being insecure, ashamed and self-conscious when feeling as if they do not fit in or are different from their peers. My findings furthermore indicate that learners with CVD may also be ridiculed if they do not perform well at school and may, as a result, be treated differently, be singled out by teachers and/or peers, or even teased or excluded due to their condition. In certain cases, these learners may even be misdiagnosed as presenting with behavioural problems or a learning disability, resulting in the possibility of them being wrongly labelled by both teachers and peers.

These findings I obtained align with my conceptual framework as the work of Vygotsky (1983) indicates that the marginalisation of children in social, cultural and learning environments may be caused by a primary disability, in this case CVD. To be more specific, through the lens of my conceptual framework, every learner's unique abilities, including those with CVD, need to be acknowledged, with the focus falling on how to accommodate these learners in the mainstream classroom. As a result, I argue that teachers' limited understanding of CVD and what the condition implies may prevent them from planning for and implementing accommodations and support provision to learners with CVD, even though this can be expected when considering inclusive education policy.



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### 6.4.2 Secondary research question 2: How is colour used in the school context, in teaching resources as well as in teaching practice?

The findings of my study indicate that colour is widely used within the school context. To be more specific, teachers use colour on notice boards and other places. They use colour on a daily basis within the classroom, with this conclusion being true for all the teachers who participated in my study. They use colour for many purposes, for example to explain important concepts, organise and code work, draw attention, make work more enjoyable, highlight important concepts, increase retention, or distinguish between objects and concepts. Furthermore, teachers make use of colour when marking learners' work and when writing on the board.

These findings on the multiple uses of colour during general teaching and classroom instruction can be related to my conceptual framework that highlights the important role of teachers' communicative practices (such as teaching and instruction) and how they use colour in teaching resources such as textbooks and other teaching media during this process. According to Vygotsky's socio-constructivist theory, learning entails a social process that occurs through interactions between teachers and learners (Vygotsky, 1978), with teachers often using colour to facilitate such interactions even though this may impact learners with CVD. For this reason, I argue that teachers' use of colour during teaching and instruction practices may add value to the learning experiences of the average learner, yet may negatively affect a learner with CVD, placing teachers in the difficult position of selecting resources that can meet the needs of both these groups of learners.

Colour is specifically used widely in the Foundation Phase as part of teaching, instructions, explanations and teaching resources. During this phase, colour is used across the learning areas Languages, Mathematics and Life Skills. For example, Foundation Phase teachers commonly use colour to indicate new words, phonics, or parts of sentences when teaching Languages. In Mathematics, these teachers often use colour to differentiate between shapes and numbers. In later school years, colour is widely used in various subjects offered from Grade 4 to 12, such as Mathematics, Science, Art, Geography and History. To be more specific, in Mathematics, colour is often used to highlight differences and explain geometry. In Science, colour is associated with the properties of different substances as well as concepts such as electromagnetic force, ultraviolet and infrared. In Art, colour is used in art pictures and widely used when creating artworks. In Geography, information on maps is typically colour-coded and in posters and images colour is used to convey important



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information. Similarly, in History, the use of colour in images, documentaries and videos may convey important information.

As indicated, the findings of the current study indicate that colour is widely used in school resources, such as textbooks, posters, manipulatives, worksheets, reading windows and shapes. An important example entails the prescribed DBE workbooks and readers that contain much colour and are commonly used by most schools in the country. Yet, when designing teaching resources, the challenges that learners with CVD may experience are seldom taken into consideration. Based on these findings I argue that existing teaching resources require adaptions when teaching learners with CVD.

In addition to the colourful physical resources often used in modern-day classrooms, teachers generally integrate technology when teaching, by, for example, displaying videos or movies, or using PowerPoint presentations, smartboards and visualisers. The findings of my study indicate an increase in the use of technological devices in the classroom and teachers often using colour when integrating such devices during their teaching. The scholastic performance of learners with CVD may be affected negatively by this trend, implying the possibility of them obtaining lower marks than their peers with normal vision.

Besides the potential negative effect of colour on learner performance in the classroom, the findings of my study indicate that colour is often used and may thus potentially affect learners with CVD during extra-curricular activities, such as netball, hockey, cricket, rugby, chess, drama, soccer, swimming, athletics, archery, tennis and revue. In addition, I found that sport equipment and clothing such as cones, balls, field markings, bibs and other clothing items are often colour-coded, which once again poses challenges to learners with CVD wanting to participate. As such, my study confirms that colour is widely used in school resources, not only within the classroom, but also during extra-curricular activities. Considering this, it can be concluded that learners with CVD will face barriers on varies levels, with this negatively impacting their performance as well as their emotional wellbeing and functioning.

### 6.4.3 Secondary research question 3: How can teachers accommodate and support learners with CVD in the school context?

The findings of my study indicate that teachers can play an important role in supporting learners with CVD in the school context. The teachers who participated acknowledged their potential role in offering support to such learners, indicating that learners with CVD should



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be accommodated in mainstream education, which would, however, require of teachers to make adjustments to be more supportive of these learners in the school context.

As indicated, based on the findings of my study, it can be concluded that learners with CVD are at a disadvantage due to the use of colour in the classroom and that they require supportive changes in teaching and instruction to be able to thrive. My findings on such possible supportive changes in teaching practices relate to the use of shapes, symbols and numbers and/or the use of different fonts and line thickness instead of or with colour when wanting to highlight something or differentiate between aspects. Other recommendations include that teachers can write down the steps when colour is used to explain different steps and limit the use of colour in general or use only colours that learners with CVD can differentiate.

Learners with CVD can also be provided with individual support or exposed to situations where they will know what to expect when colour is used in the classroom. Accommodation in the form of, for example, extra time and having policies and support structures in place to support learners with CVD in schools can similarly be relied on to support these learners to perform as can be expected. In addition, the use of colour during extra-curricular activities requires careful consideration in terms of the possible impact thereof and practical changes that can be made in support of learners with CVD.

The findings I obtained on the inclusion of and support for learners with CVD align with South African school policies such as the White Paper 6 (Department of Education, 2001), the South African Schools Act (Republic of South Africa, 1996b), and the Bill of Rights (Republic of South Africa, 1996a). Based on the findings of the current study it is clear that teachers are of the view that learners with barriers to learning, such as those with CVD, can be supported and accommodated in mainstream education. This conclusion can be related to the conceptual framework of the current study, as Vygotsky`s theory of dysontogenesis (Vygotsky et al., 1993) provides a theoretical basis to understand the possibility and implementation of inclusive education. In addition, the theory of socio-constructivism (Vygotsky, 1987) indicates how teachers' communicative practices can support learners with CVD, as is also suggested by the findings of my study.



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### 6.4.4 Secondary research question 4: What are the needs of teachers for guidance on possible supportive strategies for learners with CVD?

My study underscores the need for increased awareness of CVD and the associated challenges that learners may face amongst teachers as well as other important role players. As the majority of all teachers have seemingly not received sufficient training on how to accommodate and support learners with barriers to learning, specifically those with CVD, I propose training in this area, not only as part of pre-service training programmes but also for teachers in the profession. Based on the teachers who participated expressing the need for an increased awareness and training on how to support and accommodate learners with CVD within the school context, I argue that teachers may benefit from such opportunities of continued training.

As indicated earlier, the findings of my study emphasise that teachers may not always be aware of learners with CVD in their classrooms and that learners with CVD may similarly not even be aware of their condition themselves. The teachers in my study often became aware of learners with CVD in their classrooms merely based on their own observation of challenges experienced by learners when completing colour-related tasks. As a result, I can conclude that learners with CVD who are not aware of their condition due to not being formally diagnosed may remain unaware of the challenges they are experiencing until teachers become aware of them facing colour-related challenges, at which time the CVD may be identified. Teachers' understanding of CVD, even though this may be limited, and how CVD may impact learners with the condition can in this way not only provide valuable information but also serve as a source of support to learners with CVD in the classroom, with the identification of such a learner accounting for a form of support. As such, the need for increased awareness of CVD amongst teachers can be regarded as core to the need of teachers to receive guidance on how to support learners with CVD.

The findings of my study indicate that increased awareness of CVD and of learners with the condition amongst teachers may result in supportive change within the school setting. The teachers in my study explained how they, once becoming aware of learners with CVD in their classrooms, were able to make changes in their teaching practices in support of these learners by, for example, reducing the use of colour and using only colours that learners with CVD can distinguish. Considering this, it can be concluded that teachers who are aware of learners with CVD in their classrooms will be able to make adjustments in support of these learners in terms of their own teaching practices and the use of colour in tasks and supportive resources. For this reason, I propose a teacher guidance intervention that may



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equip teachers with possible ways of identifying learners with CVD within the school context in support of accommodating their specific needs.

The findings of my study furthermore indicate that, although teachers may have some understanding of what CVD is, they generally lack in-depth understanding of the condition and how this may impact learners with CVD. The teachers who participated accordingly expressed the need for a better understanding of what CVD entails and how this may affect learners. To be more specific, knowledge on what CVD is, the types of CVD and how learners with different types of CVD may see colour when compared to learners with normal vision may enhance teachers' understanding of the condition and ultimately the support they could offer learners with CVD in their classrooms and during extra-curricular activities.

When teachers gain a better understanding of the colour-related challenges that learners with CVD in their class experience they may feel better equipped to support these learners to address such challenges. For this reason, I argue that teachers need to be educated in the possible colour-related challenges that learners with CVD may experience not only in the classroom but also during extra-curricular activities. Furthermore, a better understanding of the possible psycho-social challenges that learners with CVD may experience can enhance teachers' understanding of these learners and their unique needs.

Even though the participating teachers provided some suggestions on how to accommodate learners with CVD within the school context in terms of accommodations, school documents, support policies and the use of colour in the classroom and teaching resources, they indicated the need for information on additional practical guidelines that can be followed. In this regard, I argue that teachers can benefit from receiving information on practical ways of supporting learners with CVD – both in and outside the classroom.

These findings of my study on accommodating learners with CVD in the mainstream school context align with a worldwide move towards inclusion and South African school policy on inclusive practices and support for learners with barriers to learning (Republic of South Africa, 1996b; Department of Education, 2001; Department of Basic Education, 2011; Department of Basic Education, 2019). Furthermore, these findings can be explained in terms of the conceptual framework that guided me in undertaking the study, where I integrated Vygotsky`s theory of dysontogenesis (Vygotsky et al., 1993) and his theory of socio-constructivism (Vygotsky, 1987) to explain how teaching practices in mainstream schools can become more inclusive and what the role of teachers would be in facilitating such inclusive learning opportunities.



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### 6.4.5 Primary research question: How can insight into teachers' understanding of CVD in the classroom inform a teacher guidance intervention in support of learners with CVD?

The teachers who participated in my study indicated that they widely used colour for numerous purposes such as teaching and classroom instruction, teaching media and resources, and the utilisation of technology in class. The frequent use of colour in and outside the classroom can, however, have a negative impact not only on learners with CVD's understanding of the learning content, their scholastic performance or their participation in extra-curricular activities, but also on their psycho-social state. By understanding teachers' use of colour in the classroom and the possible impact thereof on learners with CVD, insight is possible on how teaching and instruction practices can be changed in support of learners with CVD. To this end, I posit that the teacher guidance intervention that is conceptualised in Section 6.5 can be developed and implemented in schools with in-service teachers to support learners with CVD, not only during classroom activities but also when participating in extra-curricular activities and on a psycho-social level. In addition, such a teacher guidance intervention can form part of pre-service training programmes for prospective teachers.

The frequent use of colour by teachers in the school context despite the possible negative impact it may have on learners with CVD confirms a limited awareness of CVD and what the condition entails amongst teachers. In this regard, the teachers who participated in my study expressed the need for an increased awareness of CVD and teacher training in support of learners with CVD. This confirms the need for a teacher guidance intervention, not only to increase an awareness of the condition but also to guide teachers on how to adjust their teaching and instruction practices to be more inclusive of learners with CVD in mainstream schools.

The teachers who participated furthermore reported a lack of awareness of CVD and what it implies amongst learners with CVD themselves, their peers and other role players. A teacher guidance intervention in support of learners with CVD may thus not only provide teachers with knowledge on how to support learners with CVD but also guide them on how to identify learners who experience challenges with colour differentiation and when to refer such learners for a possible formal diagnosis. In addition, if guided, teachers may share their newly gained knowledge and skills with other role players and the learners in their classrooms. This may, in turn, result in an understanding of the condition by learners with CVD as well as their peers, thereby contributing to more inclusive school environments.



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In this regard, the reports by teachers who participated on positive change in their teaching practices and how they became more inclusive of learners with CVD once being aware of learners with CVD in their classes, informed the proposed teacher guidance intervention, with other future teachers potentially benefitting from the lessons learnt in the past by fellow teachers. This finding that suggests that an awareness of learners with CVD in school may contribute to more inclusive teaching of learners with CVD, informed my development of the proposed teacher guidance intervention, with the aim of making future recipients of the intervention aware of the importance of being informed of learners with CVD to be able to support these learners effectively.

The findings of my study on the use of colour in schools and the specific challenges that learners with CVD may experience provide insight that can inform possible ways of supporting learners with CVD, with these ideas being included in the teacher guidance intervention proposed in the next section. More specifically, the insight gained on the wide use of colour in the Foundation Phase and in various subjects taught from Grade 4 to 12 can guide future teachers in identifying ways of accommodating learners with CVD in class, across the various school phases. Furthermore, the findings I obtained on accommodating learners with CVD can provide examples of practical ways in which teachers can change their teaching and classroom practices to become more inclusive of learners with CVD. These examples and related strategies that have been identified may all form part of the content of the proposed teacher guidance intervention.

In addition to the findings of my study providing insight into the use of colour and the associated challenges that learners with CVD may experience in class, the findings add insight into the use of colour and the associated challenges during extra-curricular activities, such as sport and culture activities. By including information of this nature in the proposed teacher guidance intervention, other teachers may be sensitised to provide holistic support to learners with CVD within mainstream schools.

As already indicated, the findings of my study also provide insight into possible psycho-social challenges associated with CVD that learners may experience. When teachers are aware of such potential psycho-social challenges, they may foster an inclusive classroom environment where learners with CVD can feel understood and included, which may reduce the psycho-social challenges experienced by them. In this way, learners with CVD may feel less excluded and better understood. Teachers may furthermore be able to create a



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supportive environment for learners with CVD, where peers with normal vision are more understanding and supportive of these learners when better informed.

The teacher guidance intervention I conceptualise in the next section aligns with my conceptual framework as it promotes inclusive practices and should provide teachers with practical guidelines on how to adapt teaching and instruction practices to be more inclusive of learners with CVD. In this way, learning content can ultimately be explained in a way that may allow learners with CVD to reach their ZPD. Although I obtained findings on the challenges that learners with CVD may experience due to the use of colour in schools, the focus of my study does not fall on challenges with colour differentiation but rather on supportive practices for learners with CVD in support of them performing according to their abilities instead of being limited by CVD. This view aligns with Vygotsky's theory of dysontogenesis as it acknowledges the ability of learners with CVD to learn and provides a potential way to foster these learners' inclusion in mainstream education. To be more specific, when interpreting the findings of my study against the background of the conceptual framework, the focus falls on the abilities of learners with CVD and on positive changes in teaching practices that can make mainstream schools more inclusive of such learners. In this way, a teacher guidance intervention on supporting learners with CVD can facilitate opportunities for learners with CVD to experience equal learning opportunities, thereby contributing towards inclusive education in general.

## 6.5 CONCEPTUALISING A TEACHER GUIDANCE INTERVENTION

Based on the findings of my study, I propose a teacher guidance intervention in this section. By utilising such an intervention, teachers can be empowered to support learners with CVD. In conceptualising the teacher guidance intervention, I relied on the findings I obtained related to the use of colour in schools and the challenges that learners with CVD may experience as a result, as well as the participating teachers' recommendations on how to support learners with CVD based on their personal experiences in teaching learners with CVD in the past. Figure 6.1 captures my conceptualisation of the proposed teacher guidance intervention.



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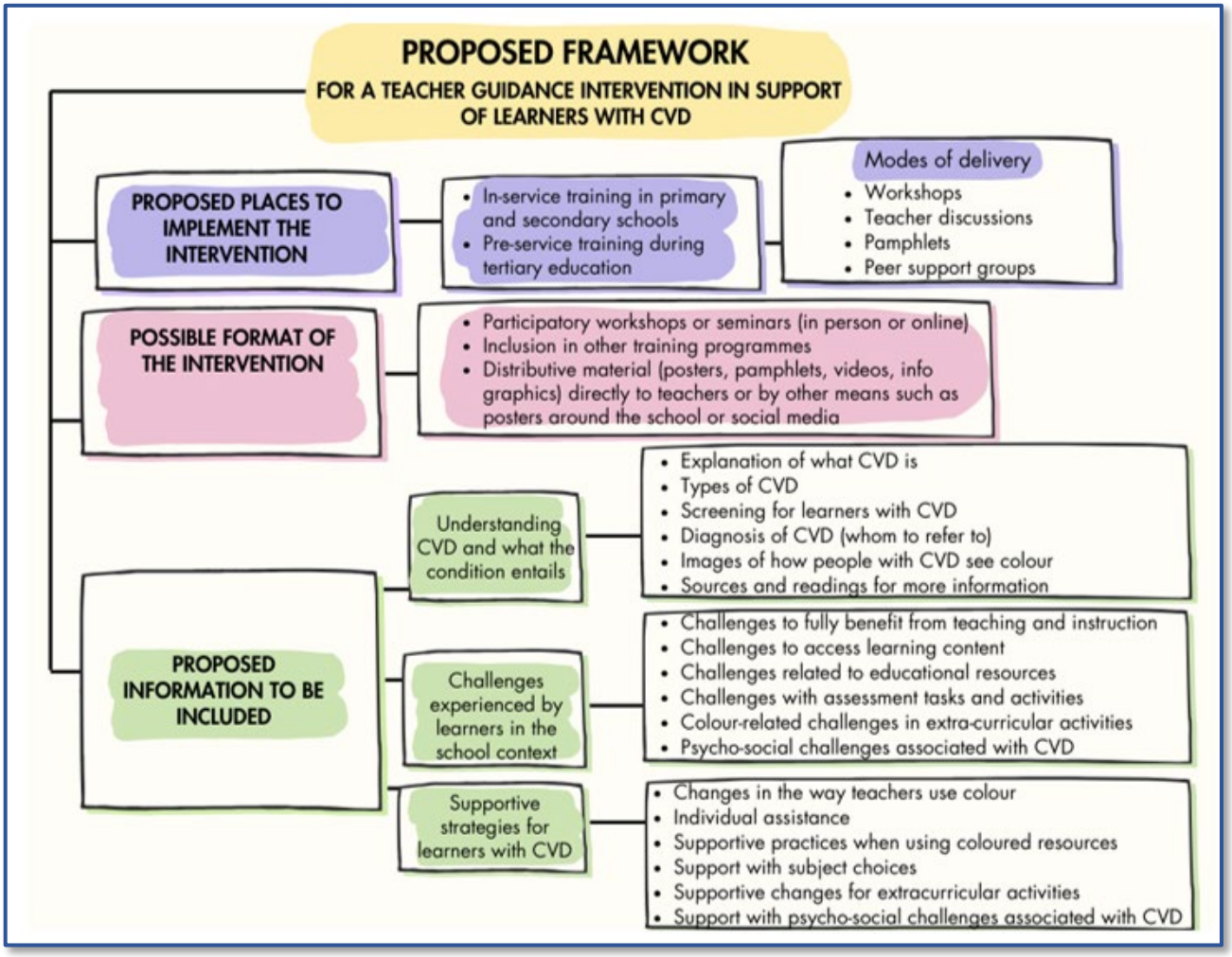
**Figure 6.1:**

*Proposed framework for a teacher guidance intervention in support of learners with CVD*




The proposed teacher guidance intervention includes three recommended focus areas for discussion. The first area of focus concerns the understanding of CVD and what the condition entails. Here teachers can be provided with information on how CVD affects visual ability as well as the types and severity of CVD, with this content being supported by visual images of how people with different types of CVD may perceive an image in comparison with people with normal vision. Teachers can furthermore be provided with information on the prevalence of CVD and what this implies in terms of the presence of learners with CVD in the classroom context. Next, the causes of CVD can be explained and teachers can be provided with information on how to screen for CVD and whom to refer learners to in their area when any learners experience challenges with colour differentiation. It is recommended that teachers be provided with reputable sources on CVD and what these entail when discussing this topic with them, so that they are able to continue reading up on the condition and refresh their memory when encountering a learner with a specific type of CVD.



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Teachers who are informed of CVD and what the condition entails may be more observant of learners who experience challenges with colour differentiation. This may, in turn, contribute to teachers' ability to identify learners with CVD who may themselves be unaware of their condition, thereby contributing to the increased support of these learners. Based on the findings of my study, I argue for increased teacher awareness of CVD as prerequisite for sufficient support provision to learners with CVD within the school context.

Another topic that can be included in a teacher guidance intervention on supporting learners with CVD relates to teachers being educated on the possible challenges that learners with CVD may experience to gain the necessary background knowledge when planning their support provision to such learners. When discussing this topic, teachers can be encouraged to reflect on their own use of colour during teaching and classroom instruction, the use of colour in textbooks and teaching media, and the use of colour when utilising technology in class. Participating teachers can be provided with pictures of how learners with CVD may see learning content where colour is used (similar to the pictures included in Section 2.4.3.5) to demonstrate the possible impact of the use of colour in school on learners with CVD. In this regard, the various school-related challenges that learners with CVD may face, as found in my study, may be shared with teachers when discussing this topic. In the same way, information on the challenges that learners with CVD may face during extra-curricular activities such as sport and culture events can be included in the teacher guidance intervention. In this section, teachers can once again reflect on the use of colour during extra-curricular activities and how this may impact learners with CVD.

Next, the possible psycho-social impact of CVD can be discussed with teachers, explaining how learners with CVD may be misunderstood or marginalised due to their condition and how the challenges they face within the school context related to colour differentiation may affect them on a psycho-social level. An increased understanding of the challenges that learners with CVD may face can enhance teachers' willingness to offer support to these learners. In the same way, teachers who are well-informed may also be able to identify learners who experience such challenges that have not been formally diagnosed with CVD and then refer them for a possible diagnosis.

Once teachers have gained insight into the challenges that learners with CVD may face they can reflect on possible supportive strategies that can be implemented to enable these learners to perform well. Supportive strategies that may address the challenges that learners with CVD experience can thus form the third main topic of the proposed teacher guidance



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intervention. In this regard, teachers can be provided with supportive strategies for teaching and classroom instruction, such as the incorporation of shapes, different fonts and numbers instead of or with colour to explain or highlight differences. Teachers can also be encouraged to reflect on the use of colour in the specific subjects they teach and on how they can adapt their teaching practices and teaching media in support of learners with CVD. Furthermore, teachers can reflect on how information on the use of colour in their specific subjects may impact learners with CVD and subsequently provide information that may assist learners with CVD when, for example, making subject choices.

In addition, teachers can be provided with information on supportive strategies for extra-curricular activities such as sport. Other supportive strategies that can be discussed as part of the proposed teacher guidance intervention include strategies on how to support learners with CVD with the psycho-social challenges they face. By making teachers aware of possible strategies to support learners within the school context, they may feel empowered to provide support to these learners. Teachers may, in turn, share this knowledge with other role players within and outside the school context and with the loved ones of learners with CVD, which may enhance the overall support offered to learners with CVD.

The proposed teacher guidance intervention can be implemented in primary and secondary schools with in-service teachers during workshops as part of teacher discussions or teacher forums, or as part of peer support group sessions. In a similar way, the proposed teacher guidance intervention can be implemented during tertiary education with pre-service teachers as part of their training programmes. The proposed intervention can be presented in various formats that include both in-person and online modes of delivery, for example, through workshops or seminars, as part of formal training programmes offered at tertiary institutions, or through distributive material in the form of posters, pamphlets, videos or info graphics that can be distributed to schools or *via* social media platforms.

## 6.6 CONTRIBUTIONS OF THE STUDY

In this section I reflect on the potential contribution of my study, specifically related to the theoretical and practical contributions.

### 6.6.1 Theoretical contribution

Although ongoing contributions are made to existing theory on inclusion within the school context, limited research has been conducted on how to include and accommodate learners with CVD. The findings of my study add insight to this field of knowledge as it sheds light on



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teachers' awareness and understanding of CVD, to what extent these learners are considered during teaching and instruction, and which guidance teachers would like to receive on how to include and support these learners.

The findings of the current study highlight how colour is used within the school context, not only during teaching and classroom instruction but also in school resources and during extra-curricular activities. Insight into teachers' reasons for using colour emphasises the perceived benefits and usefulness of colour in the teaching profession. In addition to the knowledge of how most teachers use colour during teaching and instruction activities, the findings foreground the potential impact of such use of colour on learners with CVD.

To be more specific, the findings of the current study contribute to the body of knowledge on how learners with CVD are impacted on various levels that may require support. In addition, insight was gained into ways in which teachers may realise that learners are struggling with colour differentiation and how teachers can assist in identifying learners with CVD. Some insight was also gained in terms of teachers' experiences of learners with CVD, and how teaching and instruction practices can be adapted in support of learners with CVD.

These findings build on existing theory related to a universal design for teaching. The teacher-participants provided practical examples to accommodate learners with CVD by adjusting teaching and learning practices so that all learners (including those with CVD) can benefit. In this way the findings of my study contribute to the broader body of knowledge on inclusive education, shedding light on how learners with barriers to learning, specifically those with CVD, are currently considered and supported. In addition, it provides insight in terms of the need for additional teacher training and a raised awareness of CVD and the associated special needs of such learners.

Based on the findings I obtained, I conceptualised a teacher guidance intervention that may be developed and implemented in future. This proposed framework can guide teachers to support learners with CVD, thereby contributing to available knowledge on possible strategies to enhance inclusion within the school context and more specifically support and accommodate learners with CVD in mainstream schools. Should this teacher guidance intervention be developed and implemented in future it has the potential not only to offer guidance to teachers within the profession but also for those currently enrolled for pre-service training programmes.



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### 6.6.2 Contribution to practice

During the sampling and data collection/generation process I engaged in informal conversations with the respondents/participants. These conversations as well as formal data collection/generation activities focused mostly on CVD, specifically within the school context, which is the context where the participants work. In this way, the conversations and activities of this nature may have increased an awareness of the condition amongst the respondents/participants, with the possibility of them sharing their personal experiences with other teachers in the profession following their involvement in my research. In addition, the teachers may have gained knowledge on practical ways of supporting learners with CVD that they can apply in practice. As some of the participants explained how they became aware of learners with CVD, other teachers may also have benefitted from such contributions on the identification of learners with CVD.

In addition, the mere completion of the questionnaire may have increased the teacher-respondents' awareness of CVD, in addition to them benefitting from their reflections on their own use of colour. This may have sensitised the respondents to be more accommodating in class and to consider the possibility of learners with CVD when planning and presenting their lessons. Current and future learners with CVD may have benefitted in this way.

By reaching out to principals, school governing bodies and administrative staff at schools to obtain permission to conduct my research in schools, an increased awareness of CVD by people other than teachers may also have been supported. As the sampling and data collection/generation may have facilitated conversations on the topic with people outside the teaching sector, an increased awareness of the condition and its effect is therefore possible.

## 6.7 REFLECTING ON POTENTIAL LIMITATIONS AND CHALLENGES EXPERIENCED DURING THE STUDY

Although the sample of the present study was large enough to allow for statistical inferences, it was not diverse enough to represent the larger population of South Africa. All schools that participated were from resourced, urban areas, which limits the generalisation of the findings across different school contexts.

Secondly, the school climate caused by COVID-19 and the associated restrictions posed a number of challenges. Several school governing bodies and principals were, for example, not willing to provide me with permission to conduct research at their schools as they noted that the staff members were under stress because of COVID-19 and that they did not want



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to add to this by creating additional work for the teachers. This negatively affected the number of schools that were initially willing to participate in my study. In addition, due to not being allowed on site, my observations and field notes were limited. I could, for example, not observe the use of colour on the school premises, in classrooms, or on sports fields and had to rely on the accounts of the respondents/participants in this regard. I was further not able to observe the participants' body language and facial expressions during the semi-structured interviews I facilitated.

In addition, due to contact limitations, I had to revisit and adapt my initially proposed methods of data collection/generation. Even though I had planned to collect data through an online questionnaire, I encountered a poor response rate to the online questionnaire and subsequently had to distribute hard copies of the questionnaire to schools in an attempt to address this challenge. Furthermore, only a few of the respondents from the first phase of my study were willing to participate in the second phase, resulting in me having to actively recruit additional participants to conduct semi-structured interviews with.

Due to the inclusion of some telephonic interviews, I could not rely on observation as a data generation and triangulation method in a few cases. With these participants, I primarily had to rely on follow-up questions and probing to ensure a clear understanding of what the participants shared with me.

## 6.8 RECOMMENDATIONS

Based on the findings and conclusions of my study, I formulate recommendations for training, practice and future research in this section.

### 6.8.1 Recommendations for training

Based on the findings and conclusions of my study, I recommend that the conceptualised teacher guidance intervention be refined, developed and implemented with teachers in the profession. In addition, the content can be included in teacher training programmes of pre-service teachers. The findings of the current study on the challenges that learners with CVD may experience within the school context and on possible ways to support them can thus be included in both pre- and in-service teacher training initiatives. Training opportunities for in-service teachers such as professional development programmes required by SACE may include such information to assist teachers that are currently in the profession to support learners with CVD in their classes. In-service training can, for example, be offered during



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workshops as part of teacher discussions where teachers share their personal experiences with peers or information can be distributed in the form of written material.

In addition, the training programmes of other professions where people work with child and adolescent development or where people work in helping professions may be enriched through information on CVD and the challenges typically faced by learners with the condition. For example, understanding CVD and its associated challenges can be beneficial for school counsellors and educational psychologists. Based on the challenges that learners with CVD may experience with certain subjects and potentially in certain future careers where colour plays an important role, professionals who are knowledgeable can support these children with subject choices and career choices, thereby better preparing them for the future.

As the findings of the current study also shed light on the use of colour and possible associated challenges that learners with CVD may experience during extra-curricular activities, physical education teachers, sport coaches, cultural events organisers and other health care professionals who work with sport rehabilitation or cultural activities may benefit from receiving information on how to include and accommodate learners with CVD who participate in extra-curricular activities. Alternative ways of coaching may, for example, increase participation in sport and assist learners with CVD to perform according to their potential.

Basic information on CVD, together with information on how to screen for CVD, can furthermore be provided to people in the health profession who do health screenings at schools. Optometrists, ophthalmologists and other health professionals who work with children may similarly benefit from information on how to support learners with CVD and how to guide parents and teachers in supporting these learners. In the same way, learning support teachers, occupational therapists and other specialists working with children may benefit from obtaining this information as it can provide insight into the possible challenges that children with CVD may experience and ways to address these. When being trained in this field, specialists who provide professional support to children may be better equipped to support learners with CVD.

### 6.8.2 Recommendations for practice

Based on the findings of my study, I recommend the development and implementation of targeted interventions in support of learners with CVD. One such an intervention can take



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the form of a teacher guidance intervention in support of learners with CVD, as discussed in Section 6.5.

To be more specific, officials from the Department of Education, educational psychologists and experienced teachers can facilitate and promote the inclusion and accommodation of learners with CVD by facilitating such interventions. Accommodations that are already implemented can also be incorporated in the accommodation policy of the Department of Education and subsequently implemented in schools. In the same way, school policies that address the specific challenges that learners with CVD may face together with possible ways to identify these learners at school level can be implemented in schools on a broader level. In this regard, I recommend that school-based support teams and the Department of Education create platforms for the accommodation and facilitation of targeted support structures for learners with CVD. Such school-based support initiatives can provide an avenue of continuous professional development for teachers, thereby promoting inclusive education.

### 6.8.3 Recommendations for future research

Based on the findings of my study, the following focus areas are recommended for follow-up research in the field of CVD:

- A comparative study on teachers' perceptions of CVD and the extent to which it is taken into consideration during instruction, specifically involving teachers from rural areas.
- A comparative study on teachers' perceptions of CVD and the extent to which it is taken into consideration during the preschool phase.
- An intervention study on the effect of a teacher guidance intervention in support of learners with CVD.
- A descriptive study on identifying learners with CVD at a young age.
- An exploratory study involving learners with CVD on how they experience teaching and instruction in the school context and how it influences them.
- A follow-up explanatory study on the impact of the use of colour in teaching media and resources on learners with CVD.
- A follow-up explanatory study on the impact of the use of colour in different subjects on learners with CVD.
- An exploratory study on the use of assitive devices in support of learners with CVD in the school context.



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- An explanatory study on the impact of the use of technology in the classroom on learners with CVD.
- A follow-up exploratory study on the impact of CVD on children's emotional functioning.
- A follow-up exploratory study with secondary school and university students with CVD on the challenges they experience in the various domains of functioning.
- An intervention study on the effect of developed screening and identification instruments for learners with CVD.
- An intervention study on support provision to learners with CVD for subject and future career choices.
- A comparartive study on teachers' levels of understanding of CVD and the level of support offered to these learners in the classroom.

## 6.9 CONCLUDING REMARKS

In this study, I aimed to explore and describe teachers' current understanding of CVD and what the condition entails, as well as the extent to which CVD is taken into consideration during classroom instruction. The findings of my study highlight the wide use of colour in the school context, teachers' limited understanding of what CVD entails and of the challenges that learners with CVD may experience in the school context, and possible ways to support learners with CVD. Based on the findings of the study I conceptualised a teacher guidance intervention that can be developed and implemented in support of learners with CVD.

The findings of my study indicate that learners with CVD may not only experience scholastic challenges associated with CVD, but also be challenged when wanting to participate in extra-curricular activities, along with psycho-social challenges as a result of their condition. The findings of my study indicate that when teachers are aware of learners with CVD in their classes they tend to make changes to accommodate and support these learners during teaching and instruction, yet that they are not always aware of such learners. Hence, a teacher guidance intervention that may foster a better understanding of CVD and provide teachers with possible ways of identifying learners with CVD and with practical ways of supporting these learners may lead to increased accommodation of learners with barriers to learning and specifically those with CVD. A teacher guidance intervention in support of learners with CVD can thus not only support individual learners with CVD but may also form part of a global movement towards more inclusive schools, where those who experience barriers to learning are less marginalised. I conclude with a related reflection provided by



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The Color Blind Organization (n.d.) that summarises this view as follows:

> *One of the very first things we teach young children are the colors of the world around them. They learn that grass is green, and the sky is blue, but what if the colors we see and describe are not the same for all of the children we are teaching?* (Color blind organization, n.d.).

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# APPENDIX A – PERMISSION TO CONDUCT RESEARCH

## Appendix A1– University of Pretoria ethics approval

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Education

Ethics Committee

26 February 2021

Mrs H Gevers

Dear Mrs H Gevers

**REFERENCE: EDU208/20**

We received proof that you have met the conditions outlined. Your application is thus **approved**, and you may start with your fieldwork. The decision covers the entire research process, until completion of the study report, and not only the days that data will be collected. The approval is valid for two years for a Masters and three for Doctorate.

The approval by the Ethics Committee is subject to the following conditions being met:

1. The research will be conducted as stipulated on the application form submitted to the Ethics Committee with the supporting documents.
2. Proof of how you adhered to the Department of Basic Education (DBE) policy for research must be submitted where relevant.
3. In the event that the research protocol changed for whatever reason the Ethics Committee must be notified thereof by submitting an amendment to the application (Section E), together with all the supporting documentation that will be used for data collection namely; questionnaires, interview schedules and observation schedules, for further approval before data can be collected. Non-compliance implies that the Committee's approval is null and void. The changes may include the following but are not limited to:
    - Change of investigator,
    - Research methods any other aspect therefore and,
    - Participants.

The Ethics Committee of the Faculty of Education does not accept any liability for research misconduct, of whatsoever nature, committed by the researcher(s) in the implementation of the approved protocol.

Upon completion of your research you will need to submit the following documentations to the Ethics Committee for your

Clearance Certificate:

- Integrated Declaration Form (Form D08),
- Initial Ethics Approval letter and,
- Approval of Title.

Please quote the reference number EDU208/20 in any communication with the Ethics Committee.

Best wishes

---

Prof Funke Omidire
Chair: Ethics Committee
Faculty of Education

Room 3-63, Level 3, Aldoel Building
University of Pretoria, Private Bag X20
Hatfield 0028, South Africa
Tel +27 (0)12 420 5656
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Faculty of Education
Fakulteit Opvoedkunde
Lefapha la Thuto



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# Appendix A2 – GDE approval

**GAUTENG PROVINCE**
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

**GDE RESEARCH APPROVAL LETTER**

| | |
|---|---|
| **Date:** | 03 May 2021 |
| **Validity of Research Approval:** | 08 February 2021– 30 September 2021<br>2021/110 |
| **Name of Researcher:** | Gevers H |
| **Address of Researcher:** | Boomvaring street |
| | 24 Ingwe Complex |
| | Glen Marais |
| **Telephone Number:** | 066 340 6727 |
| **Email address:** | heloisegevers@gmail.com |
| **Research Topic:** | The effect of the development, implementation and outcome of a teacher-based intervention addressing colour vision deficiency. |
| **Type of qualification** | PhD (Educational Psychology) |
| **Number and type of schools:** | 6 Primary Schools and 6 Secondary Schools |
| **District/s/HO** | Ekurhuleni North and Ekurhuleni South |

## *Re: Approval in Respect of Request to Conduct Research*

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

03/05/2021

**The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:**

1. *Letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*

1



**Office of the Director: Education Research and Knowledge Management**
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za



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2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. ***Because of COVID 19 pandemic researchers can ONLY collect data online, telephonically or may make arrangements for Zoom with the school Principal. Requests for such arrangements should be submitted to the GDE Education Research and Knowledge Management directorate. The approval letter will then indicate the type of arrangements that have been made with the school.***
4. ***The Researchers are advised to make arrangements with the schools via Fax, email or telephonically with the Principal.***
5. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
6. *A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
7. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
8. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
9. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
10. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
11. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
12. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
13. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
14. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
15. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
16. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....
Mr Gumani Mukatuni
Acting CES: Education Research and Knowledge Management

DATE: 03/05/2021





**Office of the Director: Education Research and Knowledge Management**
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# Appendix A3 – Permission from School Principal

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**PERMISSION LETTER TO PRINCIPAL OF SCHOOL**

**Phase 2 of the research**

Dear Sir/madam

**RE: REQUEST FOR PERMISSION TO DO RESEARCH IN YOUR SCHOOL**

I hereby apply for permission to conduct research in your school. I am a doctoral student at the University of Pretoria, Department of Educational Psychology. The research project will involve teachers in your school. My research topic is **"The effect of the development, implementation and outcome of a teacher-based intervention addressing colour vision deficiency."**

This research will involve completing an online questionnaire, as well as workshops with educators in your school after school hours. The questionnaire will explore the use of colour within the school context, teachers' disposition towards colour vision deficiency (CVD) and how learners with CVD can be supported within the school context. The workshop will explore the development, implementation and outcome of a teacher-based intervention in support of learners with CVD.

The information obtained will be treated with the strictest confidentiality and will be used solely for the purpose of this research. Anonymity of participants and the school will be maintained. Participants may also withdraw from participation at any time during the research process. I would also like to request your permission to use the data confidentially and anonymously, for further research purposes, as the data sets are the intellectual property of the University of Pretoria. Further research may include secondary data analysis and using the data for teaching purposes. The confidentiality and privacyl applicable to this study will be binding on future research studies.

The research findings can potentially make a credible contribution in assisting teachers to understand how colour is currently used in the classroom. Thus, I firstly aim to gain insight into the potential barriers to learning which learners with CVD may experience within the school context with regards to instruction and resources. Secondly, I aim to develop, implement and evaluate the outcome of a teacher-based intervention addressing CVD. By following how colour is presently used within the classroom, insight may potentially be obtained on possible barriers to learning which learners with CVD experience within the school context. Lastly, by developing, implementing and analysing the outcome of a teacher-based intervention in support of learners with CVD, learners with CVD may potentially experience equal learning opportunities and inclusive education may be enhanced.

Yours Sincerely

Heloise Gevers
(Researcher)
Email: heloisegevers@gmail.com

Prof Ronél Ferreira
(Supervisor)
Email: ronel.ferreira@up.ac.za



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# APPENDIX B – DATA COLLECTION/GENERATION INSTRUMENTS (WITH INFORMED CONSENT)

## Appendix B1 – Questionnaire (Respondent consent form at front)

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Dear Teacher**

I am a doctoral student at the University of Pretoria, currently conducting research on the potential barriers to learning that learners with colour vision deficiency (often referred to as "colour blindness") may experience within the school context with regards to teaching and educational resources. As a second phase of my study, I aim to conceptualise a teacher guidance intervention addressing the needs of such learners.

**Reason for the study**

I am exploring how colour is currently used within the school context, teachers' views colour vision deficiency and how learners with colour vision deficiency may be supported within the school context.

**Who can take part in this study?**

Teachers working in public schools in Ekurhuleni, Gauteng.

**What will you be asked to do if you take part in this study?**

If you agree to participate in this study, you will be asked to complete an online questionnaire, that takes about 20 minutes to complete. Your participation is voluntary and you may discontinue participation at any time, without being penalised in any way.

**Are there any benefits for you if you choose to take part in this study?**

It may enhance your awareness of colour vision deficiency and how to support learners with this condition.

**What about any potential risks?**

No risks are foreseen, however, should a participant experience any emotional discomfort, she/he will be referred for professional support.

**How will information about you be kept confidential?**

All efforts will be made to keep your personal information confidential. Data collected during the study will be stored at the University of Pretoria in a safe place. Only I as primary investigator and my supervisor will have access to the raw data. Participant personal information will be assigned with codes during the analysis and reporting process, and identifiable information will be password protected. No information regarding any participant or school will be disclosed, and the results will be used for research and publication purposes only.

**THE USE OF DATA FOR FUTURE FOLLOW UP STUDIES**

I would also like to request your permission to use your data, confidentially and anonymously, for future research purposes, as the data sets are the intellectual property of the University of Pretoria. Further research may include secondary data analysis and using the data for teaching purposes. The confidentiality applicable to this study will be binding on future research studies.



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**AGREEMENT TO PARTICIPATE**

I have read this form, or it has been read to me, and I understand what has been discussed.

- ☐ Yes
- ☐ No

**Please complete the following questionnaire by ticking the relevant boxes.**

| Demographical information |
|---|
| **1. Gender**<br>☐ *Male*<br>☐ *Female*<br>☐ *Prefer not to say* |
| **2. Where do you teach?**<br>☐ *Primary school*<br>☐ *High school* |
| **3. What grades do you teach?** |
| **4. What is the first subject that you teach?**<br>☐ *Elementary phase (Gr R to 3)*<br>☐ *Languages*<br>☐ *Mathematics*<br>☐ *Science (Natural science/ life science/ physical science)*<br>☐ *Geography or social studies*<br>☐ *History*<br>☐ *Art (art, design, creative art)*<br>☐ *Life orientation*<br>☐ *Economic Managements Studies (EMS, Business studies, accounting, economics)*<br>☐ *Technology (Engineering graphics and design, civil technology)*<br>☐ *Other. Please specify.* |
| **5. What is the second subject that you teach?**<br>☐ *Elementary phase (Gr R to 3)*<br>☐ *Languages*<br>☐ *Mathematics*<br>☐ *Science (Natural science/ life science/ physical science)*<br>☐ *Geography or social studies*<br>☐ *History*<br>☐ *Art (art, design, creative art)*<br>☐ *Life orientation*<br>☐ *Economic Managements Studies (EMS, Business studies, accounting, economics)*<br>☐ *Technology (Engineering graphics and design, civil technology)*<br>☐ *Other. Please specify.* |
| **6. What is the third subject that you teach?**<br>☐ *Elementary phase (Gr R to 3)*<br>☐ *Languages*<br>☐ *Mathematics*<br>☐ *Science (Natural science/ life science/ physical science)*<br>☐ *Geography or social studies* |



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☐ *History*
☐ *Art (art, design, creative art)*
☐ *Life orientation*
☐ *Economic Managements Studies (EMS, Business studies, accounting, economics)*
☐ *Technology (Engineering graphics and design, civil technology)*
☐ *Other. Please specify.*

**7. How many years have you been a teacher?**

**8. Do you have colour vision deficiency?**
☐ *Yes*
☐ *No*
☐ *Not Sure*

*9. If yes, how has this impacted your life?*_____

**Colour in the school**

**10. Colour is often used on notice boards and signs around our school.**
☐ *Strongly agree*
☐ *Agree*
☐ *Not sure*
☐ *Disagree*
☐ *Strongly disagree*

**11. Colour is used in extracurricular activities.**
☐ *Strongly agree*
☐ *Agree*
☐ *Not sure*
☐ *Disagree*
☐ *Strongly disagree*

**12. During sport activities, teams wear different colour clothing to identify teams members.**
☐ *Yes*
☐ *No*
☐ *Not sure*

**Example of sports where this is done:**

**13. I generally make use of colour when coaching extracurricular activities.**
☐ *Strongly agree*
☐ *Agree*
☐ *Not sure*
☐ *Disagree*
☐ *Strongly disagree*

**The use of colour in the classroom**

**14. Are there any learners in your class that confuse colour or coloured objects?**
☐ *Yes*
☐ *No*
☐ *Unsure*

*14.b If yes, please specify*_____



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**15. For which of the following activities do you use colour in class?**

- ☐ *Writing on the board*
- ☐ *Power point*
- ☐ *Class activities*
- ☐ *Homework*
- ☐ *Instruction*
- ☐ *Other* (please specify)

**16. A How often do you use colour in the classroom?**

- ☐ *Daily*
- ☐ *Weekly*
- ☐ *Monthly*
- ☐ *Less than monthly*

**16. B How often do you make use of colour during instruction and teaching? (for example by giving instructions such as "look at the red block" or "use a green pencil")**

- ☐ *Daily*
- ☐ *Weekly*
- ☐ *Monthly*
- ☐ *Less than monthly*

**17. Which colour/s do you often use in the classroom? (Please mark all that apply)**

- ☐ *Black only*
- ☐ *Blue*
- ☐ *Red*
- ☐ *Yellow*
- ☐ *Green*
- ☐ *Purple*
- ☐ *Other (please specify)*

**18. How are colours used in the prescribed textbooks of the subject/s you teach?**

- ☐ *Only black and shades of grey are used*
- ☐ *Black and colours are used in the text and images*
- ☐ *Only some images include colour*
- ☐ *Other (please specify)*

**Please respond to the following questions by indicating your view.**

**19. The resources that I use, such as books, posters and worksheets, generally contain colour.**

- ☐ *Strongly agree*
- ☐ *Agree*
- ☐ *Not sure*
- ☐ *Disagree*
- ☐ *Strongly disagree*

**20. I use colour for structure and organisation in my classroom.**

- ☐ *Strongly agree*
- ☐ *Agree*
- ☐ *Not sure*
- ☐ *Disagree*



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| |
|---|
| ☐ *Strongly disagree* |
| **21. I often use colour to code information.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **22. I generally use colour when presenting content via the smartboard, Chromebooks, on computer via power point presentations, etc.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree*<br>☐ *I do not use a smartboard or computer for instruction in class* |
| **23. The majority of the paintings/images/posters on the walls in my classroom are colourful.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **24. I generally use different colours of chalk or white board markers when writing on the board.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **25. The majority of the manipulatives, blocks, puzzles and other objects that learners use in my classroom are colourful.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree*<br>☐ *Not applicable to the subject/s I teach* |
| **26. The images I use to explain important concepts often contain colour.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **Colour and learning** |
| **27. Colour plays an important role in learning.**<br>☐ *Strongly agree*<br>☐ *Agree* |



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| |
|---|
| ☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **28. Colour is valuable when wanting to highlight important concepts or work.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **29. Good performance in school can be linked to the ability to differentiate between different colours.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **30. I use colour to explain differences between objects/concepts in my classroom.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **31. I often use colourful pictures and/or worksheets to make the work more interesting.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **Colour and the use of technology in the classroom** |
| **32. How has the use of technology changed the way that you use colour in the classroom?**<br>☐ *No difference*<br>☐ *Decrease my use of colour*<br>☐ *Increased my use of colour (e.g. PowerPoints, movies, colour printing, YouTube videos)* |
| **33. For which of the following do you use technology in the classroom (mark all that apply)?**<br>☐ *PowerPoint presentations*<br>☐ *Colour images*<br>☐ *YouTube videos*<br>☐ *Smartboard*<br>☐ *Movies*<br>☐ *Other (please specify)* |
| **34. When choosing colours for PowerPoint presentations I consider the challenges that some learners may experience in seeing different colours.** |



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| |
|---|
| ☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **35. When choosing images and/or YouTube videos I consider the challenges that some learners may experience in seeing different colours.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **Inclusive education** |
| **49. I am aware of the different needs of learners in my classroom and take this into consideration when planning and presenting lessons.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **50. I have received sufficient training on how to accommodate and support learners with barriers to learning as part of my teacher training programme/s.**<br>☐ *Yes*<br>☐ *To an extent*<br>☐ *Not sufficient*<br>☐ *I was not trained in this field* |
| **51. I have attended additional training opportunities on how to accommodate and support learners with barriers to learning in my classroom.**<br>☐ *Yes*<br>☐ *No* |
| **52. I use a variety of teaching methods and assessments to give all learners in my classroom equal opportunities, despite their learning preferences and abilities.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **53. I am able to identify learners that experience barriers to learning.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **54. I know who to refer to when I suspect that a learner experiences barriers to learning or may need additional assessment opportunities or intervention.**<br>☐ *Yes*<br>☐ *No* |



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| |
|---|
| ☐ *Not sure* |
| **55. I believe that learners with mild disabilities or who experience learning challenges should be accommodated in mainstream schools.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **56. I create a classroom environment that takes into consideration the diverse needs of all the learners in my class.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **57. Accommodations (concessions) for learners with barriers to learning are applied during tests and examinations in my subject/s.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **58. I have received training on how to implement the SIAS (Screening, Identification, Assessment and Support) policy in my classroom.**<br>☐ *Yes*<br>☐ *To an extent*<br>☐ *Not sure*<br>☐ *No* |
| **59. The SIAS policy considers the needs of learners with colour vision deficiency.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **60. I receive information, feedback and guidance from the School-based support team (SBST) regarding the learners with barriers to learning that I teach.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **Experience of learners with colour vision deficiency** |
| **63. How do you understand the condition of colour vision deficiency?** |
| **64. Have you ever taught learners with colour vision deficiency?**<br>☐ *Yes* |



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☐ *No*
☐ *Unsure*

**If yes, please respond to the following questions, OR proceed to the next question:**

1. How many learners with this condition have you taught?_____
2. How did colour vision deficiency affect these learners' learning?

   _____

3. How did you become aware of the condition of this/these learner/s?

☐ *Through observation*
☐ *Informed by the learner*
☐ *Informed by the parent*
☐ *Informed by another teacher*
☐ *Other (please specify)*

4. Were the learner/s you taught ever singled out due to being colour vision deficient?

☐ *Yes*
☐ *No*
☐ *Unsure*

*If yes please specify*_____

5. In your opinion, will colour vision deficiency have an effect on a learner's emotional functioning?

☐ *Yes*
☐ *No*
☐ *Unsure*

*If yes please specify*_____

6. In your opinion, will colour vision deficiency have an effect on a learner's social functioning?

☐ *Yes*
☐ *No*
☐ *Unsure*

*If yes please specify*_____

7. In your opinion, will colour vision deficiency have an effect on a learner's scholastic performance?

☐ *Yes*
☐ *No*
☐ *Unsure*

*If yes please specify*_____

**68. I received sufficient training to effectively address the needs of learners with colour vision deficiency in class.**

☐ *Strongly agree*
☐ *Agree*
☐ *Not sure*
☐ *Disagree*
☐ *Strongly disagree*

**69. In my view, learners with colour vision deficiency are at a disadvantage in the classroom.**

☐ *Strongly agree*



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| ☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **70. Learners with colour vision deficiency are supported in the school where I teach.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **71. Tests and assessments are adjusted in the case of learners with colour vision deficiency in the school where I teach.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **72. Learners who are colour vision deficient may be labelled as slow learners in subjects or grades where colour plays a role.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **73. It remains the responsibility of the learners who are colour vision deficient to adjust to school, as teachers cannot be expected to cater for their specific needs.**<br>☐ *Strongly agree*<br>☐ *Agree*<br>☐ *Not sure*<br>☐ *Disagree*<br>☐ *Strongly disagree* |
| **75. How do you think the use of colour in your specific subject may negatively affect learners with colour vision deficiency?** |
| **76. Learners in the foundation phase who confuse colours are screened to determine the reason for their confusion.**<br>☐ *Yes*<br>☐ *No*<br>☐ *Unsure* |
| **77. Learners who are colour vision deficient receive support when choosing subjects in the school where I teach.**<br>☐ *Yes*<br>☐ *No*<br>☐ *Not sure* |
| **78. Learners who are colour vision deficient are guided in terms of future career choices.** |



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|---|
| ☐ *Yes*<br>☐ *No*<br>☐ *Not sure* |
| Thank you very much for your participation in Phase 1 of my study. I appreciate your time and expertise. The second phase of this study involves interactive workshops, activities, and discussions with small groups of teachers. Should you be willing to participate in the second phase, please provide me with your email address.<br>_____ |

**Thank you once again for your participation.**



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# Appendix B2 – Interview guide

**Interview guide for semi-structured interviews**

**Interview questions**

1. What is your understanding of colour vision deficiency, often referred to as colour blindness?
2. Tell me about your experiences of teaching learners who are colour blind.
3. How do you use colour when teaching and also when involved in after-school activities?
4. How is colour used in the resources used for learning, such as textbooks and posters?
5. According to you, which challenges are faced by learners who are colour blind within the school context?
6. How can schools accommodate learners who are colour blind within the school system? Please provide me with practical examples or suggestions.
7. How can teachers be supported to better accommodate learners who are colour blind?



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# APPENDIX C – DATA ANALYSIS PROCEDURES

## Appendix C1 – Transcribed recordings of interviews

### Transcribed interviews with codes:

### Interview 1 (Participant 1 and 2)



| | | |
|---|---|---|
| 3 | Interviewer | Good afternoon. Thank you so much for joining me today. I really appreciate it |
| 5 | Participant 1 | Good afternoon. |
| 6 | Participant 2 | Good afternoon. |
| 9 | Interviewer | I just have a few questions for you regarding the use of colour in schools and in your school specifically and your own experiences. I would appreciate your input. And and to be as honest as possible telling me how you experience it. Thank you for your willingness to participate. I really appreciate it. Uhm, I think just to make things easier if we can take turns answering uhm that would be great. And then if you want to add something before I go to the next question you're more than welcome to. So my first question to you today is to describe your current awareness of colour-blindness. |
| 10 | Participant 2 | Okay so I am currently aware of colour-blindness. I have experienced one of my students being colour-blind in one of my math classes in high school that I taught before. So I have experienced colour-blindness from a students and am aware of colour-blindness. |
| 13 | Participant 1 | Me too, I'm aware of it in last year. A learner kept on asking me specifically not to write in orange uhm because she can't see that colour on the board. |
| 15 | Interviewer | Thank you. Will you please tell me about your experiences with these specific learners that you taught who were colour-blind? |
| 16 | Participant 1 | Can you please repeat the question? |
| 19 | Interviewer | Can you please tell me about your experiences teaching these learners who are colour-blind? |
| 20 | Participant 2 | The student that I taught he was not able to see the colour red. So when I marked his tests and everything I had to rewrite his scores and everything in a different colour so he'll actually be able to see his test scores to see where he made mistakes in tests. As well as when doing examples on the board I could not use the colour red as he could not see it as sort of colour used to basically share different concepts on the board as well. So that's my experience with a student having colour-blindness. |
| 23 | Interviewer | Sjoe, that's very interesting. So you saying you had to mark his tests in a different colour? That is so interesting. How did you become aware of it? Did he tell you or did you pick it up? |
| 26 | Participant 2 | Uhm, he actually told me and I think like it was a bit awkward for him in class because all the students were like ah he doesn't know. And I think because of the way they reacted as well, he had like a no care uhm attitude towards it. But he was the one who told me there were no other teachers or anybody else that made me aware of it. So he told me teacher I cannot see this colour. What is my test score? And I was like what? Then I had to implement the changes so that he can actually see. |
| 28 | Interviewer | Oh, wow, that is so interesting. Tell me uhm, you said the other children reacted in a certain way, how did they react? |
| 29 | Participant 2 | It was more of like a teasing manner as some people they do not understand of not being able to see a different colour. So when he was like he cannot see his test scores all the other students wanted to see his test score and one of the other students test score, which kind of led to all of his test scores. And that kind of sometimes leads to teasing from the other students. Some students do understand but others they don't, there not actually quite aware of colour-blindness. So they receive the teasing manner. |
| 30 | Interviewer | Thank you for sharing this. I appreciate it. Uhm Participant 1 if you will share with us your experience. |
| 33 | Participant 1 | Mine was a Grade 8 learner and she just couldn't see orange so after the one period after the beginning of the first lesson of the year. She actually came to me and she asked me at the end of the period to please not use orange when doing examples on the board that she could not see the colour. I don't think her friends were aware, but after after the period where nobody could hear her, she asked me politely. |
| 38 | Interviewer | So that's not something she did in front of everyone. She did it in private and only asked you. |
| 38 | Participant 1 | Yes, in private. |
| 39 | Interviewer | Okay and uhm when teaching her is it only on the board where you avoid using the colour orange or is it in other places as well? |
| 40 | Participant 1 | Uhm It was only I tried to to, obviously the posters that were already in my class I couldn't change, but I tried not to use use orange at all. |
| 43 | Interviewer | Wow. Okay. So next question, how is colour used in your school and in your classroom? |

1:2 I h... Working with learners who a...
1:5 I a... Awareness
1:3 I'm... Working with learners who a...
1:4 The student that I t... Working with learners who a...
1:6 The student tha... Working with learners who a...
1:7 he actually t... Awareness; Becoming aware of learners ...
1:8 I think... Emotional/ social impact
1:9 It was more of like a te... Awareness; Emotional/ social impact; Other learners awareness
1:10 a Grade... Awareness; Becoming aware of learners ...
1:11 I d... Emotional/ social impact; Other learners awareness
1:12 It... physical barriers in scholasti...



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| 45 | Participant 2 | Colour is used for basically to bring up ideas of certain concepts. For example, for math uhm you'll do a question and then I'll use different colours to explain different parts of the question and what parts that have to remember and the definitions of different concepts are in different colours as for them not to get confused with the original questions answered. So you'll have the original question, for example, in black and then I'll have in blue the definition of why we're doing a certain step or the definition of a word or something like that. Especially like in geometry or something like geometry were you use different colours for your different angles and your different sides. So that's also on the board when we use colour. And I also use colour in uhm doing slideshows on the board for them to like to do the start of a new or different concept or start a new chapter or start of a new unit. And then posters on in the classroom as well. As indicated previously the posters are in different colours as well. Colour is used quite generally everywhere in schools or in the school we were teaching at. |
| 48 | Participant 1 | Ja, then like participant 2 just said uhm highlighting the certain steps we would use colour or in the process previously mentioned. So it's really used everywhere all the time. |
| 49 | Interviewer | And tell me in school itself is colour often used in posters or communication around the school as well? |
| 50 | Participant 2 | Yes it is. |
| 52 | Participant 1 | Ja, in all the posters around the school you'd find the colours, different colours as it tends to draw attention to to the posters. |
| 55 | Interviewer | And in extra mural activities is colour involved there as well? |
| 56 | Participant 2 | Yes, in a way, so for example, when I was coaching hockey for the grade eights, you'll have different cones for different steps. So I'll say okay, to the red cones we'll be jogging and the cones next to it will be green cones that we're going to be running or sprinting. And then also for long distances you'll have different colour where we have to do different like the dynamic warm up. So we'll do high knees to this cone and to the blue cone, for example and then like high kicks to the red cone so it's just different cones will represent different exercises that they will have to do next. Or for example, in the hockey we had okay at the first cone we'll have to hit the ball and the next cone you'll have to set the ball. So it was just different colours do play a big role in sport and mural activities not just sports. |
| 59 | Interviewer | Thank you. |
| 60 | Participant 1 | Uhm I agree with everything Participant 2 said, but also like I mentioned sometimes especially with the astro we have at school now they'll make the ball a bright green colour, it's a bright colour because it's easier to be seen on the field. And I think for learners with colour-blindness that could be difficult. |
| 62 | Interviewer | Mmm, especially if it's the colour they struggling to differentiate. I assume the school clothing for sports is also different colours for different teams or not? |
| 65 | Participant 1 | Oh the clothing as well yes. So everyone in your team would wear a certain colour. Even during practices when playing many games, all the learners from a certain team would wear uhm certain colour bib so that it's easy to identify who's in your team. |
| 68 | Interviewer | So colour is actually used all around to identify, to label, to organize. It's really used everywhere in school. |
| 69 | Participant 1 | Yes, everywhere. |
| 70 | Interviewer | So if I then have to ask you what challenges learners with colour-blindness face would you be able to elaborate on that? |
| 73 | Participant 2 | I think one of the biggest challenges is if you just look at the two students we've had is basically being bold enough to come out and say hey, I actually have this problem. I cannot see this colour. So for my student, he was kind of like, he's like friends, because they were not aware of it. So I think that's a very big step where they have to have a lot of courage to say, hey teacher I cannot see this colour and to kind of admit to having colour-blindness, it's, I think a very big step for them. |
| 75 | Participant 1 | Um, can I just ask you to repeat the question, I apologize. |
| 76 | Interviewer | No problem. I asked, what challenges do learners who are colour-blind face at your school. |
| 79 | Participant 1 | Like Participant 2 mentioned, it would be very difficult for them to just come forward and say that they have colour-blindness. So the teachers are aware so that they can work around that and accommodate them when necessary if possible. I feel in all high schools uhm teenagers tend to be quite cool. So as soon as learners find out about that they would tease them. |
| 80 | Interviewer | So both of you now highlighted that they face the the social and emotional challenges of the way other people react to them being excluded, being teased or laughed at. But then if you think about the scholastic side, what challenges would you think they face with regards to schoolwork and the scholastic side? |
| 83 | Participant 2 | I think they have to make sure that they are able to work in the, that like write in the colour they were able to see and to make sure that they can actually see their work properly. So if the teacher is doing art in colour, uhm busy, because a lot of kids they learn from using different colours and they, the colours help them to basically remember certain definitions. For someone that has colour-blindness the variety of colours are less sometimes or not as many. So they have a smaller variety of colours to work with, if when doing like examples or learning different concepts and theories |

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| 86 | Participant 1 | I think also uhm scholastically a problem would be in textbooks, but the math textbooks wouldn't be a problem because it's all just in black and white. But I know for the languages uhm a lot of the time the textbooks is in colour and some of the stuff would be in colour or even if you take science, the experiments that they do requires you to be able to identify certain colours. In experiments if the reactions took place or something like that. And that will be very difficult for them to identify if that is the colour they are having difficulty seeing. So I think in general and also if they never have the courage to go and tell the teacher or their educator that I can't see this colour or the teacher isn't accommodating of them then it can also be very difficult to see what the teacher is talking about if she is using the colour that they can't identify. | 1:24 scholastically a problem would be in t... Challenges for learners who... physical barriers in scholasti... |
| 88 | Interviewer | So in other words they they might miss information or miss an instruction or struggle to read and take in information if something is is in that colour that they are struggling to see. Do I understand you correctly? | |
| 89 | Participant 1 | Yes, that is what I'm trying to say. | |
| 90 | Interviewer | Tell me, in your first question you indicated that you teach EGD uhm is there colour used in this subjects and how does, what colour influence the child that is struggling to differentiate between colours? | |
| 92 | Participant 1 | Uhm, I don't know. In Civil they use a lot of colour and there's a specific program that we have. We we got a program from the EGD department that helps you that does the questions on the board so then I don't have to do the questions and in that they also use colours to indicate, I want to use the word, steps. So which line you would draw next and I think that would make it difficult for the learner as that is the actual textbook that is being used. Uhm I miss something. I feel that your question wanted me to elaborate more. | 1:25 In Civil they use a... Challenges for learners who... physical barriers in scholasti... |
| 95 | Interviewer | So are you saying that for certain certain topics the colour is used and they will struggle then to differentiate colour, but also when you say the program does it on the board, are you talking about a projector then showing almost like a video on the board of the steps? Do I understand you correctly? | |
| 96 | Participant 1 | Yes, yes, it's on the projector and could show you what to do next. | |
| 99 | Interviewer | Okay, so with the use of technology, how do you think that has impacted colour in the classroom? | |
| 100 | Participant 1 | For the EGD because that's the only time I use the projector, it has impacted a lot because I can't change those colours. And that would uhm make it uhm difficult for me to change the colour to accommodate the learner. However I will try and luckily I haven't had any EGD learner that I am aware of with colour-blindness. Uhm so so that would make it difficult to accommodate the learner but still be still be possible to do so. But those are the colours that are given on the system is the colours that you kind of working with. | 1:26 EGD because t... Challenges for learners who... physical barriers in scholasti... |
| 103 | Interviewer | So if you now think about children who are colour-blind, how can you accommodate these learners in your classroom? | |
| 105 | Participant 2 | I feel like it depends on which colours the students cannot see, if it is a lot of colours the students cannot see we can maybe look into uhm getting them a book or for example, if it's not a science to get them a textbook printed in colour so that they can see. Making sure that the test paper or the examples on the board are for that specific student or the class that the student is in is than in different colours as well. If it was more colours that the student cannot see it. Yeah, it gets a little bit more difficult to accommodate the students in that way. | 1:27 I feel like it depends... Accomodate learners who ar... |
| 106 | Interviewer | Can you think of anything else you can use besides colour to differentiate between things or to organize? Like you've said you marked in one colour and the question and then the definitions in other colours. Can you think of another way to do that? | |
| 109 | Participant 2 | Maybe use the different shapes to say okay, at this square this is why we do this step or just using different numbers, but at maths using different numbers would be a bit more difficult. So maybe you can do that in languages but ya. | 1:28 se th... Accomodate learners who ar... |
| 110 | Interviewer | So are you saying everybody look at the star, at the star is the instruction now everybody go and look at the square and at the square is where the definition is? Or the definition for example is inside the square and the question is inside the cloud or something like that. Am I understanding you correctly? | |
| 113 | Participant 2 | Yes and then instead of using different colours, you can use different shapes, cause it's just something different that students can relate to and say okay, this is now a different step, it's not something different, it's not the same. It's just something to for the students to be able to understand. | 1:29 instead... Accomodate learners who ar... |
| 116 | Interviewer | And participant 1 for you, I want you to think maybe specifically at the subjects you teach. How would you accommodate learners who are colour-blind in your subject? | |



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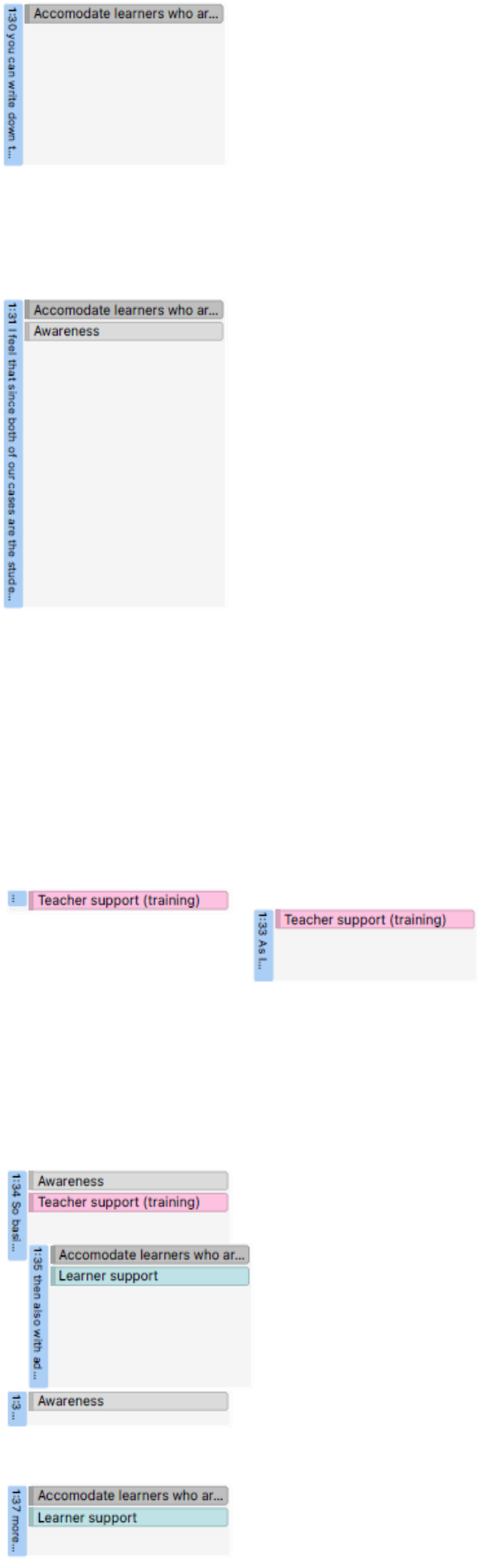
| 118 | Participant 1 | What we could do as well, but already do with the colours you can write down the steps next to the question. So for example, step one, for EGD for example draw the base of the line or bisect the line, step two we did this so you can write down your steps afterwards. Like Participant 2 also mentioned just writing the steps out in words would also already uhm accommodate the learners and not just drawing the lines or such in a different colour so that you can see which one you're doing and how to do that. |
| 119 | Interviewer | Okay, so are you saying while they watch the video you write down the steps next to it, so that the child is struggling to see the colour in the video can follow the steps that are easy to read? |
| 120 | Participant 1 | Yes. |
| 123 | Interviewer | Okay, if you think about the school in general, how do you think the school can be more accommodating to learners who are colour-blind? |
| 125 | Participant 2 | I feel that since both of our cases are the student had to tell us that they are colour-blind that maybe if the school can make everybody the students more aware of colour-blindness so that students can, don't feel as shy and as intimidated to say hey, I cannot see this colour. For the rest of the students although the rest of the school to be more aware of colour-blindness to maybe have like someone to come in and to speak about colour-blindness and about, like, how to accommodate someone who has colour-blindness just to make people more aware of it. And also for the students to feel more safe to basic to have like maybe in grade eight, where they can come forth and say, okay, I have colour-blindness to have like a more safer environment for them to come out with boldness and say okay, hey, I cannot see this colour or, hey, please don't use this colour because I cannot see it. So just to be more to make the students and the teachers even more aware of colour-blindness in the school. I think that would be the first step for the school to take to improve. |
| 128 | Interviewer | Raising awareness? |
| 129 | Participant 2 | Yes. Raising awareness. |
| 130 | Participant 1 | I'm just concerned that a lot of the teachers now after we filled out the survey that you gave us, a lot of the teachers said that they were and still are very unaware of colour-blindness and they weren't sure how to answer some of the questions because they haven't even thought about it and in their how many years of teaching. So it's the teachers. It's not even the learners it is the teachers if they were just more aware of colour-blindness. I feel that we could already start accommodating the learners better. |
| 133 | Interviewer | Thank you for that. If you think about school and moving towards more inclusive schooling, have you received any training to support learners with uhm barriers to learning? And in this case, more specifically have you received any training to support learners who are colour-blind? |
| 135 | Participant 2 | No, at the school I have not received such training. |
| 138 | Participant 1 | As I have mentioned in my previous question, a lot of the teachers were so unaware that we haven't even thought about colour-blindness until you brought the survey. So no I don't think that we have not received any of such training. |
| 139 | Interviewer | And my last question is what support do you need in order to accommodate learners who are colour-blind? |
| 140 | Participant 2 | So I just want to find out when you say support, what do you mean? |
| 143 | Interviewer | Whether its training or or uhm it can be any type of support, whether you need training. Do you need additional time? Do you need a uhm just maybe something to read for more information on this, on how to accommodate them? What supports do you need to include and accommodate those children in your classroom? |
| 145 | Participant 2 | So basically, I think basically, the extra support that would be most important is awareness. So basically either having like someone coming in with a slideshow making the teachers more aware. Then the teachers can maybe take that information and make the students more aware. And then also with additional time maybe if there's a student that is colour-blind in class to have a little bit more time to prepare beforehand in classes uhm to say okay I'm not going to using these colours or let's change this in the book. If there is something in the book that the student cannot see to maybe get it printed in a different colour. So in that case, it will completely depend on what severity of colour-blindness the students have in classes. |
| 148 | Participant 1 | Ja I would have to agree, if if maybe they could come and just like raise the awareness. |
| 149 | Interviewer | So you say to come and make the teachers first of all more aware of colour-blindness and how it influences learning? Is that what you are saying? And then? |
| 150 | Participant 1 | And then more support will also be being able to reprint some of the notes in not in a specific colour. So maybe just black and white reprinting parts of the textbook for the learners that are colour-blind in a specific colour. That would also be very helpful. |
| 153 | Interviewer | Okay, when you spoke about awareness, do you, would you say it's only the teachers that need to be aware or other role players in the school as well and why would you say so? |



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| 158 | Participant 1 | I think the teachers uhm and the learners. The learners should also be more aware of it so that the teasing doesn't take place or even when they are doing projects that they uhm are more aware of the learners in their class. And so that they're more aware, not just uhm are insensitive to the fact that they can't see certain colours. |
| 158 | Interviewer | Okay, so basically, in a group project, being understanding that this is my friends challenge and how can I still include them in the project? Is that what you saying? |
| 159 | Participant 1 | Yes, that's what I'm trying to say. |
| 160 | Interviewer | Okay, and awareness amongst the children as well? |
| 162 | Participant 1 | Yes. |
| 165 | Interviewer | Okay, that's it from my side. Is there anything else that you maybe want to add? |
| 166 | Participant 2 | Nope, there's nothing that I want to add. |
| 169 | Participant 1 | What I can say after after being made aware of the colour-blindness through the learner that came to me last year, what I've tried to do what I've tried to do is ask in every class if before using a new colour now I just ask if everyone is able to see the colour. If they don't want to tell me in class they can come to me after the class and just tell me. The teacher could just be more aware by doing that as well. It already helped. |
| 170 | Interviewer | Almost being open and creating an opportunity for them. |
| 172 | Participant 1 | Yes. |
| 175 | Interviewer | Oh wow, that's quite special. I think that's very valuable information. Thank you for that. Ladies, thank you for your time. I really appreciate it. I hope you have a lovely afternoon further. |
| 176 | Participant 1 & 2 | Thank you very much. |

178

1:38 he learners...
Accomodate learners who ar...
Emotional/ social impact
Learner support

1:39 What I can say ...
Accomodate learners who ar...
Learner support



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## Interview 2 (Participant 3)

| | | | |
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| 62 | Interviewer | Good afternoon. Thank you for joining me today I really appreciate it. I'm going to ask some questions and I would appreciate your honesty. I found that if teachers are honest and they share their real experiences uhm it will be valuable. Okay, so my first question is what is your understanding of colour vision deficiency that is often referred to as colour-blindness? | |
| 3 | Participant 3 | My understanding of colour-blindness uhm normally or more often seen with men than with women and mainly the blue-green and orange-red combinations as far as I can remember. | 2:1 My... Awareness |
| 6 | Interviewer | Thank you. Tell me about your experiences of teaching learners who are colour-blind. | |
| 8 | Participant 3 | Uhm, I cannot remember teaching any person with colour-blindness. | 2:2... Working with learners who a... |
| 10 | Interviewer | Sjo, that's interesting. | |
| 12 | Participant 3 | Maybe they were there but never mentioned that they are colour-blind and then I never knew that I taught learners with colour-blindness. | 2:3 M... Awareness; Working with learners who a... |
| 14 | Interviewer | That's quite interesting. So tell me more about how you use colour when teaching and how is colour also involved in after school activities at your school. | |
| 16 | Participant 3 | Uhm, normally we encourage teachers to make use of colour mainly uhm because of uhm keeping learners attention uhm and then with different colours you can actually remember things because you make it colour specific and then also the the effect of different colours on the emotional state of learners. | 2:4 normally... physical barriers in scholasti...; use of colour during instruct...; 2:10 normall... Colour perceptions by teach... |
| 18 | Interviewer | That's quite interesting. So are you saying that uhm colour helps children to remember the content and it's also used to highlight work in the classroom? | |
| 20 | Participant 3 | Yes, definitely. | |
| 22 | Interviewer | Okay, uhm how is colour used in the resources useful learning such as textbooks and posters? | |
| 24 | Participant 3 | I think the the brightness that that it brings in for black and white although grey sometimes battle to distinguish between different objects at the moment you've got different colours uhm, you see it better uhm it brings a quicker understanding of uhm what is covered in the textbook. So definitely the the colour the colourful text books especially in my subject we work with science and also cover topics like light uhm electromagnetic force, ultraviolet, infrared, etc etc. Is a lot of colour in textbooks were it uhm it helps the learner to understand specifically when you refer to colour then you cannot work with black and white photos or pictures in textbooks. | 2:5 I think the the brightness tha... Colour perceptions by teach...; physical barriers in scholasti...; use of colour during instruct... |
| 26 | Interviewer | So uhm just to clarify are you teaching physical science and at what level? | |
| 28 | Participant 3 | Yes, I taught physical science now for 15 years and up to matric level. | |
| 30 | Interviewer | Up to matric level. And you say the use of colour in textbooks is making it easier to explain specific concepts to learners for example uhm, how light goes through a prism or uhm different colours used for experiments and in that sort, do I understand you correctly? | |
| 32 | Participant 3 | Yes, yes definitely. Uhm, also in chemistry we have the different substances where uhm some properties of certain substances are related to them. | 2:6 Is... physical barriers in scholasti...; use of colour during instruct... |
| 34 | Interviewer | Okay, that's quite interesting. | |
| 36 | Participant 3 | To identify substances through colour as well. | |
| 38 | Interviewer | So in your subject colour actually plays an important role to convey information. | |
| 40 | Participant 3 | Yes yes. | |
| 42 | Interviewer | Okay. Tell me in after school activities at your school how is colour used there? | |
| 44 | Participant 3 | Uhm the same in class because the after school classes take place in the same classes. So you've got the different posters against the walls, you make use of whiteboard markers to teach or uhm and we are privileged to have electronic board. Even with a projector, projecting images on a whiteboard we can use colour. Uhm I say it's more or less the same than in the normal classes after schools making use of the same technology. | 2:7 Uhm the same i... physical barriers in scholasti...; use of colour during instruct... |
| 46 | Interviewer | So is technology used at your school, are there projectors available? | 2:8 So... physical barriers in scholasti... |
| 48 | Participant 3 | Yes, definitely. | |
| 50 | Interviewer | And uhm then often with these projectors is the images used in colour? Do I understand correctly? | |
| 52 | Participant 3 | Yes. | |
| 54 | Interviewer | Okay. And then after school activities such as sports or culture activities how is colour used there? | |
| 56 | Participant 3 | In some school or extra mural activities, they use colour. Like we've got archery at school, the targets different colours. Uhm and then well most other sports making use of like cricket got the red ball and hockey's got a white ball uhm with tennis we work with yellow balls but that's more sports specific. But uhm what I found is that when when learners can dress in uhm brighter colours then uhm it's it's got a positive impact on their uhm performance. | 2:9 In some school or... Colour perceptions by teach...; Emotional/ social impact |
| 58 | Interviewer | Mmm, tell me more about that. | |
| 60 | Participant 3 | Just to feel like a team everybody's dressing the same and if it's only white or grey so then it doesn't look good. If you look good you feel good you play better. | 2:11 J... Colour perceptions by teach...; physical barriers in scholasti... |



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| 62 | Interviewer | Okay, so a specific team would then wear a specific colour. And the whole team would wear that colour and you're saying this has then an influence on their emotional performance and their performance doing the specific activity? |
| 64 | Participant 3 | Ja. |
| 66 | Interviewer | That's so interesting thank you. According to you which challenges are faced by learners who are colour-blind within the school context. |
| 68 | Participant 3 | Uhm, especially in in my subject now if you have to identify certain colours and and you can't, then it will uhm be a problem. Then you'll have to divert and use other methods to do the exact same thing. |
| 70 | Interviewer | Can you give me a practical example. |
| 71 | | |
| 72 | Participant 3 | If you asked to identify substances uhm when you do uhm chemical chemistry in chemistry experiments. We have to use sulphur for instance. Sulphur is bright yellow. Uhm but if if you want to identify it as a colour-blind person I think it won't be a problem in future to identify the same because they have seen it. Although it doesn't seem yellow to you, you know exactly know what to expect. |
| 76 | Interviewer | Do you think children might get confused between uhm I know, for example of experiments the colour sometimes changes in an experiment and that gives you an indication of maybe the pH balance or or other other things. Do you think a child that has challenges with colour-blindness might find it difficult to identify the colour and therefore difficult to describe what happened in that specific experiment? |
| 78 | Participant 3 | Yeah, definitely. Definitely it is a challenge. |
| 79 | Interviewer | Is there other uhm places in your subject where colour is often used where it may also be a challenge? |
| 80 | Participant 3 | Uhm, no, only when you make it colourful for learners to understand better and then refer to certain colours then the colour-blind person will have a problem because they won't be able to identify the colours. |
| 82 | Interviewer | That's quite interesting. So uhm you saying when you, when you teach children you make use of different colours. How do you do that? Do you use different colours on the whiteboard or do you use different colours during projection, lecture when you use the projector or how is that done? |
| 85 | Participant 3 | Even with PowerPoint presentations and then of course when I do whiteboard, whiteboard markers they use different colours. Definitely. Uhm, because uhm only blue or only black uhm gets boring. So you attract the the learners attention by making use of a different colour uhm to explain different things. |
| 86 | Interviewer | Okay, so on your board you would have different things or or different steps in different colours so that they know, okay, now look at the blue now look at the green, for example something in that sense. |
| 88 | Participant 3 | Yes. |
| 90 | Interviewer | Okay, so how can schools accommodate learners who are colour-blind within the school system? Uhm if you can please maybe provide me with some practical examples or suggestions. I would appreciate it. |
| 92 | Participant 3 | I think in the first place they must be identified. So like I've told you earlier maybe I taught a lot of colour-blind people and I never knew that they are colour-blind. So identification of the colour-blind learners I think is the important thing. And then when that learner is in class I would then like to in the first place know it and then maybe get some training on how to help them because I think most teachers, even myself, when I did my teacher training, there was no specific training for teaching colour-blind children. So uhm I will put that person in front in the class so that I can remember this person and that I can give extra attention and speak to that person uhm with a softer voice so that that it's not necessary to disturb the whole class when I speak to that specific person. That's why I want the learner close to me. And then just to make sure that he understands he's got an alternative way of explaining the same thing not using colour. And then also I think we have to identify the type of colour-blindness of how severe it is so that you know not to make an issue where there is no issue. |
| 95 | Interviewer | Okay, so when you saying identify the severity, let's say it's it's a specific type of colour-blindness, for example red-green will that impact the way you teach or the colours you use on the board? What would that impact? |
| 96 | Participant 3 | I don't think it will impact my teaching. I will still make use of the same teaching methods using colour. But then I will give special attention to that one person in the class or two that are colour-blind and then uhm making use of alternative methods with them. |
| 99 | Interviewer | Mmm, what would be alternative methods that you would use? |
| 100 | Participant 3 | Instead of colour then you know use thicker and thinner lines. uhm I don't know. Use other colours that that that person doesn't have a problem with because if I know it's blue-green then I will maybe in class try and revert from blue-green and then use either blue or green and other colours. So that they doesn't have to distinguish between the blue and the green. So just block out one colour if you can and use less colours to accommodate that person then |

2:12 espe... — physical barriers in scholasti...

2:13 If you asked to... — Accomodate learners who ar... — physical barriers in scholasti...

2:14 only... — Colour perceptions by teach... — physical barriers in scholasti...

2:15 Even wit... — Challenges for learners who... — Colour perceptions by teach... — physical barriers in scholasti... — use of colour during instruct...

2:16 I think in the first place they must be identified. So... — Accomodate learners who ar... — Awareness — Becoming aware of learners ... — Learner support — Teacher support (training)

2:17 I don't t... — Accomodate learners who ar...

... — Accomodate learners who ar... — Learner support

2:19 Use other col... — Accomodate learners who ar... — Learner support



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| 103 | Interviewer | To limit the spectrum of colours used colours that child is able to differentiate. |
| 105 | Participant 3 | Yes. |
| 106 | Interviewer | Okay thank you for that. My last question is how can teachers be supported to better accommodate learners who are colour-blind? |
| 109 | Participant 3 | Uhm I think they they must be aware of the fact that we have a number of children that normally have that problem because you know at the moment I don't know what is the tendency, what is percentages you know. I think with your research, you will be in a better position to to give an answer to that. How often you get colour-blind learners in your class, is it only one per school? Is it maybe one per grade or one per class? So if you make them aware that this problem uhm appears more often than what we thought then they will be more alert. That then secondly definitely I think they need training uhm to give more solutions than what you and I have spoken about today. |
| 110 | Interviewer | Okay, so first of all raising awareness and then second of all specific training that is focused on how to accommodate that learner in the classroom and ow to teach in a more inclusive manner. Do I understand you correctly? |
| 113 | Participant 3 | Yes. |
| 115 | Interviewer | So thank you so much for your time. Is there anything else you would like to add? |
| 116 | Participant 3 | No, not at this stage. |
| 119 | Interviewer | Thank you so much. I appreciate it. |

2:20 Uhm I think they they must...
Awareness
Teacher support (training)
Working with learners who a...



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## Interview 3 (Participant 4)

| | | |
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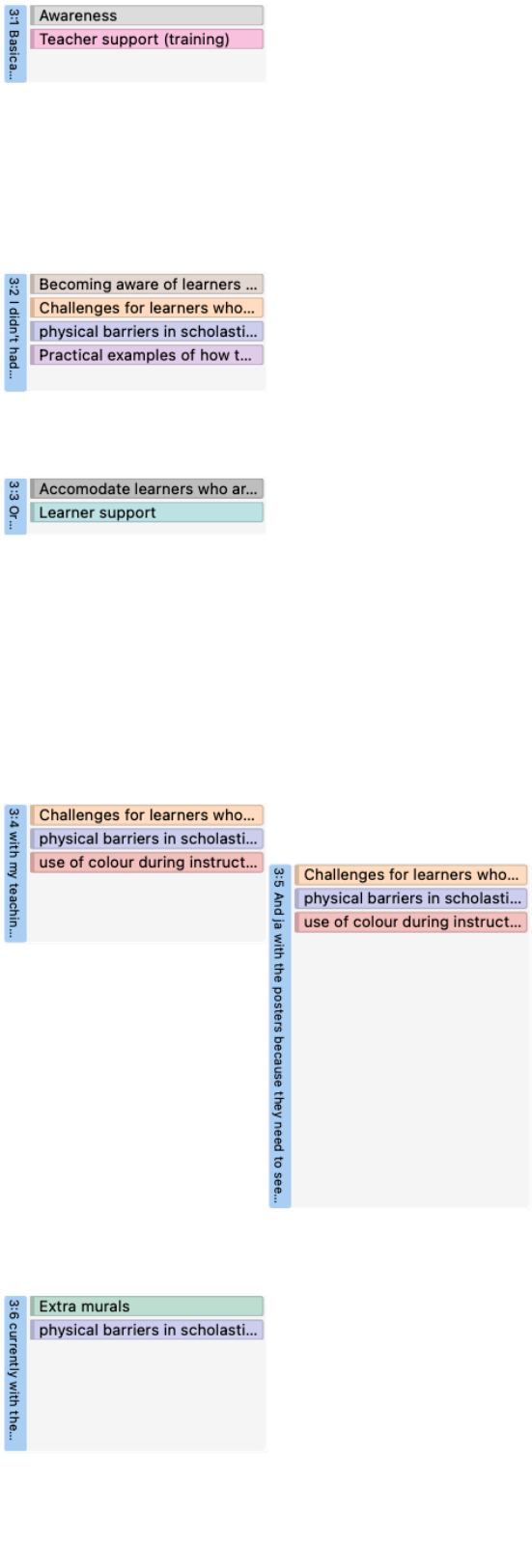
| 1 | Interviewer | Good day Participant 4, thank you for your time today. I'm going to just ask you a few questions and I want you to try to be as honest and open as possible. |
| 3 | Participant 4 | No problem. |
| 6 | Interviewer | First question is what is your understanding of colour vision deficiency which is often referred to as colour-blindness? |
| 8 | Participant 4 | Basically the people can't distinguish between colours like red and green. I don't really have extensive knowledge on it. A lot of the time they often just see grey when it's supposed to be colour, I think. |
| 10 | Interviewer | Okay, so sometimes difficulty distinguishing between colours and sometimes only see in grey if it's severe. |
| 12 | Participant 4 | Ja. |
| 13 | Interviewer | Tell me about your experiences teaching children who are colour-blind. |
| 16 | Participant 4 | I haven't actually really had anybody in my class. (could not hear the rest of the sentence). |
| 18 | Interviewer | I'm really struggling to hear you. |
| 20 | Participant 4 | I didn't had one personally in my class, so it'll have to be a different teacher's encounter. It was an art student from this year that they discovered is actually colour-blind. So it made their practical's a little bit more challenging. |
| 22 | Interviewer | Okay, so let me just make sure I've got this correct. You are the HOD of the Humanities Department and Art falls under this. So one of the teachers that work under you experienced this challenge. |
| 24 | Participant 4 | Yes, that is correct. |
| 26 | Interviewer | So you say the practical's had to be adapted for this learner? |
| 28 | Participant 4 | Well to a certain degree yes. Or all they did was, she would actually just tell them what colours she had in mind and then they obviously just assisted her in that direction. |
| 29 | Interviewer | Okay, so then they just, for example, gave her that coloured paints of that colour art materials when she wanted to use it. Do I understand you correctly? |
| 32 | Participant 4 | Yes. |
| 33 | Interviewer | Okay, that's interesting. Any other accommodations or other learners that you know that experience challenges like this? |
| 36 | Participant 4 | Not actually no. Sorry, I'm not being very helpful. But I actually don't have. |
| 38 | Interviewer | That fine. I think only certain subjects experience these challenges or face them maybe. So tell me about how do you use colour when teaching? And how is colour involved in in after school activities at the school you work at? |
| 40 | Participant 4 | Uhm well with my teaching I think it relates to watching documentaries or videos. Another subject that falls under me is the Geography. That's very important to be able to distinguish colours there because of the maps. And ja with the posters because they need to see certain things are written in bold or written in a different colour to create affect, like if they don't, you know, distinguish between colour, it's going to be a problem. |
| 42 | Interviewer | Mmm, so so in all subjects for a poster or specific subjects that you referring to? |
| 43 | Participant 4 | Well, for my subjects, personally, because there is a lot of index discussion with drawings and paintings because of primary sources and secondary sources but I think it links with all subjects anyway. Because they're not going to be able to see what stands out and what doesn't. Everything is all grey. |
| 46 | Interviewer | That's so true. So basically, to highlight important information and to draw connections between sources. |
| 48 | Participant 4 | Yeah. |
| 50 | Interviewer | Okay. Just to confirm you teach History to high school learners. Am I correct? |
| 52 | Participant 4 | Yeah, that is correct yeah. |
| 53 | Interviewer | And in after the curricular activities that you're involved in how is colour used there? |
| 56 | Participant 4 | Well, currently with the hockey they always need to know we have different kinds of balls for practice. And then match balls are generally just white. So I don't think that would be too much of an issue but sometimes the field markings, you know, use different colours with field markings. And also maybe to distinguish between a fellow teammate and an opponent because if they're not seeing different coloured uniforms they're not always going to distinguish who's on their team. |
| 58 | Interviewer | Mmm, Definitely. I know you have already spoken about posters, but the next question might feel like I'm asking you that again. The question is how is colour used in resources for learning such as textbooks and posters. You have touched on the poster can just elaborate on the textbooks for me I'd appreciate it. |



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| 60 | Participant 4 | Okay well, we obviously adapted the textbooks that we bought because of our subjects. So previous textbooks the maps were black and white. So they just use a key to say what was what. So we read some textbooks that actually had a green to show a forest and the blue to show the river and those sort of things. So for a child that's battling to distinguish between colours suppose that's very problematic because we did it to help. But it would actually hinder that child. | 3:7 we obviously adapt... Challenges for learners who... physical barriers in scholasti... use of colour during instruct... |
| 62 | Interviewer | That's quite interesting. So is this for Geography or for History that you're talking about? | |
| 64 | Participant 4 | Well, for both. A lot of the History stuff we were lucky and we did have colour but there are combined textbooks for the juniors. So the maxima are in colour. In posters of Geographical things are in colour. And then obviously with the senior History, which I'm more familiar with all of the posters are in colour, so they can actually get visual, a better visual. | 3:8 A lot of the... Challenges for learners who... physical barriers in scholasti... use of colour during instruct... |
| 66 | Interviewer | So there's actually a lot of colour used in the textbooks and in class? | |
| 68 | Participant 4 | Yeah, because it's also nice to distinguish between different uniforms. If there's been a bad call, you know, sometimes you can see blood or violence or something because of the use of colour. | 3:9 It'... Challenges for learners who... physical barriers in scholasti... use of colour during instruct... |
| 70 | Interviewer | Okay, according to you which challenges are faced by learners who are colour-blind within the school context? | |
| 72 | Participant 4 | I lost you there for a brief moment, sorry. | |
| 74 | Interviewer | According to you, which challenges are faced by learners who are colour- blind within the school context? | |
| 76 | Participant 4 | I suppose there's quite a lot. I guess number one would affect their education, because maybe they're not going to interpret things in the correct way unless they've just learned to fight for it on their own. Because somebody told them that this is the colour for this. So it should look like that. Yeah, and I guess going back to sports it's also going to hinder them, are they going to be successful in seeing a yellow ball coming at them or a white ball? Because there are different colours for every sport. So for me, I think it's a big challenge. | 3:10 I suppose there's qui... Challenges for learners who... Extra murals physical barriers in scholasti... |
| 78 | Interviewer | So it impacts scholastically but also extracurricular activities especially the sports. | |
| 80 | Participant 4 | Yeah. I think in your everyday life it's going to affect things as well. So I'm not going to say yes to just that, but I just think it affects every spheres of their life. | |
| 82 | Interviewer | Can you think of other spheres apart from the scholastic and the sports where you think it might impact them as well? | |
| 84 | Participant 4 | Uhm, well, I mean, driving is pretty important if you actually must see stop signs and robots and those sorts of things. I mean eventually when they do come of age to drive, that's going to affect them. I suppose the clothes they choose to wear uhm, yeay that would affect them. Those sorts of things, normal things that we take for granted but are they really actually experiencing that? | 3:11 I mean, driv... Challenges for learners who... |
| 86 | Interviewer | Definitely. I think about you mentioned the learner that is in your departments in art that is facing. What challenges does that specific learner face? | |
| 88 | Participant 4 | Uhm, she was very easy going and luckily she never really took the subject seriously. But by the time we actually figured it out, she was in grade 11. And her biggest concern is that she was quite happy to just paint black and white pictures and we could never really understand why. But even when we assisted with the colour she was still far more comfortable sticking to black and white painting. | 3:13 Uhm, she was very easy going and luckily she never really too... Emotional/ social impact Working with learners who a... 3:12 she was very e... Awareness Becoming aware of learners ... Challenges for learners who... physical barriers in scholasti... Practical examples of how t... use of colour during instruct... Working with learners who a... |
| 90 | Interviewer | Sjo that's interesting, so almost sticking to her comfort zone? | |
| 92 | Participant 4 | Yeah. | |
| 94 | Interviewer | Why do you think she would do that? Even though you assisted her with colour? . | |
| 96 | Interviewer | (Lost participant 4 there for a second). | |
| 98 | Participant 4 | Whether or not they feel comfortable with the teacher, like they can experiment. | |
| 100 | Interviewer | So being comfortable with the teacher? Sorry, I lost you there for a second. I don't know. | |
| 102 | Participant 4 | No, no, no it's fine. I just think it boils down to being in their comfort zone and whether or not they feel they can trust their teacher to actually go out of their comfort zone and try something new. | |
| 104 | Interviewer | Mmm, Definitely. Okay. How can schools accommodate learners who are colour-blind within the school system, and if you don't mind, please provide me with some practical examples or suggestions. | |
| 106 | Participant 4 | Again, a very tough one. I can only speak to the one that I've just told you about. I mean that the only thing we could do was to actually give her the colours that she asked for, and explain the colours to her if she wanted to go down that road. | 3:14 I... Accomodate learners who ar... Learner support Practical examples of how t... |
| 108 | Interviewer | Can you explain what what do you mean by giving her the colour she's asked for? So if she's busy with her painting how does that work? | |



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| 109 | Participant 4 | Well, if she's busy with practical then she can always say, I've decided to do this section over here red. And you know, then we would actually then just have to show her that this is the red paint. And you need to put it in this section here. It's almost like you're prompting them. But anything you can really do, because our school is not really equipped for children or I suppose those kinds of needs. | 3:15 Well, if she's b... Accomodate learners who ar... Challenges for learners who... physical barriers in scholasti... Practical examples of how t... Teacher support (training) |
| 112 | Interviewer | Okay, so almost a providing that accommodation and saying, okay, this is the colour and this is what you want to use, and making sure she stays within that area. So becoming a prompter in that regard? | |
| 114 | Participant 4 | Yeah, because I mean, obviously, you know, with children with any kind of concessions, we need to be given the approval to actually do that. And were not always given those types of concessions. | 3:16 obvi... Accomodate learners who ar... Challenges for learners who... Learner support |
| 116 | Interviewer | So has concessions been given to this specific learner to be able to do that? | |
| 118 | Participant 4 | She actually didn't want it and we sent her for the testing and she said, no, she was fine she didn't want it. So like I have just said she just continued to feel a lot more comfortable just doing things in black and white. | 3:17 She... Challenges for learners who... Practical examples of how t... Working with learners who a... |
| 120 | Interviewer | That's so interesting. So did you send her for testing to the department or where? | |
| 122 | Participant 4 | Uhm I'm not a 100% sure, because Mrs. XXX sort of deals with that we just refer and then Mrs. XXX will do it or the psychologist would then do it. | |
| 124 | Interviewer | That's so interesting. Thank you for sharing that. If you think about your subject about History and thinking how you could possibly accommodate learners who are colour-blind do you have any suggestions? | |
| 126 | Participant 4 | When it comes to the sources, because they are, the majority of them are obviously texts sources. So that's not a train smash, but when it comes to, if we're going to print colour exams, because bear in mind it printed black and white so that's not an issue. They could do what they do with some of the words, they draw a little line and put a little block and say that if in case that's not bold enough. Maybe they could actually say viva written in red, you know, just to help them understand why would stick out a lot more. Because sometimes that helps with answering the question like what is the message or what is the effectiveness of that type of poster. | 3:18 When it comes to the sourc... Learner support |
| 128 | Interviewer | That's so interesting. Thank you so much for sharing. And then the last question is. How can teachers be supported to better accommodate learners who are colour-blind? | |
| 130 | Participant 4 | Well it's just like with anything, you can't really pretend to know what that child's going through. So they need to feel like they can trust you and tell you when things are a problem. And you have to do your best to try and meet them halfway so that they feel comfortable. | 3:19 Well it's... Accomodate learners who ar... Becoming aware of learners ... Challenges for learners who... Emotional/ social impact |
| 132 | Interviewer | So with the teachers as well being open so that they can approach you, is that what you're saying? | |
| 134 | Participant 4 | Yes. So otherwise, I mean, as a teacher, you're just going to assume that maybe the child is just not interested and a little backward and in the meantime there's bigger issues there. Until you actually get them tested. You're not really going to know what the underlying issues are. So in my path of profession, I feel being approachable and trustworthy is probably the most important thing. | 3:20 Yes. So other... Accomodate learners who ar... Challenges for learners who... Emotional/ social impact Learner support |
| 136 | Interviewer | Definitely, definitely. Thank you for sharing. The question is how can teachers be supported? So if you think about teachers, what are their needs? How can we support them so that the teachers can better accommodate the learners? | |
| 138 | Participant 4 | Courses I suppose. Most of us have not actually been trained. So it would actually be nice if there were courses available if you were faced with a situation in your class, can tell you this is how you can maybe go about assisting the children or something like that but you as a teacher don't feel useless because there's nothing more annoying than you trying to help, but you actually probably making the situation worse because you don't know where to start. | 3:21 Courses I sup... Accomodate learners who ar... Teacher support (training) |
| 140 | Interviewer | So courses where they inform you what is the condition and how to support, how to identify the learners and how to support them? | |
| 142 | Participant 4 | Yes, | |
| 144 | Interviewer | Okay, thank you so much. Is there anything else you would like to add? | |
| 146 | Participant 4 | I can't think of anything right now. | |
| 148 | Interviewer | Thank you so much. | |



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## Interview 4 (Participant 5)

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| 1 | Interviewer | Good day Participant 5 and thank you for joining me today. I really appreciate it. Thank you for your time. |
| 3 | Participant 5 | It's a pleasure. |
| 6 | Interviewer | I'm going to ask you a few questions. And I'm going to ask you to just be as just as honest as possible and share your experiences. I believe they are valuable. And I can learn from you as a teacher, what are the challenges in class and how things work in school. Thank you so much. My first question to you is, what is your understanding of colour vision deficiency that is often referred to as colour-blindness? |
| 8 | Participant 5 | What I understand about it is that the uhm the learners of the children struggle with certain colours they can't see like, like, for example, like, maybe blue looks different to them. They don't, they can't distinguish between the certain colours. |
| 10 | Interviewer | Okay, so it's just to distinguishing between specific colours. Thank you. Tell me about your experience in teaching learners who are colour-blind. |
| 12 | Participant 5 | Personally, I have never had a learner that was colour-blind in my class. But I have heard about a lot of teachers that have taught for many years and what they have done to help the children. Like the one teacher, I know the little boy was very shy about having colour- blindness. So she told him no that he mustn't be shy and no one needs to know. So on the back of his pencils, she wrote the colours for him, so to help him so that he can doesn't have to be shy about it. Yeah. |
| 14 | Interviewer | That's so special. So you have not been aware of any child in your class that has colour-blindness. |
| 16 | Participant 5 | No. |
| 18 | Interviewer | Okay, so, tell me a bit more about how you use colour when teaching. |
| 20 | Participant 5 | As a Grade 1 teacher I use colour for everything especially when we even in the books when you write new phonic words. So let's say we write sentences today. Then we'll write the whole sentence in grey pencil and then the words that we use with a certain phonic like let's say it's the "th" or the "th" sound, then we write that in different colours or maybe in math that you can say colour all the circles red and all the squares blue. And so you can also see if the children understand what is squares and circles. And so colour especially for me in a grade one class is very important, we use it a lot. |
| 22 | Interviewer | Okay, so what I'm hearing is you using colour to highlight certain letters, you're also using colour to identify different things for in your case for shapes in math. |
| 24 | Participant 5 | Yes, absolutely. |
| 26 | Interviewer | And in extra and after school activities for extracurricular activities. How is colour used in those activities at your school? |
| 28 | Participant 5 | Like sports and stuff? Ah I can't really think now. I think like we use colour without even knowing we use colour like example for netball. Let's say we we play a little bit especially with the little ones you start then you divide them up in teams like the green team and the orange team. So if they can't see that they are the green team then maybe they're going to play for the other team or or you can use the colours for when you practice different stuff in netball or like for…… uhm, ag wat noem mens dit? Vir fiksheid en goed, om soos… |
| 30 | Interviewer | Fitness? |
| 32 | Participant 5 | Yes, for fitness. |
| 34 | Interviewer | How would you use colours when you do fitness? |
| 36 | Participant 5 | Hehe, Oh genade.. |
| 38 | Interviewer | I know one of the other people told me that they use different colour cones and at each cone they have to do a different thing. |
| 40 | Participant 5 | That's also nice. Yeah you can do that. Uhm or, ek kan nou aan niks dink nie. |
| 42 | Interviewer | And other extracurricular activities for example culture, is colour used there or not as much? |
| 44 | Participant 5 | Culture like in especially in like revues and stuff they like to have colours but that's more like just for the show is not like or even let's say if we have a concert then sometimes they will have like let's say all the grade ones especially for the little ones they will put stickers on the floor so that they know where to go stand. So maybe if my dot is blue and I can't see the blue then I'm not going to know where to stand. So they trying to help them but actually, ja. |
| 46 | Interviewer | It can become confusing for that specific child if they're struggling to differentiate. |
| 48 | Participant 5 | Exactly yes. |
| 50 | Interviewer | Okay, and you saying then colours is used with the concerts and that in aesthetic manner as well, for things to look pretty and decorative? |
| 52 | Participant 5 | Yeah. |
| 54 | Interviewer | Okay, thank you for that. How is colour used in resources for learning, for example, textbooks and posters? |

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- Awareness

4:2 Personally, I have...
- Accomodate learners who ar...
- Challenges for learners who...
- physical barriers in scholasti...
- Practical examples of how t...
- Working with learners who a...

4:3 As a Grade 1 teacher I use c...
- physical barriers in scholasti...
- use of colour during instruct...

4:4...
- Challenges for learners who...
- Colour perceptions by teach...
- use of colour during instruct...

4:5 Let's say...
- Challenges for learners who...
- Extra murals

4:6 us...
- Challenges for learners who...
- Extra murals

4:7 Culture like in espe...
- Challenges for learners who...
- Extra murals

4:8 Okay,...
- use of colour during instruct...



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| 56 | Participant 5 | I think, especially with like, the DBE books that we have, like, they use a lot of colour in it to make it more interesting for the children to draw their attention with the pretty pictures and stuff, or they will, especially in the DBE books, they try to put words in different colours. So it's easier for the children to go write it like let's say the other day I did a lesson on was different animals. So the words were there, but the words are a bit still difficult for them to read. So then I would read them for them and said okay, line is the pink word. So go look where's the pink word. And then the pink word, we're gonna right underneath the word line. So if they can't see the colour, then maybe they're not going to know what word I'm talking about. | 4:9 the DBE books that we have, like, t... — Challenges for learners who... / physical barriers in scholasti... / use of colour during instruct... |
| 58 | Interviewer | To be able to follow the instruction. And in posters in your class? | |
| 60 | Participant 5 | Posters is a lot of colour is so ja, like everything. I can't even think of one thing in my class that's not in colour. It's colourful. And I think it's just you make it exciting for the children. And especially with maths as well and shapes, they tried to make it always different colours. So it can also see, especially like maybe it's a circle and oval, it won't be the same colour. So that you can see the differences. Yeah. | 4:10 Posters is a lo... — Challenges for learners who... / Colour perceptions by teach... / physical barriers in scholasti... / use of colour during instruct... |
| 62 | Interviewer | So you can see that there are differences. Tell me a bit about, now I'm referring to maths, other tools you use in math for example, counters or an abacus, are those in colour? | |
| 64 | Participant 5 | Yes. So the counters are usually well, the ones that I have, I think the first ten is in yellow, and the rest is in blue. So that you can see the first ten, I think it's ten. No, it's the first five sorry and the next five is another colour. So I mean, also, if you can't see the difference, it's going to be difficult for you to know okay this is five and five and that makes ten and especially the the big number chart that's usually on the wall. We use colours for that as well. If we count in two's, usually when we give them one they say okay, so like let's say red, and go colour all the red, and count in two's all the even numbers. And then you can do the same with different colours of all the fives and then for the tens. So if the colours looks the same, then they're going to struggle to count in two's and in fives and tens. | 4:11 So the counters are usually well, the... — Challenges for learners who... / physical barriers in scholasti... / use of colour during instruct... |
| 66 | Interviewer | Sjo. So it's actually used a lot in mathematics as well. And so I'm trying to think you've got the language and then you've got mathematics and then is it life skills the other? | |
| 68 | Participant 5 | Yes, life skills as well. Especially the Art section of life skills we use a lot of colours and stuff for that as well. It's more like just art and not really something else. | 4:12 lif... — Challenges for learners who... / physical barriers in scholasti... / use of colour during instruct... |
| 70 | Interviewer | They'd be painting different colours in your class and use that for the arts. | |
| 72 | Participant 5 | Yes. | |
| 74 | Interviewer | And magazines I assume are printed in different colours. | |
| 76 | Participant 5 | Yes, everything is colourful. | |
| 78 | Interviewer | And all the other resources as well. Is there any other resources in your class that I haven't referred to? | |
| 80 | Participant 5 | Not that I can think of no. Just the board but I did say the board is cream, the old school board. | 4:13 Not that I can think of no... — Challenges for learners who... / physical barriers in scholasti... / use of colour during instruct... |
| 82 | Interviewer | With what colour do you write on the board? | |
| 84 | Participant 5 | Usually white but then i i like to like with the different words I would if there's important words then I'll write it in colour so they can see it, so it can stand out. | |
| 86 | Interviewer | So actually in instruction as well? | |
| 88 | Participant 5 | Yes, and sometimes when they have to leave a line open then I will make like a red little cross so that they know leave that line open or. | |
| 90 | Interviewer | That's interesting. We don't realize how often we use colour. | |
| 92 | Participant 5 | Yes, we use colour a lot. | |
| 94 | Interviewer | So according to you, which challenges are faced by learners who are colour-blind within a school context? | |
| 96 | Participant 5 | I think there's a lot of challenges that we don't realize as people who can see colour, like for example, if the instructions in a certain colour, then if you say do the blue ones or they can't see the blue then they will misunderstand the instructions and maybe lose marks if it's something that's been assessed or if, like you say, colour all the squares blue, and he sees maybe green as blue and go colour, and then it's wrong. So I think they can lose a lot of marks. And it's it's unnecessary because they know what, they try to the best of their ability to do the instructions and to, but it's not their fault that they can't see this. | 4:15 think there's a lot of challenges that we don'... — Challenges for learners who... / 4:14 I think there's a lot of challe... — use of colour during instruct... |
| 98 | Interviewer | So what you're saying is they understand the concepts, but because they cannot follow the instruction because of colour, it seems like they don't know the work. | |
| 100 | Participant 5 | Yes it seems as if they don't understand, but actually they do. | |
| 102 | Interviewer | So the example you use relating to difficulty following instruction. | |
| 104 | Participant 5 | Yes. | |
| 106 | Interviewer | Any other challenges that you think they might struggle with in the classroom? | 4:16 Any... — Challenges for learners who... / physical barriers in scholasti... |
| 108 | Participant 5 | I can only think like, if maybe like a practical thing that they have to maybe sorts sort things by colour or uhm.. | |



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| 109 | Interviewer | You now spoke about maths and the counter use, how do you think it will influence them there? | 4:17 You now spoke ab... Challenges for learners who... physical barriers in scholasti... |
| 112 | Participant 5 | I think it will influence them as well like, like what I said, if, let's say they had to count in two's, and now they can't, because they can't see the colours. So maybe they're going to count, colour ahg count two, four, five, because the five is also coloured in, but in a different colour. So I think that will also affect them. | |
| 118 | Interviewer | Okay. Any other place? | |
| 116 | Participant 5 | What I also do with comprehension, like what, especially with the little ones when you introduce them to comprehension, I would like I read, I read the comprehension with them, then we read the questions, and I will go back to the comprehension and then we'll read the questions the last time. Then the third time that we read the comprehension, I will tell them, okay, now get out a yellow. So then we will read it and not the story again, sorry, the questions, then let's say the question is, what colour is the cat? Then we will go back and it's like, then I will tell them, okay, take a red. And then we go read what colours is the cat and it will say it's a black cat, then they will underline a black cat. So then I like to do each question in a different colour. So then they can go on their own and go look okay, number one was yellow. So it's a black cat, just to to help them to get into the whole comprehension. | 4:18 What I also do with comprehension, like wh... Challenges for learners who... use of colour during instruct... |
| 118 | Interviewer | Teaching them the technique of doing a comprehension test? | |
| 120 | Participant 5 | Yes, yes. | |
| 122 | Interviewer | Sjo, That's a wonderful way of teaching them, if they can see colour. | |
| 124 | Participant 5 | Yes, if they can see, otherwise it won't help. | |
| 126 | Interviewer | Yes otherwise they are just going struggle to follow. Okay, | |
| 128 | Participant 5 | But also, if you're aware that someone is colour-blind, and you can also maybe tell them okay, in instead of using a colour, maybe use a different symbol, like make the one make a heart at the right answer or a star or whatever. | 4:19 But... Learner support |
| 130 | Interviewer | That's my next question, you are thinking ahead. So my next question is, how can schools accommodate learners who are colour-blind within the school system, and please provide me with practical examples or suggestions, which you just did. | |
| 132 | Participant 5 | So I like the idea that the other teacher did with the pencils to help them. So that they can, you don't have to mark all of the colours, but maybe just the ones that they struggle with. And then like instead of, sorry, using colour, maybe use symbols, then like with the comprehension test, then you can make symbols instead of underlining with a certain colour. And I think just keeping them in mind with everything because I know you tend to forget not on purpose but you tend to forget about the one child that has one specific challenge, especially if you have like a class of 25 or 30, or whatever. So just make a note in your back of your head and tend to just ask them, are you fine? Did you see this? Or is there something I can help you with or make it easier or.. | 4:20 So I like the idea that the other te... Accomodate learners who ar... Becoming aware of learners ... Learner support |
| 134 | Interviewer | So visual attention for that specific learner? | |
| 136 | Participant 5 | Yes. | |
| 138 | Interviewer | If you think about instruction on the board, how would you be able to accommodate that learning in that regard? | |
| 140 | Participant 5 | I think maybe just incorporate the symbol with the colour then. So the rest of the class can still see colours, and then maybe just for him or her and just make a symbol. You can even ask them what will work for them what what do they prefer. Because I know also if you have one child now and you make just for that child, the symbols then the rest of the class always find a way to explain or treat them different or tease them or something. | 4:21 I think maybe just... Accomodate learners who ar... Emotional/ social impact Learner support |
| 142 | Interviewer | So, so treating them different might lead to teasing? | |
| 144 | Participant 5 | Yes. | |
| 146 | Interviewer | Okay. So, let me see if I understand you correctly you said when they leave a line open you make a red X? | |
| 148 | Participant 5 | Yes | |
| 150 | Interviewer | So the X is the symbol so that your colour-blind child knows to leave the line open but the red emphasizes it to the rest of the class? | |
| 152 | Participant 5 | Yes. | |
| 154 | Interviewer | Okay. That's a very good example. And any other place where you can think of where you can accommodate or make things easier or more practical? Maybe with the counters or maths that we referred to. | |
| 156 | Participant 5 | Think maybe with like the counters, the counters is difficult, because they already come like that, but maybe you can use like, stickers on them. So maybe put the first five, you can just put a sticker so it would look different. Even if they can't see the colour, then they know at the first five with a little dot on or whatever. And maybe with the the number card, then you can make instead of counting them, maybe make all the two's circle them and all the fives make a cross over it or just use symbols again. | 4:22 Think maybe with lik... Accomodate learners who ar... Learner support |
| 158 | Interviewer | That's a wonderful idea. Last question is how can teachers be supported to better accommodate learners who are | |



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| 160 | Participant 5 | Supported? Like how? |
| 162 | Interviewer | Whether it's training or awareness or a program? |
| 163 | Participant 5 | I think training or maybe just like awareness, because I think they tend to forget about, like colour-blindness, or they think it's not that not that bad, or it's not a serious problem like ADHD or whatever. I don't think everyone is always. Because we can see colour, we don't usually think, oh okay what if I couldn't see this is red, or we tend just to go on on our own abilities we don't, we forget sometimes about, like colour-blindness and stuff. So I think like awareness and training and stuff will be nice. |
| 166 | Interviewer | Just for curiosity did you receive any training in this regard during your degree? |
| 168 | Participant 5 | No, not really about colour-blindness nee. |
| 169 | Interviewer | And I know you, you did your honours in remedial therapy? Am I correct? |
| 172 | Participant 5 | Yes. |
| 173 | Interviewer | Any training there in this regard? |
| 176 | Participant 5 | Well, no, actually, what if I think about now they like, they like to use colour like for different groups and say, if it's a more a stronger group, use one colour and and the more so they use colour a lot. Now that I think of it, I don't really didn't really have a lot of things. |
| 178 | Interviewer | So colour was often used as a tool to explain and organize, to highlight and to emphasize, to help. But not ever to identify as the challenge? |
| 179 | Participant 5 | No, never. Not that I can recall. He didn't have anything about colour-blindness. |
| 182 | Interviewer | That's so interesting, thank you for sharing. And as teachers, I know, the CPD courses and training available, any training in that regard you received? |
| 183 | Participant 5 | No, none of that I can recall. |
| 186 | Interviewer | So when you say the first thing is to make teachers aware, am I correct? And then some training on how to support them,? |
| 188 | Participant 5 | Yes, definitely. Because well, but I think I'm trying to help the child maybe I'm making it more difficult for them. Or if you're if you have more baseline or just more idea of how to or even if I can just understand more like now I think, okay, you can totally not see any colour maybe you can, it just looks a little bit different if they can. I'm sure there's like different types of like colour-blindness, like maybe you just see like some colours grey, or maybe you see blue as green or stuff like that if you can have training on how each one is different and how to approach it and how to help the child and I think that will be nice. |
| 199 | Interviewer | That so interesting. Thank you for your time. I really appreciate it. I hope you enjoy the last few days of your holiday and all the best for the last term. Thank you so much. |
| 192 | Participant 5 | Thank you so much. |
| 193 | Interviewer | Thank you. |

4:23 I think training or ma... — Accomodate learners who ar... / Awareness / Teacher support (training)

4:24 J... — Teacher support (training)

4:25 And I know you, you... — Teacher support (training)

4:26 Well, no, actually, what i... — Teacher support (training) / use of colour during instruct...

4:27 So when you say the first thing is to... — Teacher support (training)



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## Interview 5 (Participant 6)

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| 62 | Interviewer | Morning **Participant 6.** Thank you so much for your time. I'm just going to ask you a few questions related to colour and children who are colour-blind and your experiences in school. I ask that you be as open as honest as possible. Thank you so much for your time. | |
| 3 | Participant 6 | No problem at all. | |
| 6 | Interviewer | So my first question is, what is your understanding of colour vision deficiency which is often referred to as colour-blindness? | |
| 8 | Participant 6 | My understanding is that while the person or in this case the learner will have difficulties differentiating between different colours that can be seen if you don't have any sight impairment. | 5:1 My... Awareness |
| 10 | Interviewer | Okay, thank you for that. Tell me about your experiences teaching learners who are colour-blind. | |
| 12 | Participant 6 | I had a case this year with a girl I taught. We will look at the map on the board and I will simply ask her to find a country a green one, and she couldn't tell a difference between the green one and the orange country. So that was the first time I have actually teaching a child that has colour-blindness. That does make it quite a bit more difficult, especially when we do use colour quite a bit in education. | 5:2 I had a case this year with a girl I... Awareness; Becoming aware of learners ...; Challenges for learners who...; physical barriers in scholasti...; Practical examples of how t...; use of colour during instruct...; Working with learners who a... |
| 18 | Interviewer | Sjoe, that's so interesting, and what subject do you teach? | |
| 16 | Participant 6 | I teach Geography and History. | |
| 18 | Interviewer | So in which subject did you refer to the map she struggled to differentiate? | |
| 20 | Participant 6 | Geography. | |
| 22 | Interviewer | Geography, and tell me was she aware that she was colour-blind? Or was this like the turning points? | 5:3 Geography, and tell... Accomodate learners who ar...; Awareness; Becoming aware of learners ...; Challenges for learners who...; Learner support; Practical examples of how t...; Working with learners who a... |
| 28 | Participant 6 | She said she knew something was wrong. She just didn't think it was anything too serious. So I assumed she was probably colour-blind most of her life and nobody picked it up. | |
| 26 | Interviewer | Nobody picked it up. So from there what happened? | |
| 28 | Participant 6 | I reported it to our grade head and they reported it to her parents and her parents took her to an optometrist. | |
| 30 | Interviewer | And was it then confirmed by the optometrist? | |
| 32 | Participant 6 | If I'm honest with you she came back and said that she is straight blind and not any more information other than that. | |
| 38 | Interviewer | Sjo that's so interesting. And tell me which grade is this? | |
| 36 | Participant 6 | She's in grade eight. So she was a 14 year old girl. | |
| 38 | Interviewer | Sjo. It's amazing that you were the first one to pick that up. And she's been experiencing this for 14 years. | |
| 40 | Participant 6 | Yeah, so yeah. So she just literally, she didn't know, she just assumed everything is what it is. | |
| 42 | Interviewer | Sjo, that's so interesting. And tell me how do you use colour when teaching and also, how is colour involved in after school activities that you're involved in? | |
| 48 | Participant 6 | Well, with teaching Geography, we do a lot of map work, with the map work we often colour code, and we look at terrain maps so if it's brown or green, you know, and the dam and the rivers those are blue on the map. So if a child cannot see that, it does get a bit more difficult for them. And then obviously, not obviously sorry, our colour in cricket is extremely important for either you play with the red ball or you play with a white ball and when you play with the white ball so if you are colour-blind or straight blind everything kind of looks a bit dark and looks quite greyish. You won't be able to pick up that ball whatsoever. | 5:4 teaching... Challenges for learners who...; physical barriers in scholasti...; use of colour during instruct...<br>5:5 our colo... Challenges for learners who...; Extra murals |
| 46 | Interviewer | Sjo. So tell me what is your understanding of straight blind when you refer to straight blind? | |
| 48 | Participant 6 | Straight blind, I unfortunately I don't know. | |
| 50 | Interviewer | Don't know. Okay, so you say with cricket, when it's a white ball is very difficult to see the white ball. Especially if you if you straight blind, that's your word you referencing to? And it's in teaching do you often use colour when teaching uhm? | |
| 52 | Participant 6 | Yeah with colour it makes it, does help quite a lot especially with map work and that's how I picked it up with the child and I thought about the whole year we've been teaching about terrains and all of that. And not once did she come to me to say she didn't pick it up on the map. But when I went back to her map work marks I saw that she couldn't find the river or dam because she was looking for the blue, in turn she just couldn't pick it up where the blue was. | 5:6 Yeah with colour it... Becoming aware of learners ...; Challenges for learners who...; physical barriers in scholasti...; Practical examples of how t...; Working with learners who a... |
| 58 | Interviewer | That is so interesting. Sjo and in History, do you use any colour in History? | |
| 56 | Participant 6 | Uh we don't really use colour in History but obviously with History you want to make it a bit more fun with the PowerPoint and all of that so you do have a little bit of colour in the background of the cartoon. So I would say definitely to liven the lesson up I do use colour. | 5:7 we don't... Challenges for learners who...; Colour perceptions by teach...; Emotional/ social impact |
| 58 | Interviewer | Okay to to draw attention and to to make it more interesting and then you use colour in your PowerPoint. | |
| 60 | Participant 6 | Yes. | |
| 62 | Interviewer | Okay, and then tell me um, how is colour used in other resources such as textbooks and posters? | |
| 68 | Participant 6 | Well in the posters the colour draw an eye, doesn't it. You definitely want to have a lot of colour on there. And the textbooks is the same thing, the same thing as the teaching. A lot of the time you want to keep the kids attention span going, and colours can often do that. | 5:8 Well in t... Challenges for learners who...; Colour perceptions by teach...; physical barriers in scholasti... |
| 66 | Interviewer | Okay, so in the in the textbooks for History and Geography is there a lot of colour? | |



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| 68 | Participant 6 | Yes, there is a lot of colour. Also, the term work is colour coded. So, first term is red, second term is green third term is blue is and forth term is yellow. So I mean, that would obviously make it easier when you study for your final year exam to look at each term. | 5:9 Yes, ther... → Challenges for learners who... ; physical barriers in scholasti... |
| 69 | Interviewer | Mmm, sjo, so so it's not only used to draw attention, but also used to categorize information to make it easier for them. Okay. Any other places in textbooks or posters where colour is used differently? | |
| 72 | Participant 6 | Well obviously in the maps. Most countries, you have a different colour on them, and then depending on what kind of terrain or what landscape they have so that's also something that colour-blind people would definitely struggle with. Mostly if I look at my posters, for example, most of the posters I have are maps are colour coded, so you would struggle with that. | 5:10 Well obviou... → Challenges for learners who... ; physical barriers in scholasti... ; use of colour during instruct... |
| 73 | Interviewer | Mmm. Okay. And then according to you which challenges are faced with learners who are colour-blind within the school context. | |
| 76 | Participant 6 | Well we have spoken about it, a lot of challenges in finding information would be a lot more difficult. Trying to stay, to stay awake in class, I often refer to that as a dark blue day and kind of just wanting to get into bed and then just to sleep the day away. Where it is bright blue sky and the yellow sun does get you a bit more active in the morning if that makes sense. If you think a child that is colour deficient, probably has a lot more difficulty actually even just wanting to be in the classroom and learning because I do believe colour is quite important part. | 5:11 Well we have spoken... → Challenges for learners who... ; Colour perceptions by teach... ; Emotional/ social impact ; use of colour during instruct... |
| | | | 5:12 Trying to stay, to stay awake in class, I often refer to that as a... → Challenges for learners who... ; Colour perceptions by teach... ; Emotional/ social impact |
| 78 | Interviewer | So are you then saying that colour plays a role in our emotions and how we feel? | |
| 80 | Participant 6 | I definitely think so, yes. | |
| 82 | Interviewer | Okay, and because I just want to make sure I understand you correctly, because things might be a bit more dull to them. Emotionally, they might struggle more is that the only reason why you would would say that they things might be emotionally more difficult for them? | |
| 84 | Participant 6 | Yeah, I definitely think so. If they go into the classroom as learning as well. If you go into the class and you're already a bit down, and now you must go to a lesson, you'll probably not gonna pay as much attention as you normally would. At the end of the day it will affect your marks. | |
| 86 | Interviewer | Sjo. And was the child that was in your class, was this evident for you? | |
| 88 | Participant 6 | This actually wasn't evident for me until I picked it up. But obviously we are going to work on from now on in my teaching career is to try and pick up these things a lot earlier. And I will say the institution I do work at there is steps now to put into place to make sure that the kids can see and it's not colour-blind and all of that. | 5:13 This actuall... → Awareness ; Teacher support (training) |
| | | | 5:14 nd I will say the institution I do work at th... → Accomodate learners who ar... ; Becoming aware of learners ... ; Teacher support (training) |
| 89 | Interviewer | So interesting. So what are the steps that are in place to avoid this? | |
| 92 | Participant 6 | Well, I think a simple eye test. I know back when I was in school uhm we would have a nurse who would come in with a stet and eye chart and then do it and then if there were any queries our parents would be notify. I think that is something that should be put through schools. And then a basic colour test that could just help the learners understand better. I think a lot of the children are quite smart, but they can't see colour they can't actually see what's going on. They can't then use their full ability. | |
| 94 | Interviewer | Okay, so are you also saying that because they struggling to differentiate between colours, we don't always see their full, full ability? | 5:15 Okay, so are you also saying that becaus... → Challenges for learners who... ; Emotional/ social impact ; Working with learners who a... |
| 96 | Participant 6 | Yes, I definitely think so. | |
| 98 | Interviewer | How come? Can you tell me more about that? | |
| 100 | Participant 6 | Uhmm, sjoe. Like the map work and all of that, it just takes a bit longer. I mean when you give the exam you've got 90 minutes to do it and 45 minutes on map work. And if you can see the colour the 45 minutes would go a lot longer than if you can't figure out the colour. It definitely helps you to see things a bit quicker. As I said, for example, if you've got a good map, and it tells you to look for a dam, you need to look for a blue spot, because it's going to be a dam or a river where it's a colour-blind by you have to start looking through every square to figure out where it is or every block and that will take a bit longer. | |
| 102 | Interviewer | Okay, so taking longer to do work. And then my question coming back to my question, which was, according to you which challenges are faced with learners who are colour-blind within the school context, we've now focused on academics. Can you tell me a bit about sport and other extracurricular activities? | |
| 103 | Participant 6 | So with sport colour-blindness I really think can be majorly affected. Just for the specific colours. In cricket you have a red ball you have a white ball, you literally have a side screen that's put behind where the bowler runs from so that you can see the white ball on a black cover or you can see a red ball on a white cover that's how important it is and if you're colour-blind you wouldn't be able to see that and it's going to cause major major issues. | 5:16 So with sport colo... → Challenges for learners who... ; Extra murals |



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| 106 | Interviewer | So that's an interesting, thank you for that. And then my next question is how can schools accommodate learners who are colour-blind within the school system, and if you can provide me with some practical examples I can I'll appreciate it. |
| 108 | Participant 6 | Well, I definitely think that all schools can do a bit better to identify issues, nothing deep issues, which are probably in those in the primary phase and not not even getting to the secondary phase. And I think if colour-blindness is terminal sign that the child should definitely be given a bit of help, maybe with extra time within the exam, because it is going to be a lot more difficult. And then also, I think the teachers need to be understanding of this child who is colour-blind who will teach him in lots of colours to understand that they're not going to quite know what's going on. So I think communication probably be a big part of that as well. But I don't think there should be communication to the point that learner knows about this because you also don't want to make them feel like they are different, if that makes sense. |
| 109 | Interviewer | So do you almost want to keep it from the learner then? |
| 112 | Participant 6 | No, not obviously the learner can know they have extra division but don't let the class know. |
| 113 | Interviewer | Oh okay. How come? |
| 116 | Participant 6 | Well I just feel that things like that, once the learner is comfortable to tell her peers or his peers they will. I don't think it's something that needs to be forced upon anybody. |
| 118 | Interviewer | Okay, so this is something that that's are you saying this is something that's personal that they they maybe want to decide if they wanted to share with everyone and it shouldn't be almost announced throughout the class? |
| 120 | Participant 6 | Yes 100%. It's up to them if they would like to let the class know about it. |
| 122 | Interviewer | Okay, so because it's personal. Okay and then I wanted to ask you. If you mentioned that the first step is to identify learners who are colour-blind, and then from there to accommodate them. And one thing you mentioned was extra time. Can you think of any other ways to accommodate these learners in class or in tests or during instruction in class? |
| 123 | Participant 6 | If I'm honest with you, I wouldn't actually be too sure. |
| 126 | Interviewer | Okay, so not too sure? |
| 128 | Participant 6 | Not too sure no. |
| 130 | interviewer | And then if you think about sports, how can you accommodate learners who are colour-blind specifically if I think you've used cricket and you coach cricket. Can you think of ways there to accommodate them? |
| 132 | Participant 6 | Well, you definitely have to know if they are colour-blind and then you definitely have to know where to place the person if that makes sense. They probably couldn't field very close to the bat as they would need that little extra protection to be able to differentiate where the ball is, things like that would definitely help and just to know what their capabilities is if that makes sense. If the person is colour-blind it would be best to rather be a bowler then a bats man because as a bowler you deliver the ball and as a bats man you have to face the ball coming to you that's 130 kilometres + and that might be a bit difficult if you can't differentiate between the colours. |
| 138 | Interviewer | Okay, so as a bowler the ball is in your hand, you don't need to wonder where it is. But as the batsman you need to find the ball and identify the ball at a very fast pace. So is that why you referring to a bowler rather than a batsman? |
| 136 | Participant 6 | Yes. |
| 138 | Interviewer | Okay, that's interesting. And then my last question is, how can teachers be supported to better accommodate learners who are colour-blind? |
| 139 | Participant 6 | I think that education is extremely important part of that I think that teachers have a need to get educated on the risks and of colour-blindness and how the child will struggle. And then teachers need to get taught on proper strategies as to help the learner and I think it goes back to the question you asked me a few minutes ago, what would I do to change? And if I'm honest with you, I don't know enough about it to to come up with an educated answer. Whereas if I went to a seminar lecture, for example, and I could explained it, I'll will feel a lot better if a child came to me with this condition, and I was able to help. |
| 142 | Interviewer | Thank you for that. I really appreciate it. Anything else you would like to add? |
| 143 | Participant 6 | No, I'm happy. |
| 146 | Interviewer | Thank you so much for your time. I hope you have a lovely day. |
| 148 | Participant 6 | Thank you. You to. |
| 150 | Interviewer | Okay, good bye |
| 152 | Participant 6 | Bye bye. |

5:17 Well, I definitely think that all schools...
- Accomodate learners who ar...
- Awareness
- Becoming aware of learners ...
- Challenges for learners who...
- Emotional/ social impact
- Learner support
- Teacher support (training)

5:18 So I think communication proba...
- Emotional/ social impact

5:19 Well, you definitely have to...
- Accomodate learners who ar...
- Challenges for learners who...
- Extra murals

5:20 I think that education is...
- Awareness
- Teacher support (training)



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## Interview 6 (Participant 7 and 8)

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| 62 | Interviewer | Good morning. Thank you so much for your time. I I really appreciate it so much. Uhm I'm busy with my PhD on how to support learners who are colour-blind within the school system. And I just want to ask you a few questions. Uhm is that okay with you? |
| 3 | Participant 7 | Yes. |
| 6 | Participant 8 | Yes. |
| 8 | Interviewer | Okay. My first, so I think just to make this this easier because it's a dual interview is taking turns answering so maybe Participant 7 you go first and then Participant 8 you go second each time and then afterwards if somebody wants to add something then they can. Is that okay with you? |
| 10 | Participant 7 | Yes. |
| 12 | Participant 8 | Yes. |
| 13 | Interviewer | Okay. So my first question is, what is your understanding of colour vision deficiency which is often referred to as colour-blindness? |
| 16 | Participant 7 | According to me, as you can't see colours or specific colours so you see everything in a grey – white - black manner. That's what I know about it. |
| 18 | Interviewer | And if you're partly colour-blind? |
| 20 | Participant 7 | Then you can only only see specific colours and some colours you can't see at all. |
| 22 | Interviewer | Okay, thank you for that and Participant 8 your understanding? |
| 23 | Participant 8 | Uhm I think what I've read is it's more common amongst men. Also that there are there's a specific group of colours that they can't see the same way they see it in a different shade. So at a robot, they would maybe see the same colour for all three red, green and orange but the brightness would differ. So they do see a colour but it's different to what the normal side that people can see. But it's not the orange, for example, that we know is orange it's a different shade. I noticed on the board, for example, some learners would not see orange, for example, at all. |
| 26 | Interviewer | Sjo. That's interesting. Thank you so much. So tell me about your experiences teaching learners who are colour-blind. |
| 28 | Participant 7 | So that's how I realized that the kid in my class is colour-blind. We have the interactive whiteboards at school. And whenever I did a calculation in orange, yellow or on a cloudy day, red, she could not see what I was doing on the board. And I could see on her face that she's squinting and usually she'll interact and say yes and not. And then when I use I picked up when I use those colours, she only stared at the board. So that's how I picked up on it. |
| 30 | Interviewer | That's so interesting. So I just want to confirm so red and yellow were a general concern. But on a day where it was cloudy, so the lighting was a bit poorer. She struggled to see the red as well. |
| 32 | Participant 7 | Yes, the red was then a problem. |
| 33 | Interviewer | Oh, wow. Did, was she aware that she was colour-blind? Or is this something that you picked up during your lessons? |
| 36 | Participant 7 | Well according to me, she didn't. She didn't know there was a problem. She only realized that when I asked her okay, what colours can I use? Because why are you pulling your face like somebody is thinking. |
| 38 | Interviewer | Sjo that's so interesting. |
| 39 | Participant 7 | And then she said I'm struggling to see. And then we realized it's depending on the day, it's the colour. |
| 42 | Interviewer | That is so interesting. And tell me uhm in what grade is this? |
| 43 | Participant 7 | She was grade 9 at that stage. |
| 46 | Interviewer | At grade 9? So about 15 years old? |
| 48 | Participant 7 | Yes, yes. |
| 50 | Interviewer | Wow and and what was the process from there forward? |
| 52 | Participant 7 | I went to Miss XXX at our school, a deputy because she was the only deputy available at that stage. And I asked her what can we do to help this child and with the help of the school we went to Spec-Savers and they also realize that she's partially blind as well. And then they the school bought glasses and then they also send her to a counsellor. And now unfortunately she left the school so I am unsure how she's coping now. |
| 58 | Interviewer | Oh no, sjo that's so interesting. So the school went out of their way to uhm have her tested and get her the correct glasses to be able to see? |
| 56 | Participant 7 | Yes and because they also didn't have a medical aid. So I told Miss XXX that I will even take her on my own account. I will take her to Spec-Savers just to find out what's going on. Because the kid is not when we sit and work one on one she could do all the math but as soon as she went on a paper or when I did it on the board she didn't know what I was doing. So I realized there's something wrong. I didn't have and I still don't have the knowledge of exactly what was wrong, but I knew something was wrong. So luckily the school I reported it, and the school paid for everything. And they handled everything very very nicely and promptly. |
| 58 | Interviewer | Okay. And with the glasses was there a a difference in performance? |
| 60 | Participant 7 | Yes, yes. She went from just passing to I think 60 - 65. |

6:1 According to... — Awareness

6:3 Uhm I think what I've rea... — Awareness

6:4 So that's how I realized that the kid in my class is colou... — Awareness; Becoming aware of learners ...; Challenges for learners who...

6:2 So that's how I reali... — Awareness; Becoming aware of learners ...; Challenges for learners who...; physical barriers in scholasti...; Practical examples of how t...; use of colour during instruct...; Working with learners who a...

6:5... — Challenges for learners who...

6:6 Well according to me,... — Awareness; Challenges for learners who...

6:7 I went to Miss X... — Accomodate learners who ar...; Learner support; Practical examples of how t...; Working with learners who a...

6:8 Yes and because they also d... — Awareness; Becoming aware of learners ...; Challenges for learners who...



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| 62 | Interviewer | Okay. And then the glasses did they address more the the uhm almost want to say far sighted seeing and the blindness or the colour vision? | 6:9 Okay. And then... — Awareness; Becoming aware of learners ... |
| 63 | Participant 7 | Yeah, as far as I know ja they were very thick for somebody that didn't wear any glasses. That was very thick. And the doctor even said that he cannot believe that she went 15 years without anybody picking up on it. | |
| 66 | Interviewer | Sjo and passing school uhm and passing grades? | |
| 68 | Participant 7 | And getting to grade nine and still passing without being able to see some colours and basically see. | |
| 69 | Interviewer | Okay, and is it is it was a due to financial implications that that this wasn't picked up before or do you think? | |
| 72 | Participant 7 | Yes, I think so. | |
| 73 | Interviewer | Uhm, then **Participant 8** will you be so kind to share your experiences of teaching learners who are colour-blind. | |
| 76 | Participant 8 | I've had one boy, the story is very similar to **Participant 7's** story I just didn't have an interactive whiteboard I had a normal whiteboard. And I made notes on the board that they had to copy, I think it was, it was grade 9 also and they had to make notes on congruency and similarity with geometry. And I gave them a few minutes to copy the notes. And some of it I did in orange and some in green. And he asked me what must he write down and I said what I wrote on the board. And he said but there's nothing. The green he could kind of see but very faint, the orange he couldn't see at all. And that's when he also only realized that he's colour-blind. He came from XXX so the financial circumstances was not that good. So the school also took him to an optometrist and they got him glasses also very thick. And he was an excellent athlete so the optometrist gave him contacts that he could use in his athletics. And that also helped him a lot with the running. I don't know if it's something about the grass. He was a very good hurdle runner. And it didn't just help his his school performance but his confidence in himself because when he got to grade 12 he was head boy. He was overall a lot more confident in himself, it was from another school, previous school I was at. | 6:10 I've had one boy, the story is very similar to Participant 7's s... — Accomodate learners who ar...; Awareness; Becoming aware of learners ...; Challenges for learners who...; Emotional/ social impact; Extra murals; Learner support; physical barriers in scholasti...; Practical examples of how t...; use of colour during instruct...; Working with learners who a... |
| 78 | Interviewer | Oh wow **Participant 8** this is so interesting. So in what grade did you pick up? So you say you picked it up in grade nine, and then from there, he just flourished? | |
| 79 | Participant 7 | And Heloise, I also want to add, funny enough my girl was also a athlete and she even she was a long distance athlete. And even her performance improved after she could actually after the glasses. | 6:11 And Heloise, I... — Accomodate learners who ar...; Emotional/ social impact; Learner support |
| 82 | Participant 8 | He was a hurdle athlete, a sprinter and he did long jump and his performances in the athletics, he also played rugby yes and everything improved not just the school work. | |
| 83 | Interviewer | Wow. This is phenomenal. Well, so because the schoolwork improved and the sports improved the confidence and the uhm self-esteem has also increased. Do I understand you correctly? | |
| 86 | Participant 8 | Yes. | |
| 87 | Interviewer | Oh, wow. This is phenomenal. So tell me a bit how do you use colour when teaching and also how is colour involved in after school activities you are involved in? | |
| 89 | Participant 7 | Okay, while teaching I use different colours especially. I'm going to use but I use colours. For example, in grade nine when you did the algebra the bombing into the bracket. Then each time I bomb into a letter inside the bracket I will use a different colour. And the step where I make the little rainbow on top. I will write it in that colour. So let's say it's three outside the bracket and inside the brackets x plus y then I'll take green and I'll say make the rainbow and so three times x and then I'll write 3x in the green. Then I take purple for example do the three to the Y and write plus three y in purple then they can see the rainbow colour. I like to use colour when I explain it. And that's how you realize that the kids can see it because they'll ask where did that come from now? | 6:12 Okay, while teaching I use differen... — Challenges for learners who...; physical barriers in scholasti...; use of colour during instruct... |
| 92 | Interviewer | That's so interesting. So, so you use it almost as if coding strategy so that they can follow the different steps. | |
| 93 | Participant 7 | Yes, for the different steps. And for geometry as well, the different angles when you do the fun angles you'll know about that now, the fun angles, then you show them you draw the picture in black, and then you show them the F in a colour and also write that reason and statement in that colour, then you'll use a different colour, you show the U and you use that for the whatever is equal to whatever and the statement. | 6:13 Yes, for the dif... — physical barriers in scholasti...; use of colour during instruct... |
| 96 | Interviewer | That makes so much sense. I used to do it the same way so don't worry, I'm following you. | |
| 98 | Participant 7 | Yes, yes that's why I said you will know because you used to teach maths with us. | |
| 100 | Interviewer | And then any other places where you do use colour? | |



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| 103 | Participant 7 | Actually, for example, for Netball, we will pack cones and then the first cone is for example where you do lunges and then from the orange to the pink cone you do high knees and from the pink to the green you'll do burpees and so I colour code my activities and my warm ups and my drills in netball for example. So if you are colour-blind that's going to be an issue because you will just see grey grey grey grey so then you must focus so much harder to remember what to do where because you can't see the colour so I think it's more tiring for you that's a colour-blind netball player then what it is for the colour seeing netball players. |
| 108 | Interviewer | Any other places in netball where you make use of colour? |
| 106 | Participant 7 | For netball? |
| 107 | Interviewer | Yes. |
| 109 | Participant 7 | Ja the bibs and a lot of times the positions on the bib are in colour so you won't be able to see the other schools positions. |
| 112 | Interviewer | Sjo, that's interesting a lot of people have mentioned the bibs but I haven't actually thought about it that the writing on the bibs are in also in colour so differentiating which position they play. That's so interesting. |
| 118 | Participant | Yes, because a lot of schools don't do black on a colour they will do colour on a colour. For me as an Netball ref even that is colour seeing will sometimes wonder what is the position I can't see if the sun is on a certain angle. So what even if you're colour-blind as well. You'll only see a blur. |
| 116 | Interviewer | Sjo that is so so interesting thank you for that. **Participant 8**, uhm uhm tell me about how you use colour in teaching an extracurricular activities. |
| 118 | Participant 8 | Everything **Participant 7** said because I'm also a math teacher uhm with algebra I would underline like terms the same colour and like terms each one a different colour so that they know pink goes with pink and green in yellow and orange you cannot calculate with them when you add and subtract. Also, I need if I send the notes especially now with COVID when we do a lot of WhatsApp teaching or sending notes or putting it on Google classroom I would cam scan my notes and post it on the WhatsApp group or on Google Classroom and other. I will do an example and then for every step I would make an arrow and then write the step next to the sum and explain it in a colour and put it a cloud around it so that they can follow exactly what's happening. So I could think that a learner that's colour-blind can't see some of those colours and if the camera on the phone isn't good quality would also be blurry for them but also like **Participant 7** said with geometry you use colour a lot that's how they actually learn all their proofs and how to see the different angles and how to calculate and especially with highlighters majority highlighters do come in orange, yellow and green. So I can maybe think it's difficult for them then because I've noticed those are the majority colours that they can't see all that they can't differentiate between them they can maybe see a colour but they all look the same. And I don't do sport so I can't help you there. But everything **Participant 7** said made sense. |
| 120 | Interviewer | That's so interesting. Are you involved in any culture or anything else at school that involves colour? |
| 122 | Participant 8 | Extra lessons for mathematics. |
| 128 | Interviewer | That is I almost believe like a sport on its own. I just don't think it's always that fun. Uhm, just an interesting question with that with COVID and lockdown. I hear that the the way of teaching has changed to WhatsApp groups and Google Classroom and that that, you, you actually use a lot of colour on those platforms as well? **Participant 7** do you relate to this? |
| 126 | Participant 8 | Say again. |
| 128 | Participant 7 | Say again. |
| 130 | Interviewer | **Participant 7** do you relate to this? How was COVID influenced teaching for you? And how did it influence the use of colour in your teaching? |
| 132 | Participant 7 | I always use a lot of colour. And I was on maternity leave with COVID. So I didn't really teach this intense WhatsApp online teaching. When I came back I only had math lit classes. And with that I won't say you really use a lot of colour because it's more reading everything black and white. So all I can say is that when I came back, we also I didn't use my interactive board that much, I use the visualizer. And usually with math lit I did it in black or blue. |
| 138 | Interviewer | Okay, which made it much easier and much simpler? |
| 136 | Participant 7 | Which made it easier yes. And I think out of my experience with the girl, I I'm forcing myself to use, you know, the basic colours to use more basic colours then highlighters, like **Participant 8** said, I forgot about that. And highlighter. So I'll focus on the black, the blue and then the red. More primary colours. |
| 138 | Interviewer | Yes. Interesting. Which colours did you use to use or use in in normal math uhm when teaching? |
| 140 | Participant 7 | I must say the reds and the orange and the yellows and purple and green and all of it. And I must say my way of teaching has changed because of that girl. Because there's a lot of kids in math lit that will sit there and like we always say they can't even read. And it's maybe because they can't see. |
| 142 | Interviewer | That's so interesting |

6:14 for Netball, we will pack co...
- Challenges for learners who...
- Emotional/ social impact
- Extra murals
- physical barriers in scholasti...

6:15 Ja the bibs and a lot of time...
- Challenges for learners who...
- Extra murals

6:16 with algebra I would underline like terms the same col...
- Challenges for learners who...
- use of colour during instruct...

6:17 So I...
- Challenges for learners who...
- Emotional/ social impact

...
- Challenges for learners who...
- use of colour during instruct...

6:19...
- Challenges for learners who...
- physical barriers in scholasti...
- use of colour during instruct...

6:20 I think out...
- Accomodate learners who ar...
- Awareness
- Colour perceptions by teach...
- use of colour during instruct...
- Working with learners who a...

6:21 I must s...
- Accomodate learners who ar...
- Awareness
- Becoming aware of learners ...
- use of colour during instruct...
- Working with learners who a...



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| 144 | Participant 7 | So the only thing I change and what I do now with COVID is I make them sit in my class and math lit is a lot of definitions and stuff. So I forced them that every day they each read a definition. So I'll put the definitions on the board and then I'll say, okay, the the first row today it's your turn then they read the definition and explanation. So then then the next day the next row they know even they must remember where to stop, because I am because I'm aware of the problem now then you can also see if they can see or not. So I incorporate that that's what I can maybe say that I incorporated that into my into my teaching more, the kids must read more to, jy weet, must read more out loud in class, and I don't care if they like it or not. We just do it. | 6:22 So the only thing I change and what I do... — Awareness; Becoming aware of learners ...; Challenges for learners who... |
| 146 | Interviewer | So you almost using it as a screening tool to identify children with visual problems? | |
| 148 | Participant 7 | Yes, yes that's a better word. So that and because you can't go that you can't go to them with COVID. So the only way that I can pick up there's a problem now because you need to keep your distance is for them to read out loud. | |
| 150 | Interviewer | This is so interesting. Thank you for sharing. Participant 8 which colours do you often use when teaching? | |
| 152 | Participant 8 | I didn't stop I also use all the colours available every colour I can get I use. It's I'm also more aware of colour-blindness after this boy. I do ask the learners if they can see the specific colours. I do make a point of asking can you all see this? Because I do know that most of the time they are not aware that they can't, that they're colour-blind, that they can't see the colour. It's not that I really changed my methods or not. I stray away from using specific colour, but I do pay attention to asking them can you see the colour and I will sometimes plan and then I'll say but some people don't see the colour. That's why I'm asking you. | 6:23 I didn't stop I also use all th... — Accomodate learners who ar...; Awareness; Becoming aware of learners ... |
| 154 | Interviewer | And has there been children that were open enough to come tell you that they cannot see a specific colour or they struggling to see? | |
| 156 | Participant 8 | No, no. | |
| 158 | Interviewer | Not really. Do you think it's because there aren't any challenges? Or do you think there might be other reasons for not being open to? | |
| 160 | Participant 8 | I think it's I think it's a very rare thing. I think people adapt I think many people see colours differently but they learn. It's rare they don't see the same red I see they see a different shade. I've spoken to my dad recently and he told me that he is colour-blind to some level. He can't see the colours on a robot but he has learned the brightness if is it's this brightness then it is red. He can't distinguish between red, orange and green. But he pays attention to where the light is and the brightness level. And I mean, it's my dad, I never knew this and only recently he told me. So I think people just adapt and get used to it or they don't know. | 6:24 I think it's I think it's a very... — Awareness; Becoming aware of learners ... |
| 162 | Interviewer | So not picking up that they actually experiencing this challenge. Or they, they just find another way to cope, like you say your father looks at where the light is at the top or the bottom and what shade or brightness it is, that is so interesting. Thank you for sharing. | |
| 164 | Participant 7 | Then like somebody just said now a lot of kids are ashamed. They don't want to say that they see it differently than what others do. Because of bullying and everything they're scared they're going to be mocked because they don't see orange. Yeah, you don't want to be different, because it's already so difficult just to belong. | 6:25 Then like somebody j... — Challenges for learners who...; Emotional/ social impact |
| 166 | Interviewer | So are you saying that that being colour-blind can have an emotional impact as well? | |
| 168 | Participant 8 | Definitely. Yes. | |
| 169 | Participant 7 | Definitely. | |
| 172 | Interviewer | Okay. In the in what to? Sorry, let me go to the next question. The next question is, how is colour used in resources for learning, for example, textbooks and posters? | |
| 174 | Participant 7 | I think that it's okay, because most textbooks are black and white. Uhm I only in my life seen one textbook funny enough with Participant 8 that a textbook that's in colour, where they explain each step in colour next to it. I was only before that aware of textbooks that's black and white. Well black on white. | 6:26 I think that it's okay, becaus... — Challenges for learners who...; physical barriers in scholasti... |
| 176 | Interviewer | And this is now specifically for maths hey? | |
| 178 | Participant 7 | Yes. | |
| 180 | Participant 8 | Ja. That's math specifically. Like geography and other subjects I think would have colour in it ja. But also I agree, most majority of the math textbooks would be black and white or a grey scale. Very boring. | |
| 182 | Interviewer | And the posters in class? | 6:27 Interviewer And the post... — physical barriers in scholasti... |
| 184 | Participant 8 | I have lots of colour. | |
| 186 | Participant 7 | Ja ek het ook baie colours. I have lot of colour as well. | |
| 188 | Participant 7 | So at this moment in Participant 8's class, and it's just colour even her steps, her quadratic formula is in different colours. Linear sequence, everything is in colour. My class, all the posters is colour. | |
| 190 | Interviewer | So all the all the almost the writing decoration on the wall posters, all of that is done in colour. Do I understand you correctly? | |



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| 198 | Participant 8 | Yes. |
| 196 | Interviewer | Sjo. And then any other resources that you use in mathematics, maybe uhm abacus or anything else that you can think of that you might use. |
| 198 | Participant 7 | We have 3D shapes, we just said it now, 3D shapes. And all of that is in colour, different colours. So it's not just black and white. It's it's different colours. And when we show the volume, you obviously add a coloured liquid to show them the volume of the whatever the triangular prism or the cylinder and or whatever, then you add water with a little bit of colour in it, for them to see, you don't just put water because then they won't be able to see. So yes, you use colour in all your resources. |
| 200 | Interviewer | That's so interesting. Thank you for sharing. So according to you, which challenges and I know we've spoken about this already, but if you can just elaborate a bit according to you which challenges are faced by learners who are colour-blind within the school context. |
| 202 | Participant 7 | Say your question again, sorry. |
| 204 | Interviewer | No problem. According to you which challenges are faced by learners who are colour-blind within the school context? |
| 206 | Participant 7 | Okay, I'm going to answer it in two parts. The actual physical scene and the emotional part. Okay, the emotional part is the bullying and the not want to be different. And just keeping quiet because you don't want to be the weird one. The physical part is like we just said the explaining on the board is usually in colour. Then like we said the resources, colour. The only thing that's not in colour is the textbook and it's very difficult to go teach yourself something from a textbook. We all know that especially math. So I think it's quite challenging because there's the two way street, the emotional and the physical that's going to cost you because you are colour-blind. |
| 208 | Interviewer | And then on the physical level, what we spoke about earlier I just want to make sure I understand correctly. Because we struggled to differentiate colours we struggled to follow on the board. In sports we struggled to follow and differentiated, it influence our performance. Am I correct? |
| 209 | Participant 7 | Yes. |
| 212 | Participant 8 | Yes, definitely. And I think what I'm going to add to what Participant 7 said is, it depends on their social economic background of the child also. If the parents are very involved both parents or maybe both is working, not helping with homework, they also don't pick up on this. Or maybe they can't afford to take the child yearly or at a age of 12 for an eye check-up, it's not picked up or they don't have the resources to get glasses or contact lenses or I think that also is a struggle. |
| 214 | Interviewer | Sjo Participant 8 that's such a valid point you're making. Uhm Participant 8 according to you, what challenges do learners face? |
| 216 | Participant 8 | Like Participant 7 said, I think they're scared of being different and being bullied and being looked at differently. Maybe stop doing sport completely, because they can't see what's going on. Or they don't want to participate, because there're scared to ask for help. And then then they social and they may not even notice that they have a problem. |
| 218 | Interviewer | Mmm so almost, |
| 219 | Participant 7 | I'm thinking, I'm sorry, I'm interrupting. |
| 222 | Interviewer | No problem. |
| 224 | Participant 7 | Is that also playing sport, you need to pick a shirt and a pants. And you must, if you can't see colour, how do you know what pants and top you're wearing? So maybe they'll dress weirdly and people would mock them for that? |
| 226 | Interviewer | That's interesting. Yeah, it's got such a ripple effect. It influences so many aspects of life. |
| 228 | Participant 7 | Yes, again the emotional. |
| 230 | Interviewer | And then my next question is how can schools accommodate learners who are colour-blind within the school system and if you can provide me with some practical examples or suggestions? |
| 232 | Participant 8 | Um, I think like, with my previous school and that Participant 7 said about the girl she had, having someone in management you can go to where you can report this and have a contact in the community like an optometrist. Spec-Savers I know they do give glasses or they do eye tests for learners under the age of 12. If that's just I think, advertised more at schools and we encourage the parents to take the kids or ask Spec-Savers if they can maybe come do an eye test every year at a school for a certain grade, not even all the grades, just grade eights, for example, to pick up this and not just have a cut off at age 12. Because the kids are really young in primary school and you don't trust strangers around them. So if the community can maybe help. And also if you have someone in management you can go too. And we are very pleased we have counsellors at school. So if we pick up a problem we can refer our children to counsellors and the counsellors can help them. Not all schools are this privileged though. |
| 238 | Interviewer | Yes. And apart from apart from from drawing on external resources and referring to counsellors, if you think of the colour-blind learner in your classroom, how can you accommodate them in your class? |

6:28 We have 3D shap...: Challenges for learners who... | physical barriers in scholasti... | use of colour during instruct...

6:29...: Challenges for learners who... | Emotional/ social impact

6:30 he expl...: Challenges for learners who... | physical barriers in scholasti... | use of colour during instruct...

6:31 S...: Challenges for learners who... | Emotional/ social impact

6:32 Yes, definitely. And I...: Becoming aware of learners ... | Challenges for learners who... | Emotional/ social impact | Learner support | physical barriers in scholasti...

6:33 I think they...: Challenges for learners who... | Emotional/ social impact

6:34...: Extra murals

6:35 Is th...: Challenges for learners who... | Emotional/ social impact

6:36 having someone in management you can go...: Becoming aware of learners ... | Learner support | Teacher support (training)



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| 236 | Participant 7 | So as soon as you are aware you adjust your way, like I said you adjust your way of teaching because all of a sudden now I'm using more black where I never used to use black in my sums in the calculation. So now I'll incorporate black like I said more primary colours, the black, the blue and it's not so common, so you can adjust for just that class you can approach the whole colour thing differently because you're aware of it, but the problem still remains you're not always aware of this. |
| 238 | Interviewer | Okay, so basically adjusting the way you teaching by limiting the use of colours when you are aware of that learner. |
| 240 | Participant 7 | I would rather use then different handwriting styles. So I'll write something in bold something with a thinner black pen, then maybe put a twirly wirily underlining thing. I'll add more symbols I don't know how to say more symbols or graphic. More graphic in black then use colours. That Italic bold underline from Word. Yes, put it in a block. Like you said shapes and that's how I change it now that's when she was in my class. That's how I changed it. |
| 242 | Interviewer | Sjo, so you had to be very creative to think of alternatives ways. |
| 244 | Participant 7 | Yes. Yes, be more creative, write bigger. I started writing bigger. For example I will usually do two sums next to each other to show them when you did saturation this is when what to do if there's a negative in the middle and when there's a plus and a minus. I would do the two next to each other so that they can compare. Now we can't anymore because I have to write so big. One calculation will fill the whole board. |
| 246 | Interviewer | Sjo, that's so interesting. So really accommodating a lot in the way you teaching to accommodate these learners. |
| 248 | Participant 7 | Yes, yes, and you would move him or her to the front. |
| 250 | Interviewer | How come? |
| 252 | Participant 7 | Because then it is as, remember mine was a little bit blind as well. So to accommodate, to work with and especially while she was waiting for her glasses. And also the glare on the board from the windows. |
| 254 | Interviewer | Ja, that's another thing to consider hey, all the glare. And then Participant 7 in extracurricular activities? |
| 256 | Participant 7 | I will not colour code my cones anymore. I would say we work from line to line on the netball court. I won't really add cones and stuff like that and luckily for us the bibs is black with white on. And when we play against a school I will tell her to look at the faces and the position. |
| 258 | Interviewer | Okay, so almost using a different technique to identify who goes where. |
| 260 | Participant 7 | Yes, a different technique. Yes, yes, I would say focus on the face not on the bib, but then the masks make it a little bit more difficult, then we focused on hairstyles. |
| 262 | Interviewer | Sjo, that's a challenge hey. I think our world has created a lot of different challenges, but I'm hearing you're very creative in the way you approach it. Participant 8, uhm in your teaching style, how how would you accommodate learners who are colour-blind? |
| 264 | Participant 8 | I also moved the boy a bit closer, uhm something we did is we made all his notes and test papers and we printed it on a A3 and we made it a larger font, I think it was 18 or 20 because he also had some sight problems besides the colour-blindness. So all his teachers knew that they had to print him a separate one on A3 and with a larger font. |
| 266 | Interviewer | Okay, and then I assume black and white? Am I correct? |
| 268 | Participant 8 | Yes. |
| 269 | Interviewer | Okay so no colour. |
| 272 | Participant 8 | And also like Participant 7 said instead of those specific colours I use colours that he could see. I would ask him which colours do you prefer so those would be the colours and then I would also use more shapes rather than colours to make notes or different shapes between the steps or so. |
| 278 | Interviewer | That's so interesting, thank you for sharing. And then my last question is how can teachers be supported to better accommodate learners who are colour-blind? |
| 276 | Participant 7 | I think because it's not so common, you should have a structure in place that when you are, as soon as you become aware of it you have this plan that you going to follow. And it would be different for each teacher. The problem is that not every teacher is passionate and willing to help those kids, they will just say ahg that kid is dumb, they can't take my subject. For example I really don't know, you can call XXX in here how do they take Geography because they use maps, colour maps. So that might prevent that kid from taking Geography because she, maybe that is her best subject but she can't take it because she won't be able to see the colours on the map. That for me is a problem. |
| 278 | Interviewer | So you say that colour can influence their subject they chose in Grade 10? |
| 280 | Participant 7 | Yes, because she won't be able to take it because how do you help her to see a map? How do you help her see the lines on the contours and the features and what what. Wat is die goed in die lug? Wolke. Clouds. Sorry I wanted to say wolke. |
| 282 | Interviewer | Hehe, that's okay. That's so interesting. |

6:37 So as soon as you ar...
- Accomodate learners who ar...
- Awareness
- Learner support

6:38 I would rather us...
- Accomodate learners who ar...
- Learner support

6:40 Yes. Yes, be more creative, write bigger. I...
- Learner support

6:39 Yes. Yes, be...
- Accomodate learners who ar...
- Challenges for learners who...
- Learner support

6:41 I will no...
- Accomodate learners who ar...
- Extra murals
- Learner support

6:42 differen...
- Accomodate learners who ar...
- Extra murals
- Learner support

6:43 I also mov...
- Accomodate learners who ar...
- Learner support

6:44 instead...
- Accomodate learners who ar...
- Learner support

6:45 I think because it's not so com...
- Accomodate learners who ar...
- Challenges for learners who...
- Emotional/ social impact
- Teacher support (training)



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| 284 | Participant 7 | The clouds on a picture, if they must identify the different clouds and they give it to them in colour. And also Gr. 8 and 9 they have arts and crafts. She won't be able to take art in Grade 10, 11, 12. I'm talking about a she because I have a she, but the person. |
| 286 | Interviewer | But the person, so if you think about teachers what what do teachers need or how can we equip teachers better so that they can accommodate these learners in all subjects? |
| 288 | Participant 8 | I think awareness. I don't think people are aware of it. So if you communicate, people like you that do for example doing a PhD in this specific area to discuss the different barriers of learning and this is something you need to be aware of and its more common than what we think and there are different ways that we can identify it. If you educate people especially educators, because not everyone is aware of it. I am because I had one learner and I had barriers to learning as one of my major subjects so I know about the different barriers. But not everyone does. So I think educate the educators on this. |
| 290 | Participant 7 | I want to chip in here, I never had barriers to learning whatever, so for me it was luckily, I'm not saying I'm cool, but luckily I picked up on it because I care about the kids and then I went and I read and asked people how. I educated myself because I cared enough. The problem we face today is that people don't have the time and people don't care enough anymore to actually change their way of teaching because a lot of people will say there's 30 kids in my class, so why must I change my whole way of teaching for one kid. And then make it more difficult for 29. Because people are weird like that. So the problem is that people, the passion I know it is not what you want to hear but it's the passion the lack of passion in teachers. It's costing kids, from primary school they don't pick up on problems. And then it becomes a main stream problem and then it kinda disappeared in high school, because like we said they learn how to cope with it. And then they fall through the system like Participant 8 is saying. That why I think people need to educate themselves more or they must create awareness with this barrier to learning, it's not just dyscalculia or dyslexia or all of that but colour-blindness can cost them a lot, marks and friends. |
| 292 | Interviewer | So firstly awareness and then equipping and educating teachers to identify and support these learners not only for colour vision deficiency for colour-blindness but for other areas other barriers to learning as well? |
| 294 | Participant 7 | Yes, and the third thing I would add is to, while creating awareness to also educate the kids that they don't feel like the odd one out when they can't see orange. Don't let them feel that they not special or something wrong with them because again it opens up for bullying and being normalize it somehow. That's what I was trying to say. |
| 296 | Interviewer | Sjo, that's such a valid point. Well that's all my questions. Is there anything else you would like to add? |
| 298 | Participant 7 | No I think we said everything. |
| 300 | Interviewer | You have said a lot, I actually appreciate it so much. Participant 7 and Participant 8 thank you so much for your time. I really appreciate it and thank you for sharing your experiences and your knowledge it really makes it valuable input. Thank you so so much. |
| 302 | Participant 7 | It's a pleasure and good luck. |
| 304 | Participant 8 | It's a pleasure. |

6:46 I think awareness. I don'...
- Awareness
- Teacher support (training)

6:47 I want to chip in here, I never had barriers to learning whate...
- Awareness
- Challenges for learners who...
- Emotional/ social impact
- Teacher support (training)

6:48 I would ad...
- Awareness
- Emotional/ social impact
- Learner support



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## Interview 7 (Participant 9)

| | | |
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| 32 | Interviewer | Welcome, thank you for joining me today. I'm just going to ask you a few questions regarding children that are colour-blind also known as colour vision deficiency. Uhm if you can just be as open and as honest about your experiences. I would appreciate it. |
| 3 | Participant 9 | Okay. Good, good, lets start. |
| 6 | Interviewer | My first question is what is your understanding of colour vision deficiency which is often referred to as colour-blindness? |
| 8 | Participant 9 | So my deficiency uhm of colour-blindness is if a child can't see colour, meaning red or green, or any colour to do his work. Ja. |
| 10 | Interviewer | So discriminating between specific colours or cannot see colour in general. |
| 12 | Participant 9 | No, no colour in general. Any colour Ja. |
| 14 | Interviewer | Okay. Thank you. And tell me more about your experiences of teaching learners who are colour-blind. |
| 16 | Participant 9 | So uhm ja I am a foundation phase teacher, and uhm we didn't have or in my experience of a teacher, uhm we didn't really have children that's colour-blind. But uhm ja colour-blind as a teacher, colour-blind is a well known thing in schools, because the teachers can't, can't show it out or know how to work with children that's colour-blind. Even if they had to do test. And then like, for instance, in grade one, we often use lots of colour to do the test. So please colour, please colour the, the circle orange or, and then you will find uhm two or three children that that the colour is orange, and then they take red. They ja they will colour that circle red. And sometimes you just mark it and you don't understand why. Maybe they just don't know their colours. But actually they they don't they don't see the colour orange as red. So ja then they have it wrong. |
| 18 | Interviewer | Is this something that happens quite frequently? |
| 20 | Participant 9 | No, not really. No. |
| 22 | Interviewer | And if a child uhm does that, you actually don't, do you ask questions and investigate further or do you just assume they misunderstood the question? |
| 24 | Participant 9 | Like in my case, I'll ask I'll ask uhm the child if I see this child gets it more than twice or three times wrong in their test I will go further. But that's not the case in every every uhm foundation phase, teachers will just mark wrong, they will not investigate further they will they don't have time to go and sit with the child and see where the problem is. So they will mark it wrong. |
| 26 | Interviewer | Okay. Thank you. So tell me a bit more about how do you use colour when teaching and also when you're involved in after school activities. |
| 28 | Participant 9 | So in teaching, I will write on, in my class, I have a grade three class, so in my class I will use colour a lot of colour uhm on on the board because we start with with black and then after break all my children know after break, we'll start with a new colour and that's green. So they know first break I have to do the this work and second break I'll start with that colour. So my pens on my board. Those this is the colours is black, and then green and then red for for intermediate phase work that we do on the board. We will do it on on on the other side of the book but in red. So green and red is your your most common colours that the children can't see. So uhm ja but the the other colours is that we do have they can't see all of the children can't see that so we have an orange as well. So ja, I use I use a lot of colours on my board. And even on the sport is in the sports obviously the cones, the different cones, and the flags that we that we use. And even if they go out for life skills, there's a lot of colours that those teachers use. For those children to to get a certain mark. So ja. |
| 30 | Interviewer | Okay, so for example run to the red cone or… |
| 32 | Participant 9 | Yes, or if you go to your if you have the hoopels, you know, the hula hoops you have to do two legs in the orange one, or the pink one, or the blue one, or the red one, whatever. So in that, in life skills we do use a lot of colours. |
| 34 | Interviewer | Okay, uhm you just now mentioned I'm just going back to using colour in your class, you mentioned that sometimes you use colour in tests as well. Will you elaborate on that for me please. |
| 36 | Participant 9 | Yes. So in my tests uhm I would normally give them an Afrikaans as well, I will give them a script like, like a little story. And then I will say uhm, (it's Afrikaans school) uhm please circle the vocabulary all the vocabulary words uhm in pink or in red so they have to go back to the script and do that in colour as well. And then also, even in mathematics, we use colours as well we will say uhm forms like three dimensional or we will give them all the forms, and then will say, colour all the two dimensional colour that orange or whatever. But yeah, we do use a lot of colour as well in tests. And that's also a thing that we we are struggling with. Because it doesn't if a child get it wrong or right, it doesn't mean he can't do the maths. He just can't do the colour. |

7:1 So... — Awareness

7:2 am... — Awareness; Becoming aware of learners ...

7:3 But uhm ja colour-blind as a teache... — Challenges for learners who...; physical barriers in scholasti...; use of colour during instruct...

7:4 , I'll ask I'll ask... — Challenges for learners who...; Teacher support (training)

7:5 So in teaching, I will write on, in my class, I have a grad... — Challenges for learners who...; physical barriers in scholasti...; use of colour during instruct...

7:6 hoopels,... — Challenges for learners who...; physical barriers in scholasti...

7:7 So in my tests uhm I would normally g... — Challenges for learners who...; physical barriers in scholasti...; use of colour during instruct...



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| 38 | Interviewer | We assume that they cannot do the math, but it can mean that they struggle to differentiate between the colours. That so interesting. Uhm and then if you, let's first ask the next question. So how is colour used in the resources you use for learning for example, in the textbooks and the posters in your class? | |
| 40 | Participant 9 | So everything has colour. So even if there's a poster in my class, it's with colour, everything is in colour, if you read something also plurals that that's in colour. Uhm so everything in our textbooks if we go through, it's in colour. So we will say as teachers in my school. Uhm okay, please put your hands up who can see the uhm dog or what's, what is the colour that the dog is or something like that. So everything in our text books or on the walls or everything is with colour. And I will normally say okay, uhm so look at the back, uhm ja the back poster. Uhm and then show me how many orange circles do you see in the poster or uhm what colour is the verb or the whatever circled in Afrikaans. So I would in my class I would normally use the term colour a lot. | 7:8 So everything has colour. So even if th... → Challenges for learners who..., physical barriers in scholasti..., use of colour during instruct... |
| 42 | Interviewer | And uhm other resources, I'm trying to think of maybe having abacus or counters for maths, are they in colour? | |
| 44 | Participant 9 | Uhm ja, we don't, we do have abacus but we don't normally use that. | |
| 46 | Interviewer | On Grade 3 level. | |
| 48 | Participant 9 | Ja, so so but in Grade 1 and 2 they use it a lot. Yes, ja. | |
| 50 | Interviewer | And then uhm trying to think what other resources there might be in the classroom. | |
| 52 | Participant 9 | Let's see uhm, what do we have, we have shapes, that's that's also in Grade 3, we have our shapes that's that. And then we have uhm like a reading activity, but it's a window we call it like a window activity. So there's a, you have a script, and then the window can show you where you go to read. So to get those learners to read, and those are also in colour. So we will say, okay, uhm this is a grade one sentence. Go get the window that that's yellow, so it's a window that they put in the page and then for the learners that uhm gets to the next step it's red. So we say XXX let's read, you are now at the red level so that they know for the next time, there's levels and that's also to differentiate. | 7:9 we have shapes, that's that's al... → Challenges for learners who..., physical barriers in scholasti..., use of colour during instruct... |
| 54 | Interviewer | So it's basically used in an instruction, in writing on the board on the posters, their work big books, do they also use the uhm – want to say reenboog reeks - the rainbow uhm books that come from the department? | |
| 56 | Participant 9 | Yes, everyone use that. | |
| 58 | Interviewer | Tell me a bit about the colour in those books. | |
| 60 | Participant 9 | Yeah uhm I actually want to but out of habit I wanted to show you but that's also very colourful and they also use that the term colour a lot, so colour this in or take that or uhm even in the books we the teachers uhm mark with a red and green so in those books as well it's a lot of colour everything is colour. | 7:10 eah uhm I a... → Challenges for learners who..., physical barriers in scholasti..., use of colour during instruct... |
| 62 | Interviewer | And as someone mentioned to me that in the rainbow books that uhm the writing isn't all in black, the writing is even often in colour like for example the vocabulary words or the uhm specifically on what you focusing on. | 7:11 nd as someone me... → physical barriers in scholasti... |
| 64 | Participant 9 | The alphabet, yes yes. That's 100% correct. So its uhm, most of it is in black, but there is activities that are in like, I saw one in yellow and how hard is a yellow scripture to read, you can't read it. So ja. | |
| 66 | Interviewer | Sjo so there's actually a lot of colour. According to you, which challenges are faced by learners who are colour-blind within the school context? | |
| 68 | Participant 9 | Sjo, a lot, because like I said, everything is colour. So if you can't see the colour in and there's a question that you're going to have it wrong. So with 10 points, you know what it says because you can read. You can't, just can't see the colour. So it's hard, it's hard and ja there's a, if if the child is colour-blind then it's, it's really a difficult barrier for him to overcome. | 7:12 So if you can't... → Challenges for learners who..., Emotional/ social impact |
| 70 | Interviewer | So in test actually being able to follow that instruction? | |
| 72 | Participant 9 | Ja, that's that's hard because the teacher is more than 30 children in her class and this is just a normal school and if you don't have time to go back to that child and sit and do each question about colour one on one with that child there's other people around so it's ja, it's.. | 7:13 that's th... → physical barriers in scholasti..., Teacher support (training) |
| 74 | Interviewer | So are you then saying that there might be children who are colour-blind within, for example your class, but because the class is so big and also their curriculum is so full that he won't have the time to identify. | 7:14 So a... → Awareness, Becoming aware of learners ..., Challenges for learners who..., Learner support, Other learners awareness, Teacher support (training) |



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| 178 | Participant 9 | Ja, I miss that because obviously the child uhm if he doesn't know and I don't know and he's a bit, he's not afraid of me, but he's stressing or he looks at his his uhm friend or asked his friend, give me a red. He doesn't know, he can't see, but his friend gives him because they are small children they give him a red and then he colour. So he's not afraid, he just, I can't see it. So focus on that and that's the big thing about big schools. There's nothing wrong with the child. He's just colour-blind. And I don't I am honest I don't have time. I don't have time to go back to that child and do two or three questions all over again. So ja. | 7:14 So are you then saying that the... Awareness; Becoming aware of learners ...; Challenges for learners who...; Learner support; Other learners awareness; Teacher support (training) |
| 78 | Interviewer | Still to determine what is causing that he doesn't understand that question. It's interesting uhm so when the question was, let me just get to it, according to you which challenges are faced by learners what I'm hearing now is specific academic challenges that you're referring to uhm not being able to follow instructions or struggling in tests or getting lost on the page. Besides academic challenges can you think of other challenges these children will face? | |
| 80 | Participant 9 | Ja, uhm, let me just think uhm. In normal life as well uhm because obviously when he needs to get a driver's license or outside with his normal life and just like buying stuff and just to know that as well the colour so ja there's a lot of things. Actually if I think about it now there's there's a lot of things if you are colour-blind. | |
| 82 | Interviewer | Okay. So how can schools accommodate learners who are colour-blind within the school system? Please provide me with practical examples or suggestions. | |
| 84 | Participant 9 | So what I would say is every I'd know every every school kind of have like a tutor or.. | |
| 86 | Interviewer | Or a teacher assistant. | |
| 88 | Participant 9 | Yes, but if you can, or if there's like students that can help these children they must come into, obviously the teacher must know okay, this child every time when it's that colour the child gets it wrong so there's a problem and then the student can sit with that child and work one on one with that child and say, listen here can you show me the green or can you show me and if the child is not able to show then the student can say okay, then show me the circle. And if the child gets the circle right, then you pick up the yellow and say this is the yellow, colour the circle that you showed me colour that circle yellow. So I would say the the the teachers gets someone that can assist her as well if it's a big class so uhm, and for outside as well for uhm the practical outside. The child can do two legs, let the child jump not in colour but like in a row, jump. Don't tell him to jump on one leg from the one the green uhm cubicle to the red cubicle just jump one just jump there. Don't don't use colour. | 7:15 if there's like students that can help these children... Accomodate learners who ar...; Learner support; Teacher support (training) |
| 89 | Interviewer | Rather use sequence. | |
| 92 | Participant 9 | Ja, yes. | |
| 93 | Interviewer | Okay, besides sequence is there anything else they can use? | |
| 96 | Participant 9 | Uhm no, no. | |
| 98 | Interviewer | Not that you can think of. | |
| 100 | Participant 9 | No no sorry. | |
| 102 | Interviewer | That's fine. Uhm so in a class, you mentioned that the teacher uhm first needs to pick up that there's a pattern where we struggle where colours involved with an instruction or a test, and then uhm make use of a teacher teaching assistants. Besides a teaching assistant having a teacher's assistant and being able to identify that learner can you think of other ways uhm to support or accommodate these learners? | |
| 103 | Participant 9 | And so when it started the with the teachers she can identify the pattern she must if if she don't have a student obviously she must get it right so one on one with the child as well even if it's after school. Just do those three or four points that are like 10 points of the whole test just do it one on one with the child or uhm ask the parents to have like extra classes uhm so that you can help that child to do that. | 7:16 And so when it st... Becoming aware of learners ...; Learner support; Teacher support (training) |
| 106 | Interviewer | To identify what the challenge is. | |
| 108 | Participant 9 | Ja. | |
| 109 | Interviewer | Okay so if you've identified the challenge and the child is now in your class and you are teaching writing on the board and working in the workbook what would you do differently? | |
| 112 | Participant 9 | I will I will identify that which colour you can't see even if it's not on the board with the colours. We do have a chalk chalk board so that's white on green. So maybe you can see the white on the green or I can use other colours so that it uhm accommodates everyone so you can see maybe you can see purple. So I'll write in that colour for him. And then whatever colour he can't see I won't use that obviously because he can't see it. I know that he can't see it and then in my test, I'll do the same, I won't use those colours that he can't see. | 7:17 I will I will identify that w... Accomodate learners who ar...; Learner support |



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| 114 | Interviewer | So limit limit the use of colour to the colours that that child can discriminate between? | |
| 116 | Participant 9 | Yes. | |
| 118 | Interviewer | And if there's someone in your class that you (cannot hear the rest of the sentence), can you think of ways maybe to change the way you teach to, to be more inclusive? | |
| 120 | Participant 9 | Ja see, that is hard because some children, they only, they learn better. Or they, they remember when I when I do the colours. And I was also like that I learned very fast in colours. But if it's only plain uhm then it's boring. So that's a bit actually a tricky one, because obviously, I'm a teacher who likes colour, but you know I won't use the the the colours, I will just do it as, like, normal, not normal. Uhm I would say, what do I want to say... I want to say like, I'll do my lesson without colour or as simple as possible. So that that the colour isn't that often used in my lesson. | 7:18 that is hard be... Accomodate learners who ar... Colour perceptions by teach... Learner support |
| 122 | Interviewer | Okay. So you say you are a teacher that that learns better and loves colour. So for you this would be a a challenge. | |
| 124 | Participant 9 | Ja, that will be a challenge for me. | |
| 126 | Interviewer | And then you you mentioned that children learn better and follow instructions better when when they are in colour. Tell me about this. | |
| 128 | Participant 9 | So I'm a teacher that uhm makes a lot of jokes. So I like to, uhm to explain my things. While then everyone has to remember what I said. So when I do my lesson, I normally ask my children, okay, think of something, and then we'll draw it or we'll colour it in or think of a colour that you like, and you got to remember that. So every mathematics, when we, my children know every every time that we get something new have to get something new in our heads, we will start with green, I don't know why because they normally they love me. So my children know in mathematics we'll do a hard mathematics sum we will do in green. So I promise you, I don't know why but I'll go I will when we get that under our knee. I'll say, Okay, let's do our green, green sums. So they will know okay that's the one this is the sommetjie, that's the sum that had the star in or the circle of big circle or underneath has the green one. Okay, and then they will see, then they will remember, okay, our, our normal, normal class test that we do on a Friday those words are in orange. So I'll say okay can we lead with the orange words? Those words started with a what? That's our words for the week, remember everything was in orange. So get your orange words go, then I'll say okay, then they'll know this is the word, I need to do this words. So ja I do. I love colour in my class. So ja. | 7:19 So I'm a teacher that uhm makes a lot of jokes. So I like to, uhm to exp... Challenges for learners who... Colour perceptions by teach... use of colour during instruct... |
| 130 | Interviewer | So it is used to categorize, it's used to refer back to something, for them to help them to remember where to find that page. It's actually used a lot. | |
| 132 | Participant 9 | A lot. | |
| 134 | Interviewer | So how can teachers be supported to better accommodate learners? | |
| 136 | Participant 9 | First of all, I don't think, I know it is big classes, but if the teachers had all the parents will let us know that the child has colour-blind, first of all that class can't be as big. I know it is a normal normal classes is like 30 and up in our school, but if we know that forehand, I will say keep that keep the the class a little bit like smaller. So that we can, not just go through work. We have to go be able to go back and say oh yeah, we have a colour-blind child. Let me just do it slower and maybe do it two or three times over but in different ways so that they also can understand. | 7:20 First of all, I don't think,... Accomodate learners who ar... Becoming aware of learners ... Learner support Teacher support (training) |
| 138 | Interviewer | So teach them in a different way. | |
| 140 | Participant 9 | Yes. Like your pattern can be, so I don't accommodate the colour-blind, but I do accommodate the others as well. I do it colour and I do it, even if it's double but it's fine. | |
| 142 | Interviewer | Just for interest sake, let's say for example, you are now teaching this learner that's struggling to differentiate between colours. How would you change your instruction then? | |
| 144 | Participant 9 | I will say maybe like, like, in my class, I will say, okay, so count your red, were gonna underline this vocabulary what what in what colour even, like in a pink and then I'll say it again, I'll go past and I will see obviously didn't underline anything. So then I'll say he must read it for me, you must read the sentence for me or we must read it together. And then he will take a colour that he can differentiate and he will underline as well. And if the other children didn't get it, they can do it with that. So it's ja, | 7:21 I will say maybe like, l... Accomodate learners who ar... Challenges for learners who... Learner support |
| 146 | Interviewer | Okay, so a bit of repetition and also using colour that he's familiar with. | |
| 148 | Participant 9 | Yes, he's familiar with, we will read again and again. Ja. | |
| 150 | Interviewer | So coming back to my original question of uhm how can teachers be supported, uhm besides making the class smaller and being able to identify because often, they don't identify. Have you got any other suggestions? | |
| 152 | Participant 9 | Uhm, with that. | |
| 154 | Interviewer | The support teachers need. | |
| 156 | Participant 9 | The support teachers need? Like like a student? | |



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|---|---|---|---|
| 169 | Participant 9 | That have obviously I wanted to say resources so that they know uhm how to how... That's a that's a new thing. And obviously, it's a challenge for the teacher as well. So resources she must know okay. It's a challenge for me, but it's a it's more than a challenge for the learners. So I think resources is a very uhm… | 7:2... Accomodate learners who ar... Learner support |
| 162 | Interviewer | So what resources? | |
| 163 | Participant 9 | Uhm I don't know, I am not there to, I don't know the colour-blind because there's no colour-blind in my class. But uhm for example, let's think uhm in my class if I had a child, so when I say resources, I will say uhm different activities, but I just need to think what activities. It's it's hard. It is hard. | 7:23 But uh... Challenges for learners who... |
| 166 | Interviewer | It is hard. What makes it so hard. Is this something that you haven't had to think about before? | |
| 168 | Participant 9 | Ja. | |
| 169 | Interviewer | So it's a new thing? | |
| 172 | Participant 9 | So it's new. It's a new thing. There wasn't actually in my, in my past years that I teach, there wasn't actually a child in my class that was colour-blind. And I think as life goes on, I don't sit with a teacher. I do hear of it. I don't actually sit with the teacher and ask her okay, but.. | 7:24 So it's n... Awareness |
| 173 | Interviewer | ..How did you accommodate them.. | |
| 176 | Participant 9 | Ja, so it's hard. | |
| 178 | Interviewer | It is hard. So it is actually something that you haven't thought about before. And uhm in your training as teacher in your studies. Anything, any exposure to the concept? | |
| 179 | Participant 9 | As as I said uhm I did, we had learned about it, but it wasn't, there wasn't focus on it. Like, it's like we did that. But it wasn't like a topic. Like there was like maybe like one page or two pages that we read about it. So we know about it. But it wasn't like focus. There wasn't a focus on that, okay, that's a disability. We need to focus on that. It's just after you did your grade, you can go into colour-blind so then then there's more study. But not really. | 7:25 I did, we had lear... Challenges for learners who... Teacher support (training) |
| 182 | Interviewer | Thank you for sharing. I appreciate it. | |
| 183 | Participant 9 | Thank you. | |
| 186 | Interviewer | Is there anything else you want to add? | |
| 188 | Participant 9 | No. That's a very cool subject that you have there. | |
| 189 | Interviewer | Thank you. Enjoy your day. | |
| 192 | Participant 9 | Thank you. Bye | |

193



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# Appendix C2 – Research journal

## Research journal

*In this journal I have integrated my thoughts, reflections, and decision-making processes. I have organised all notes by means of dates.*

### 2020

**1 February 2020**

Yesterday we had a meeting regarding the layout and planning of my research proposal. I have a lot to learn and read up on. I still need to read up more on:

Paradigmatic perspectives (interpretivist/ constructivist) (approach: Qual, Quan, mix) (design: case study)

3 foundations

- Theoretical
- Epistemological (ontology, axiology etc)
- Methodological (research approach)

**17 March 2020**

I am excited about this new journey. I have started planning my research approach. I am considering using a mixed methods approach. This is new to me as previously I have only done qualitative research.

**26 March 2020**

Tomorrow, lockdown will start due to Covid-19. I am concerned how this will influence my study. However, I am also grateful for more time to focus on my study. Luckily lockdown is only for a short period of time.

**30 March 2020**

The national lockdown. I am wondering how this lockdown and COVID may impact my studies. Luckily it is only two weeks. I hope to use this time to work on my studies, especially my literature review. There is not a lot of data in the field. I often have to take into account sources older than 10 years due to limited research in the field.

**3 April 2020**

The lockdown has affected schooling. I wonder how I will get access to schools and teachers. A lot of schools have moved online and even my own work is often online or telephonic. In this period of time, I have also made use of Google Forms a lot. I am considering such techniques for data generation. How will this affect my data generation process?

**22 April 2020**

The national lockdown has been extended. Although this concerns me, and I wonder about the extent to which will impact my studies I plan to continue using this time to focus on my studies and hopefully finish my proposal.

How do you do both qualitative and quantitative data collection during a global pandemic and lockdown? What does the future hold? Will I be able to access schools if all the schools are closed at this point?

I hope this does not lead to extending my studies.

I have not been on campus once since starting my studies. I have had to mainly rely on online resources and publications. Although I was able to access most information online, I wish could go sit in the library and work quietly.

What to consider from and ethical perspective when doing research online? How will participants be able to ask questions? I have not done quantitative research prior to this. I think it might be helpful to find out how others are doing this.

**7 May 2020**

How do you collect data during a pandemic? I have started using online platforms in my



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work and should probably consider such platforms for my data collection.

**6 October 2020**

Today I defended my proposal. I did this online. Who would have ever thought that this would happen? Doing it online created a lot of stress for me as I had to master the use of the online software as well.

I think it went well. I had a lot of questions, regarding data collection in the current SA context. There were specific questions related to COVID-19 restrictions and how this may impact my data collection. I will have to be creative. I think this year has created a lot of new possibilities on using online means to gather data. I have for example had to master the use of ZOOM, Teams and Google Meet for various work and study related responsibilities.

**7 October 2020**

My proposal has been approved with minor changes. My supervisor and I will discuss the challenges and possibilities of gathering data in the current climate. I assume there will be limitations to gathering data face-to-face. I would have to change my way of thinking; I am used to face-to-face interactions and gathered my data this way in my masters. I hope that all my experience in 2020 with online forms and meetings will assist me in this regard.

**2021**

**6 February 2021**

I have had to revise my ethics application several times. During this process I had to consider gathering data online and the limitations associated with the COVID-19 pandemic.

**15 April 2021**

I need to look at doing qualitative research (PRA groups) online. How would discussions work in an online context. I have had some experience with ZOOM and Google Meet.

**21 April 2021**

One of the statisticians at the university is assisting me with my online questionnaire. Although I originally planned on using Google Forms for data collection, she is recommending Qualtrix.

**20 May 2021**

Today I followed up with the statistician at the university regarding uploading my questionnaire on Qualtrix. It seems to be taking longer than expected. I am hoping it gets finalised quickly as I am not allowed to gather research in the fourth term, and this might delay my whole study.

**31 May 2021**

I am very excited. My questionnaire is finally uploaded on Qualtrix, and I was able to complete the questionnaire myself to ensure all is correct. It went well and seems easy to administer online. I have that how easy it is to administer will contribute to getting enough respondents for my study.

**4 June 2021**

Today I had a meeting with the statistician to discuss how I will share the questionnaire with schools and teachers. I am planning on sharing the link on an email with administrative staff at the school or the principal of the school who will then distribute it to teachers via email.

**19 August 2021**

I spoke to my supervisor about using Kumospace, an online programme for PRA groups. I will research and play on Kumospace to plan on how to use it. Email respondents willing to participate and ask them about their availability in the school holiday.

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Notes from my supervisor:

- 3 core questions participants can discuss in breakaway rooms (20min per question);
- 4 to 5 participants per group;
- Explain the project and purpose of these PRA groups to them; and
- Explain to participants they are the experts when it comes to this topic.

**22 August 2021**

Will I have enough participants for PRA groups??? I am struggling to find respondents to participate in phase 2. I need to speak to Prof Ronel about this.

**2 September 2021**

All the respondents I have emailed or phoned are not getting back to me. I will have to follow up and see if I can get hold of more of them.

**6 September 2021**

I do not think I have enough participants for PRA groups. What other qualitative methods are available? I have used semi-structured interviews before and am familiar with them maybe this can be an option. I need to ask Prof Ronel.

**15 September 2021**

I have emailed all 19 respondents from phase 1 of the study who indicated they I can contact them to participate in phase two. I am concerned as so far it has been a struggle to find respondents for phase 1. I hope that phase 2 goes easier and I do not have to struggle to find enough participants. I feel like COVID-19 has made it really difficult to come into contact with people. The criteria to participate in my master's degree's study in 2017 and 2018 was much more specific but I was able to get enough participants much easier. It feels like Covid-19 related restrictions has negatively impacted my social networking skills.

In my master's degree I travelled to participants and interviewed them in the comfort of their own homes. During this process I was able to observe them, and they seemed comfortable and at ease. I have lees non-verbal information to work with during interviewing if it is telephonic. What impact will this have? I will have to listen very carefully to tone of voice, pauses and background sounds during interviews.

Apart from interviewing participants at their own homes in my master's what other techniques worked to set them at ease? Initial explanation of consent and the purpose of the research. Chatting to them casually when setting appointments. Showing interest in their stories and lived experiences.

**18 September 2021**

Pre meeting

I have an upcoming meeting with my supervisor regarding data collection and the way forward. I am really concerned about data collection in the current setting. Schools have reported that their teacher are stressed out and overworked and they do not want to overburden them with more work by participating in the study. I have struggled a lot to get schools willing to participate and have a had a low response rate to online questionnaires.

I wonder to what extent the area I'm doing research in plays a role. I am in the Ekurhuleni areas and there is not a university close by. When speaking to other PHD students in Pretoria, they seem to have had a much better response rate. Could it be that the schools in that are used to participating in research and have a different culture?

I wish I could get in my car and drive to schools. I am struggling to get schools willing to participate when I phone or email them.

Ideally, I wanted rural schools to participate to compare the quantitative results of urban



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and rural schools. However, I am not finding any schools willing to participate. When I phone, the number often does not work, no one answers, or they say that they will get back to me, but they do not. I have had no response from emailing the rural schools. I am so frustrated.

**20 September 2021**

Due to the lower-than-expected response rate to quantitative, I had to change from PRA groups to semi-structured interviews. The low response rate has really made my studies challenging. I cannot help but wonder what impact Covid had on this. I hope I gather enough information to keep my study valid.

I am not allowed to do research in term 4. This means that I need to do all interviews before the 11th of October.

**27 September 2021**

My first interview will be with two participants. Although I have done semi-structured interviews during my master's I have not interviewed more than one participant at the same time. I am a bit nervous about the process.

How can I ensure I hear both participants experiences? Probing and asking the other participant if there is anything they would like to add. Maybe repeating the question and addressing the other participant. I will need to make notes as I listen to ensure both participants answer each question. I can also ask participants if there is anything else they would like to add before proceeding to the next question.

**27 September to November 2021 (Reflections on semi-structured interviews)**

**28 September 2021**

**Reflection on telephonic conversation with participant 3 whilst setting up interview**

During an informal conversation with one of the participants prior to the interview in an attempt to set up the interview the participant noted that he has never taught children with CVD. He noted that this is an interesting topic as it is not something that is occurring often. This participant is the headmaster of a large public high school. Reflecting on my reaction during this conversation I wonder if he could hear that his response came as a surprise. I thought it was strange that a teacher who teaches Physical Science a subject where research shows the use of colour may negatively impact learners with CVD has not come across this. I wonder if he has maybe taught learners with CVD, but they maybe were not comfortable sharing their experiences with him.

8:1 no... Awareness; Working with learners w...olour blind/ experience

8:2 I thought it was s... Awareness; Working with learners w...olour blind/ experience

Furthermore, if he picked up on how I felt to his response could it maybe influence his responses during the actual interview? I hope to address this by building rapport and explaining to him that his actual experiences and honest responses are valuable prior to conducting the interview.

*Follow up reflection (29 September 2021):* During the interview he once again noted that he has not been aware of teaching a learner with CVD. He did note that maybe there were learners with CVD, but he was never made aware. He also acknowledged he is not aware of how common it is.

8:3 During the i... Awareness; Becoming aware of learners who are colour blind; Working with learners w...olour blind/ experience

**30 September 2021**

**Reflection on conversation with participant 1 prior to interview 1.**

Participant 1and 2 seem very interested about my research and noted that they have both taught learners with CVD when I contacted them to set up an interview. This makes me very excited as I can gather information on their actual experiences teaching these learners. I am surprised that both of them have had such experiences as both of them are young teachers and have not taught for many years.

8:4 th... Awareness; Working with learners w...olour blind/ experience

8:5 I a... Awareness; Working with learners w...olour blind/ experience

**2 October 2021**

101 **Reflection on interview 1**



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129 During my first interview one of the participants reported that a learner in their classroom with CVD could not see red pen on his tests and she had to mark his work in another colour. When reflecting on this, I wonder how many of his teachers were aware of this how it impacted his schoolwork but also how if affected him psychologically. It seems like CVD can even influence a learner's ability to see their marks and learn from their mistakes when teachers use red pen for marking and corrections. Teachers may not often realise how often they use colour.'

8:6 learner in their classroom...
Accomodate learners who are colour blind
Awareness
use of colour during instruction
Working with learners w...olour blind/ experience

130

131 Both participants were eager to share their experiences teaching learners with CVD. This was the first time I did a dyad interview. I made use of probing and often asked if the other participants wanted to add something. It seemed as if participants fed of each other's responses, and it encouraged conversation. The preparation in terms of how to ensure both participants get a turn to speak, and probing helped to be more prepared for the interview. It seemed as of colour is used differently in different subjects. Teachers were also made aware of the challenges by the learners who informed them of their unique challenges associated with CVD. It seemed as if they had to make changes in support of these learners.

8:8 Teache...
Becoming aware of learners who are colour blind
8...
use of colour du
8:9 It ...
Accomodate learners who are colour blind

132

133 How have two very young teachers who have only been teaching a year or two share experiences of teaching learners with CVD but a teacher who has been teaching for over 15 years not recall teaching learners with CVD? Based on the percentage of people with CVD in the world it is unlikely that he has never taught a learner with CVD. Could it be that he has taught learners with CVD but never noticed or been made aware?

8:10 How have two v...
Awareness
Becoming aware of learners who are colour blind
Working with learners w...olour blind/ experience

134

135 **2 October 2021**

136 **Reflection on interview 2**

137 This interview was with a teacher of a headmaster of a large public school. I know this teacher in a different capacity and took time to gain informed consent so that he does not feel pressured in any way to participate or answer a question he does not feel comfortable to answer.

138

139 As noted previously, I was surprised that he said he according to his knowledge he has not taught any learners with CVD. During our telephonic conversation when setting up the interview we discussed the prevalence of CVD and in the interview he noted that maybe he has taught learners with CVD but was not aware of it. I wonder if my conversation with him prior to the interview may have influenced his responses. It seemed as if it made him more aware of the condition. Although he has never taught learners with CVD, he made several practical suggestions of how he could support a learner who experiences challenges differentiating between colours in class. It could be that he has experience supporting learners with barriers to learning but not learners specifically with CVD.

8:11 I...
Working with learners w...olour blind/ experience
8:12 During...
Awareness
Becoming aware
8:13 I wond...
Awareness
8:14 Although he has...
Accomodate learners who are colour blind
Learner support

140

141 **4 October 2021**

142 **Reflection on interview 3**

143 Although the participant who participated in my third interview indicated that I could contact her for follow up data collection during the second phase of my study she seemed very distracted during the interview. I wonder if she only agreed because she knows me outside of the research setting. Could it be that she came across very casual due to our relationship? Could it be that my research was not taken as seriously as I hoped it would be taken?

144

145 *How can I avoid similar interactions in future interviews?* I plan to when setting interviews to emphasize to participants the importance of a quiet environment with little distraction and that external noise could negatively impact my research process. I could also during the interview note challenges with hearing the participant and that recordings may be unclear due to this.

146

147 This participant is the HOD and shared her experiences supporting other teachers who teach learners with CVD. This could be an alternative way of support be equipping HOD's to assist teachers under them on how to support learners with CVD. She shared

8:15 This p...
Becoming aware of learners who are colour blind
Teacher support (training)
8...
physical barriers in scholastic resources
Practical examples of ho...rs who are colour blind



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experiences of teachers who taught learners with CVD in Art and Geography. It seems as if each subject had unique challenges (I noted similar findings for the first interview).

8:15 T... Becoming aware of learners who are colour blind
Teacher support (training)

8:16 S... physical barriers
Practical examp
use of colour du
Working with lea

**5 October 2021**

**Reflection on interview 4**

**Conversation when setting up interview.** The participant assisted with the distribution of the questionnaires for the quantitative part of my study at the school where she works. She noted that she had several conversations with older teachers who taught with her in the foundation phase. She explained that several of them had taught learners with CVD and shared their experiences with each other after the completion of the questionnaire. I wish I could be part of this conversation. It seems as if the completion of the questionnaire itself stirred conversation and brought awareness of CVD.

8:17 She noted that s... Awareness
Becoming aware of learners who are colour blind
Teacher support (training)

**Actual interview.** This interview was done in person as I knew the participant prior, unfortunately it could not be done on the school premises hence no observations regarding the school environment could be made. Once again, I took time explaining informed consent to the participant to unsure that she does not feel pressured to participate or answer questions. This participant teaches in the foundation phase at a local primary school. The participant noted that she has not taught learners with CVD. She reported on her conversations with other teachers who have taught learners with CVD and shared practical examples of how they have supported learners with CVD. I made a similar note when setting up the interview; it seemed as if my study initiated conversations between her and other teachers on CVD and how to support learners with CVD in the classroom. It seemed as if foundation phase teachers often use colour. The resources in the classroom are colourful and she uses colour when writing on the board.

8:18 The p... Awareness
Working with learners w...olour blind/ experience

8:19 it see... Awareness
Teacher support (training)

8:20 It... physical barriers in scholastic resources
use of colour during instruction

She noted we don't always realise the challenges learners with CVD experience. She noted that sometimes children with CVD may seem to struggle with schoolwork not because of not understanding the concept but struggling to differentiate colours.

8:21 She n... Challenges for learners who are CVD

During the conversation she seemed relaxed and at ease. She often gave practical examples of how she uses colour in the class. It seems as if colour is used for various tasks and content including art, maths and reading and writing.

8:22 She o... physical barriers in scholastic resources
use of colour during instruction

**Reflection:** She has an honours degree in remedial teaching and does offer remedial support for learners with barriers to learning. Yet it seems as if she had not considered CVD as a barrier to learning prior to my study.

8:23 She h... Teacher support (training)

**6 October 2021**

**Reflection on interview 5**

This was a telephonic interview with a young male teacher at a high school. He seems to be involved in sport and gave examples of challenges specifically related to cricket.

8:24... Extra murals

He seemed to speak softly, at a distance and it sounded as if the phone was on speaker. He referred to a concept 'straight blind' but when I asked him what this means he could not define it. It seemed as if he was uncertain about the different types of CVD and associated challenges.

8:26 He ref... Understanding

**6 October 2021**

**Reflection on interview 6**

This was a dyad interview with two teachers from a high school who both taught Mathematics. The quality of this recording was clear. The participants engaged in conversation with very little probing needed. The two teachers seemed to know each other and comfortably engaged in conversation during the interview. This made the process easy and more natural. They often shared similar experiences to each other and gave similar examples feeding on each other's examples of experiences.

147 These teachers specifically reported on socio-economic challenges some learners with CVD faced and how the schools were able to support them.

8:27 T... Emotional/ social impact
Learner support

172



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It seems as if colour is often used in extracurricular activities. Participants shared about the use of colour in sport, specifically netball where bibs, cones, balls and filed markings are coloured.

Extra murals

8:28 It see...

**7 October 2021**

**Reflection on interview 7**

I knew the participant personally and took time to explained informed consent to avoid her feeling forced to participate or answer questions she felt uncomfortable to answer. Although her home language is Afrikaans, she is comfortable speaking English. I also confirmed if she is comfortable if the interview was done in English and she said yes. However, she seemed very anxious during the interview, and it seemed as if she struggled to find the right words in English. She was expressive in her body language and would try to explain with her hands if she could not find the right word.

She is a foundation phase teacher and reported on the frequent use of colour. She notes that her class is colourful; colour is used in textbooks especially the DBE books and that she often uses colour during instruction. It seems as if foundation phase teachers who participated in my study often used colour to assist in explaining concepts.

physical barriers in scholastic resources
use of colour during instruction

8:29 She is a fo...

**Reflection after all interviews (2 to 20 November 2021)**

2 in person

5 telephonic

I realise that several of the participants who are younger and have less teaching experience indicate that they have taught learners with CVD. How is this possible? Could it be that they are more observant of barriers to learning due to inclusive education? Could it be that learners felt more comfortable sharing their challenges with them due to their openness or teaching style? I honestly do not know. This might be an interesting topic for future research. I am relatively younger and can recall teaching learners with CVD when I was teaching. Could it be that my own experiences of teaching contribute to how I view this?

Awareness
Working with learners w...olour blind/ experience

8:30 I realise that several of th...

It seemed as if during the dyad interviews teachers actually gained insight from each other's experiences and shared similar experiences. They also engaged more casually and seemed comfortable. It could however be because these teachers all had experiences teaching learners with CVD and seemed eager to share their experiences.

Awareness
Teacher support (training)

8:31 It...

I only interviewed two primary school teachers, who both teach in the foundation phase. I may not have enough information on the use of colour in the primary school. In addition, one of the schools only allowed foundation phase teachers to participate in my study. It could be that colour is used differently in primary school subjects and extra-mural activities.

Extra murals
use of colour during instruction

8:32 I only interview...

Teachers noted that they often used colour during assessment activities, for example in lower grades learners are asked to colour certain shapes or write certain words in different colour. In higher grades colour is used in assessment activities as well, for example in map work certain features are colour coded and in history and art colour may convey important information for example blood stains on clothing in a picture. It seems as if learners with CVD may lose marks in assessment activities due to challenges distinguishing colour.

Becoming aware of learners who are colour blind
Challenges for learners who are CVD
use of colour during instruction
Working with learners w...olour blind/ experience

8:38 Teachers noted that they...

The teachers I interviewed reported on the use of colour in the specific sports they were involved in. Several of the teachers I interviewed coached hockey, netball and cricket. None of them reported on the use of colour in other sports such as rugby, soccer and swimming. I do recall that cones and coloured clothing or bibs to identify teammates were used in these sports when I was still teaching. I coached cross country and hockey and often made use of coloured cones for activities. Often in individual sports such a cross country, learners from the same school would wear the same colour clothing whereas with team sports the learners often wore the same colour clothing as well as bibs that were colour coded to indicate the position the played. I wonder how this may

Extra murals

8:33 The teachers I interviewed reporte...



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impact learners with CVD when participating in sports, especially team sports where colour may be used to identify teammates and positions. The teachers identified several challenges associated with the use of colour in sports, for example challenges seeing the ball or field makrings and challenges identifying teammates where colour coded clothing or bibs are used to differentiate between teams,

8:33 The teachers I... | Extra murals

Several teachers noted how learners with CVD may be impacted emotionally due to the challenges they may experience in the school context. The one participant noted that all the learners in class knew of a learner with CVD in the class, that they made remarks in an almost teasing manner and how this may have been difficult for him. Other participants noted that learners with CVD may be perceived as different and marginalised or even teased. I recall how when I was a teacher a learner in my class would ask me to not write with red on the board as he could not see. He raised his hand in front of the whole class asking me to use a different colour, while his peers looked at him strangely.

8:39 Several teachers noted how learner... | Becoming aware of learners who are colour blind; Challenges for learners who are CVD; Emotional/ social impact; Other learners awareness; Practical examples of ho...rs who are colour blind; Working with learners w...olour blind/ experience

**30 November**

Several of the participants reported that they had taught learners with CVD. Some of the teachers and schools made a lot of effort to support these learners. In some cases, the schools sent learners for eye tests. The participants made several changes to support these learners in their classrooms, for example they used less colours and asked learners if they could see when they wrote in colour in the board. It seemed that once teachers became aware of the challenges learners with CVD faced in the classroom, they were eager to assist them.

8:41 Several of the... | Accomodate learners who are colour blind; Awareness; Becoming aware of learners who are colour blind; Learner support; Teacher support (training)

**2 December 2021**

The participants ways of becoming aware of learners with CVD in their classroom varied. Some of the participants reported that the learners came to them and told them. Some participants noted that they became aware of the learners' challenges with seeing or differentiating between colours in class and that the learners were not aware that they had CVD. Several of these participants noted that the learners with CVD lots marks due to their challenges, for example the one teacher noted that when he looked at the learner with CVD's test, he could see that she lost marks at the map work section. I wonder how many learners with CVD are underperforming at school due to associated challenges.

8:42 The participants... | Awareness; Becoming aware of learners who are colour blind; Challenges for learners who are CVD; Practical examples of ho...rs who are colour blind; use of colour during instruction; Working with learners w...olour blind/ experience

**5 December 2021**

I am surprised that there are teachers who report that they have not taught children with CVD. I was a teacher for 6 years and can recall teaching a few children with CVD. Certain participants reported that they have not taught learners with CVD. Due to the prevalence of CVD, I wonder if they really have not taught any children with CVD or if they were just unaware.

8:34 I am surprised t... | Awareness; Becoming aware of learners who are colour blind; Working with learners w...olour blind/ experience

How can it be that some of the teachers that have been teaching a year or two report on experiences teaching learners with CVD but teachers who have taught many years note that they have not taught any learners with CVD? Certain participants reported that they have not taught learners with CVD. Due to the prevalence of CVD, I wonder if they really have not taught any children with CVD or if they were just unaware. Could it be that younger teachers training was within a more inclusive environment and they are more aware of such challenges? When considering the prevalence of CVD, it is unlikely that teachers who have taught for many years have not taught learners with CVD. Or could it be that learners with CVD maybe avoid the subjects taught be these teachers?

8:35 How can it be that some of the tea... | Awareness; Teacher support (training); Working with learners w...olour blind/ experience

**10 December 2021**

The teachers' responses varied when asked what CVD is. Some noted that people with CVD cannot see certain colours at all while others noted that certain colours may look like shades of the same colour for people with the condition. Further, some of the participants or of the opinion that people with CVD cannot see colour at all. I wonder how teachers' understanding of CVD may impact the support they offer for learners with the condition.

8:36 The teachers' respo... | Awareness; Understanding

Some of the participants noted that learners with CVD need to be identified so that they can provide support to these learners. It seemed as if some of the teachers did not have a universal view for accommodations in support of all learners but rather wanted to offer individual support to the specific learners with CVD. I wonder to what extent this would be possible in the South African context where there are resource constrains with regards to professionals screening for CVD and teachers teaching large classes.

8:40 Some of t... | Accomodate learners who are colour blind; Becoming aware of learners who are colour blind; Learner support; physical barriers in scholastic resources; Teacher support (training)



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Teachers recommended accommodations such as extra time for tests and examinations to support these learners, this may be an example of support in resource constrained areas, however here once again these learners need to be identified. The participants made several recommendations on adjusting teaching and instruction in support of learners with CVD, such as using shapes or symbols and writing in different fonts and line thickness and writing down steps to accommodate learners with CVD. These changes in teaching and instruction can be used in resource constrained areas as well as in situations where screening for learners with CVD may not be possible. Further the participants who had taught learners with CVD seemed to limit their use of colour in general or only use colours that the learners with CVD could see when writing on the board.

Participants also made suggestions on how to support people with CVD in other ways. The participants for example made suggestions on how to support learners with CVD on the sport filed by limiting the use of colour during training and making sure positions are readable by printing bibs in black and white.

8:40 Some of the participants noted that learn...
- Accomodate learners who are colour blind
- Becoming aware of learners who are colour blind
- Learner support
- physical barriers in scholastic resources
- Teacher support (training)

**12 December 2021**

When I was a teacher, I taught a learner with CVD. I recall how I limited the use of red due to the learner's challenges to see when I wrote with red on the board. Similarly, it seems as if the participants experiences teaching learners with CVD changed their teaching in a way that is more supportive of learners with the condition. Some of the teachers who participated in the study noted that after the completion of the questionnaire they had conversations with other teachers regarding their experiences teaching learners with CVD. Could it be that my study itself increased awareness of CVD and possibly contributed towards support for learners with CVD?

8:37 When I was a teacher, I taught...
- Accomodate learners who are colour blind
- Understanding
- use of colour during instruction

## 2022

**10 January 2022**

I am concerned that I do not have enough respondents for my quantitative data. I have contacted so many schools with no response. I am also concerned that I might not finish in time should I have to extend my data collection period and have to gain permission from the department of education. I am hoping to discuss my data with my supervisor soon in order to plan data analysis.

**18 January 2022**

At present I am busy transcribing the seven interviews. I am using Otter to do the initial transcription and then I am working through the transcriptions to make corrections and make sure everything is correct. Although this still takes a lot of time it is going much faster when using Otter.

**2 February 2022**

I have seen my supervisor and discussed my data with her. I have finished my data collection and am starting with data analysis. A statistical from the university is assisting me with the data analysis. I will start by reading through my transcribed interviews again to familiarise myself with the data.

**13 February 2022**

I used Atlas.ti to transcribe my interviews when doing my master's degree. It worked very well. Prior to using Atlas.ti in my masters (2017-2018), I went for training at the University of Pretoria on how to use it. I still remember all the basics.

**19 February 2022**

Today I watched a few YouTube videos on how to use Atlas.ti to refresh my memory. I am excited to start using it to analyse my interviews.



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# Appendix C3 – Field notes

**Field notes**

**Field notes on interview 1 (2/10/2021)**

*Field notes made during interview*:

Dyadic telephonic interview

Two young female teachers, teaching high school students.

Both have taught learners with CVD.

Relaxed and eager to share their experiences.

Note that learners with CVD came to them and told them they cannot see certain colours.

Mention red, orange.

The one participant noted that she had a learner with CVD and she had to mark his work in a different colour due to his challenges with seeing red.

Have to repeat questions- sometimes communication unclear when we are 3 people participating in a telephonic conversation. Due to no facial cues difficult to determine who is speaking and if they heard questions clearly. Luckily, they asked when uncertain.

Practical examples of their experiences and ways of support.

In class teaching in colour and colour used in extra-curricular activities.

Participants responded to what each other shared and noted similar examples.

Do two participants participating in a dyad interview make them more comfortable? Spotlight not on them. More casual and more a conversation than the one-on-one interviews I did in masters.

I often paraphrased responses. What influence does my choice of words have on the participants?

Did I manage questions well to include both participants in the interview? How can I do this better?

Both gave examples both commented on the other's experiences.

**Field notes on interview 2 (2/10/2021)**

Telephonic interview- little opportunity for observation.

Very formal short answers

Does not recall teaching learners with CVD. Prior to interview we had a discussion on the prevalence of CVD, he was surprised and did not realise it is so common. Notes in his interview maybe he has taught learners with CVD but was not aware of it.

Headmaster of a public high school.

Physical science to Gr12 level for 15 years.

Use colour.

- Draw attention.
- Affect the emotional state.

Gives a lot of practical examples on how to change teaching and instruction for learners with CVD.

- Font
- Ask them.
- Expose

Expressed a need for awareness and practical ways on how to accommodate such learners.

**Field notes on interview 3 (4/10/2021)**



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Telephonic interview
Humanities HOD high school

Prior to starting to record the interview she asks how long this will take and notes she is busy doing washing can I hear her moving around as I am on speaker. Does not seem very keen on participating.

Due to being on speaker at times struggled to hear the participant. Can hear she is moving closer and further away from the phone and is doing something else while talking to me based on the amount of movement and background noise. (She also mentioned she is busy hanging washing)

HOD- share experiences of teachers working under her. She herself has not taught a learner with CVD.

9:10 H...
- Awareness
- Becoming aware of learners who are colour blind
- Practical examples of ho...rs who are colour blind
- Working with learners w...olour blind/ experience

Challenges in specific subjects:

- Art: only paint in black and white
- Geography: Struggle to see colour code features on a map

9:11 Challenges in specifi...
- Challenges for learr
- use of colour during
- Working with learne

Teaches history – colour in photos and videos. Learners with CVD may miss important information such as bloodstained clothes.

**Field notes on interview 4 (5/10/2024)**
In-person relaxed and at ease. Not at school.
Consent NB not forced to participate as I know her personally. (How does my relationship with her and previous conversations on my research maybe influence her responses?) Notes she had conversations with other teachers who have taught learners with CVD.

Foundation phase
Honours in Remedial teaching yet limited knowledge of CVD as a barrier to learning.

Often use colour to assist in explaining topics.
Still use green board – write with red on green (CVD?).
Maths counters colour coded.
Use colour when doing reading comprehension.

9:12 Often use c...
- physical barriers in scholastic resources
- use of colour during instruction

**Field notes on interview 5 (6/10/2024)**
Telephonic interview
Soft – struggle to hear him. Seems like I am on speaker, echo.
Young male teacher at a high school

Coach cricket- aware of challenges in cricket for learners with CVD.
He teaches Geography and only after a while realised that a learner in his class could not find features that were colour coded such as rivers on maps. He noted that when he looked at her actual work, he realised she lost marks in mapwork because of this. He then went on the explain that that was how they realised she was colour blind.

9:19 He teaches...
- Awareness
- Becoming aware of learners who are colour blind
- Challenges for learners who are CVD
- Practical examples of ho...rs who are colour blind
- use of colour during instruction
- Working with learners w...olour blind/ experience

Teaches Geography
Experience teaching a learner with CVD.
Cannot find river on map – colour coded. He realised she has CVD.

9:13 Teach...
- Becoming aware of
- Challenges for learr
- Practical examples
- use of colour during
- Working with learne

Uses concept 'straight blind' not able define it. Maybe uncertain about the different types of CVD.

9:14 U...
- Understanding

**Field notes on interview 6 (6/10/2021)**
Dyad interview
Two maths teachers, high school
Both speak load- easy to hear.
Engaged in conversation – eager to share their experiences.
Little probing needed.



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teachers seemed to know each other well.

Similar experiences

Both teach Math.

Child struggle to see writing in different colours on the board.

Realised child struggles – not aware of their CVD prior

socio-economic challenges – support from school

The participant noted the possible emotional impact for learners with CVD noting that they may at times be excluded or teased due to being different and the challenges they experience.

Practical examples of the use of colour in sport and ways to support learners with CVD.

Netball: cones, bibs, ball, field markings

**Field notes on interview 7 (7/10/2021)**

Know personally - explained informed consent to avoid feeling forced.

Home language Afrikaans - gave the option of doing the interview in Afrikaans, but she said it is fine in English.

Seems anxious, hesitant, struggled to find the right words in English.

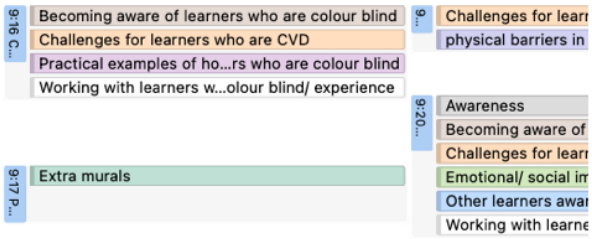
Expressive in her body language, try to explain with her hands if she cannot find the right word.

Foundation phase teacher

Frequently use of colour.

Colourful class

Often uses colour during instruction – uses it to help learners remember work.



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# Appendix C4 – Reflections on data analysis

**27 February 2022**

I have read through my data several times and am now starting to identify themes within the data. Although this was not planned, several themes that are emerging are related to the specific questions I asked. For example, I asked about the use of sport in after school activities and one of the themes that is occurring is the use of colour in sports and how this may negatively impact learners with CVD.

**2 March 2022**

The use of colour by teachers, in the classroom and in teaching resources is occurring a lot in the data. Teachers also explained how they use colour in their specific subjects and during after school activities. Teachers gave several reasons for using colour as well.

**1 March to 4 March**

Handwritten notes during coding on the use of colour:



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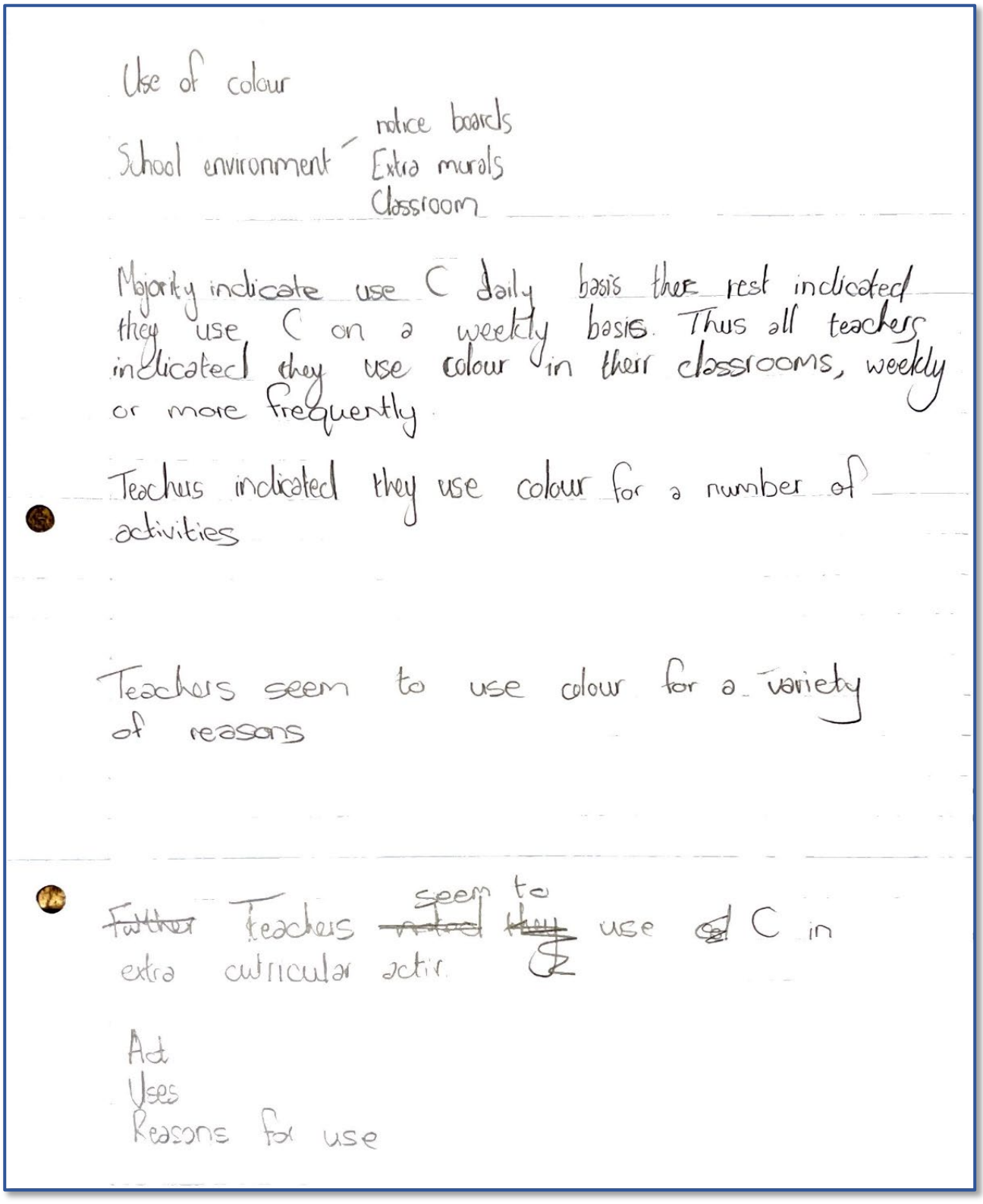


**5 March 2022**

In my process of analysing the use of colour in sport in my qualitative data, I realised that several of the teachers I interviewed coached hockey, netball and cricket. None of them reported on the use of colour in other sport such as rugby, soccer and swimming. I do recall that cones and coloured clothing or bibs to identify teammates were used in these sports when I was still teaching. I wonder how many sports strongly rely on the use of colour.



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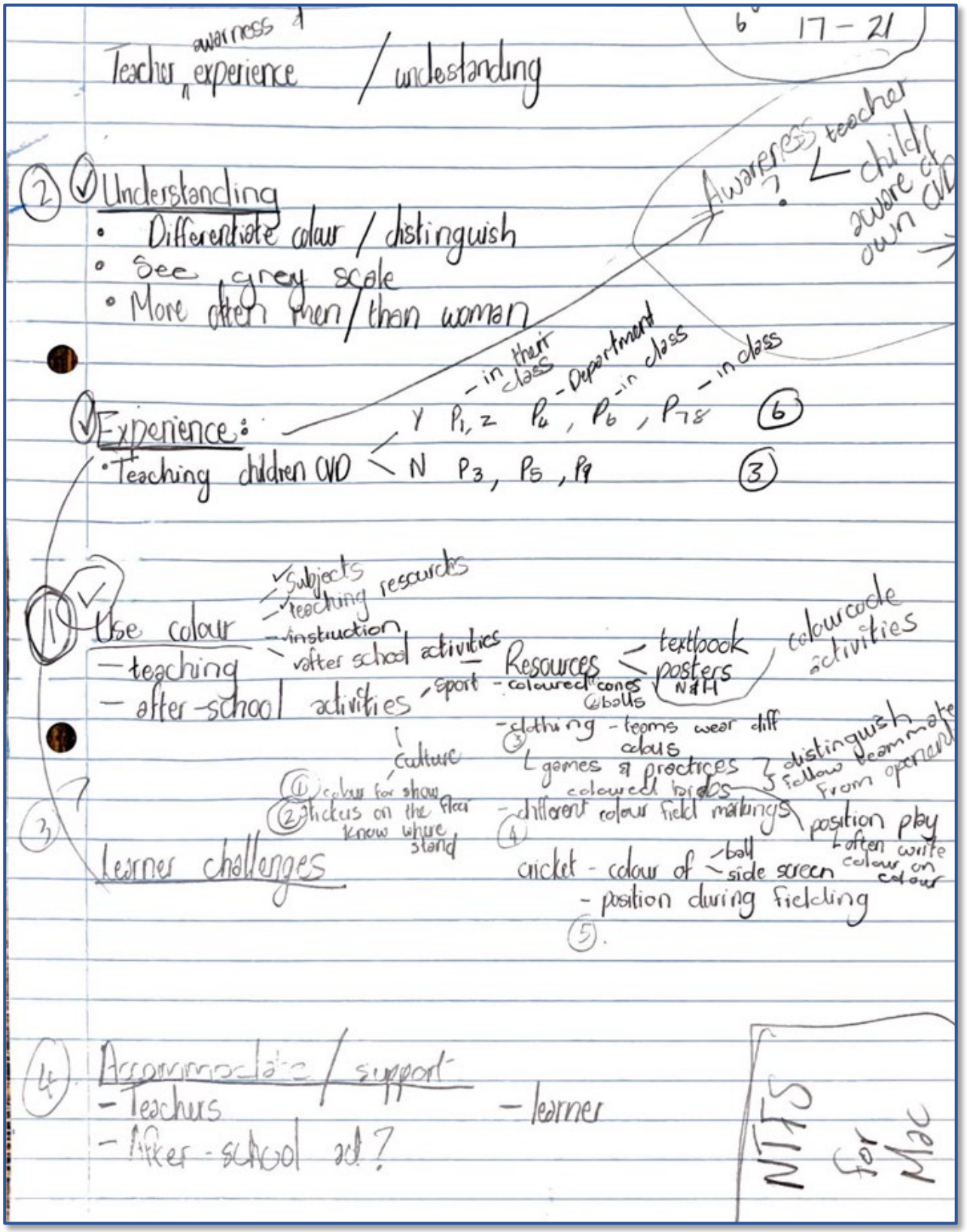
**April and May 2022**

Handwritten notes while coding qualitative data:



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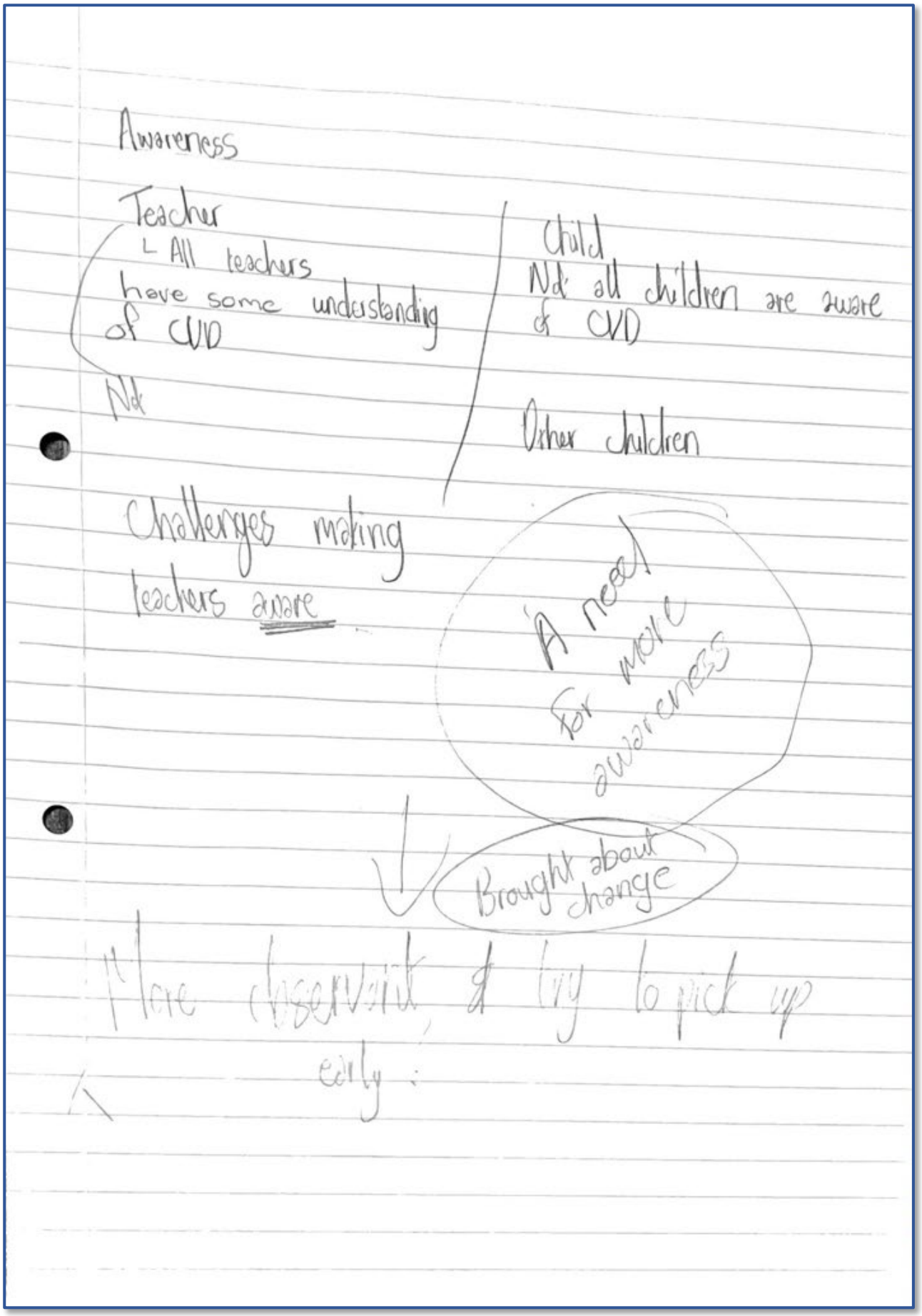




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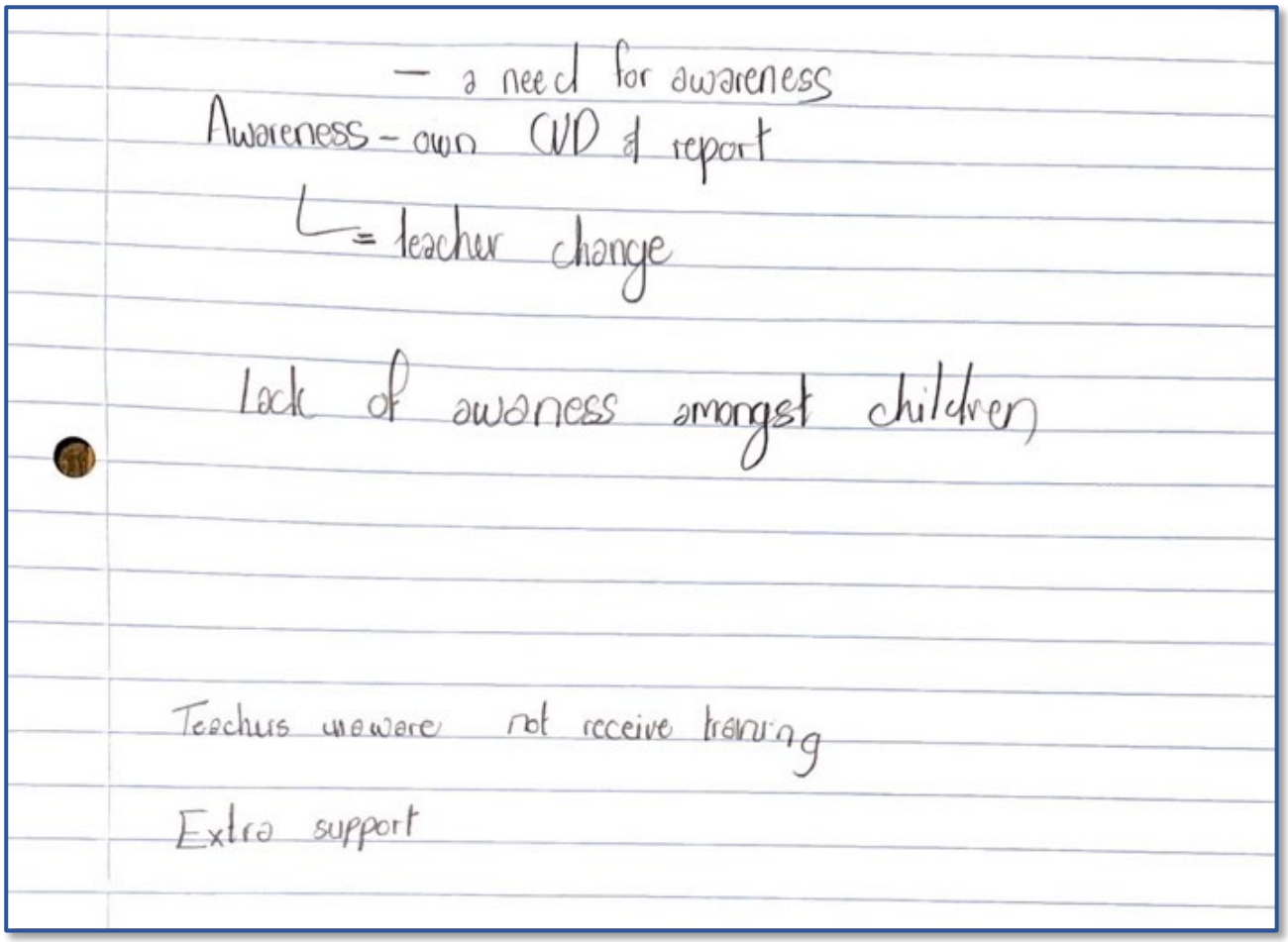




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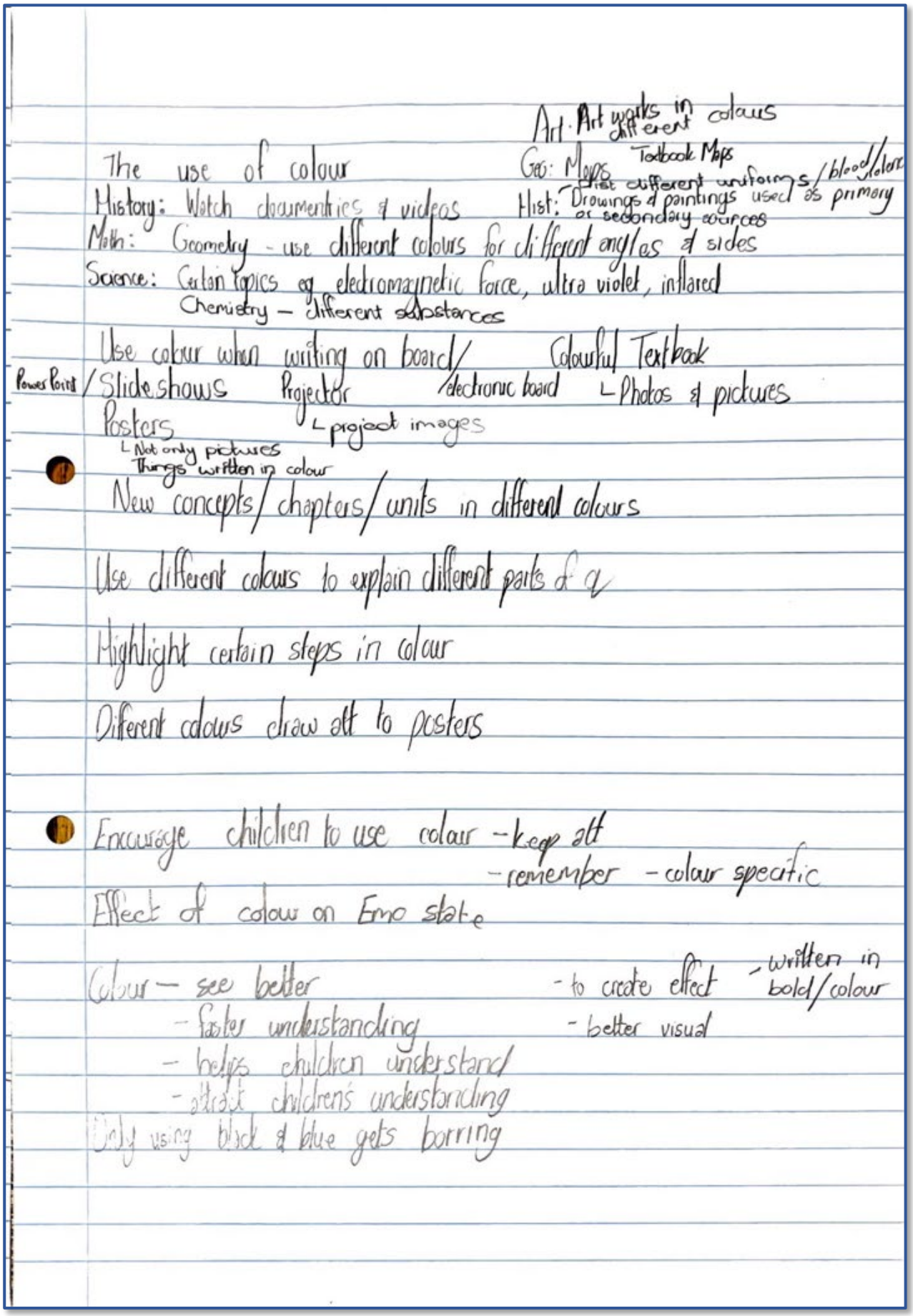

The use of colour

Art: Art works in different colours

Geo: Maps Textbook Maps

History: Watch documentaries & videos

Hist: Different uniforms / blood colour
Drawings & paintings used as primary or secondary sources

Math: Geometry - use different colours for different angles & sides

Science: Certain topics eg electromagnetic force, ultra violet, infrared
Chemistry – different substances

Use colour when writing on board / Colourful Textbook

PowerPoint / Slideshows Projector / electronic board └ Photos & pictures

Posters
└ project images
└ Not only pictures
Things written in colour

New concepts / chapters / units in different colours

Use different colours to explain different parts of a

Highlight certain steps in colour

Different colours draw att to posters

Encourage children to use colour - keep att
- remember - colour specific

Effect of colour on Emo state

Colour – see better
- faster understanding
- helps children understand
- attract childrens understanding

Only using black & blue gets borring

- to create effect - written in bold / colour
- better visual



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Chapter 4 Themes Qual

① Use of colour
- Instruction ✓
- Subjects ✓
- Perceptions?
- Teaching resources ✓
- After school ✓ Numbering

② Teachers' understanding + personal experiences
- Understanding ✓
- Awareness *
- Personal exp

Hence forth the following abreviations will apply

I = Interview PI / IL dyad
P = Participant
Line / page

Telephonic I < I
person

Dyad



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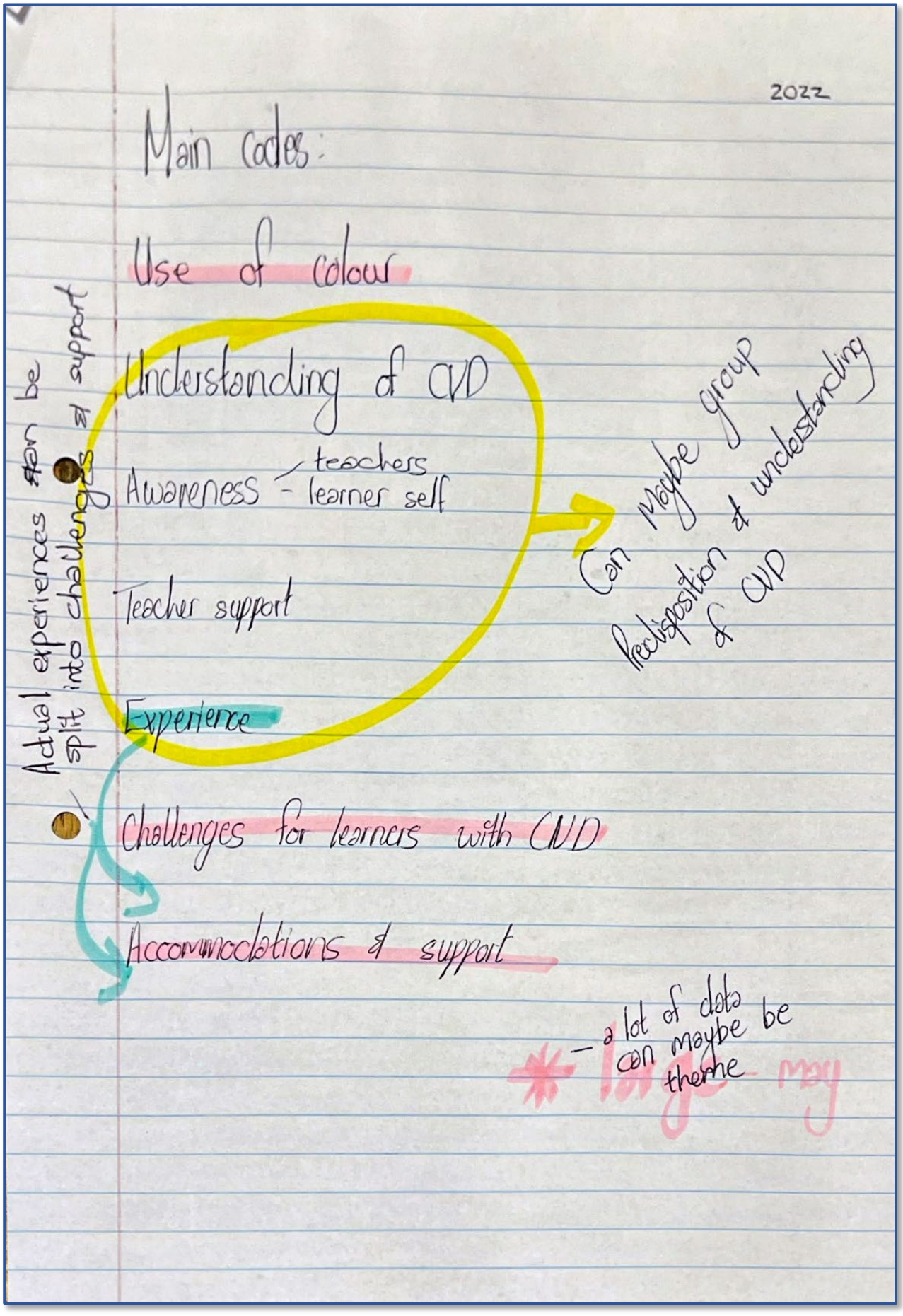
**27 June to 1 July handwritten notes on themes and data analysis**



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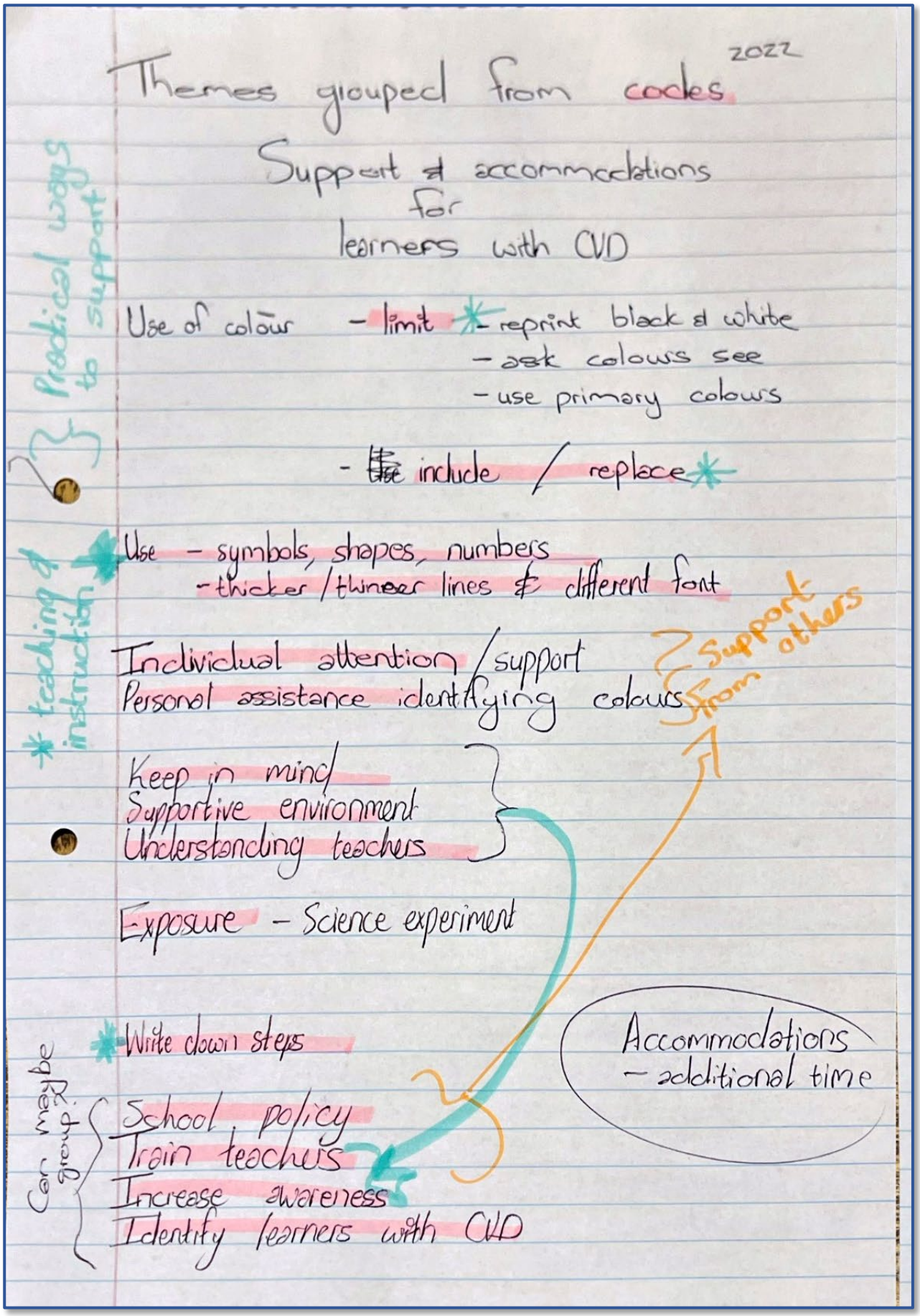




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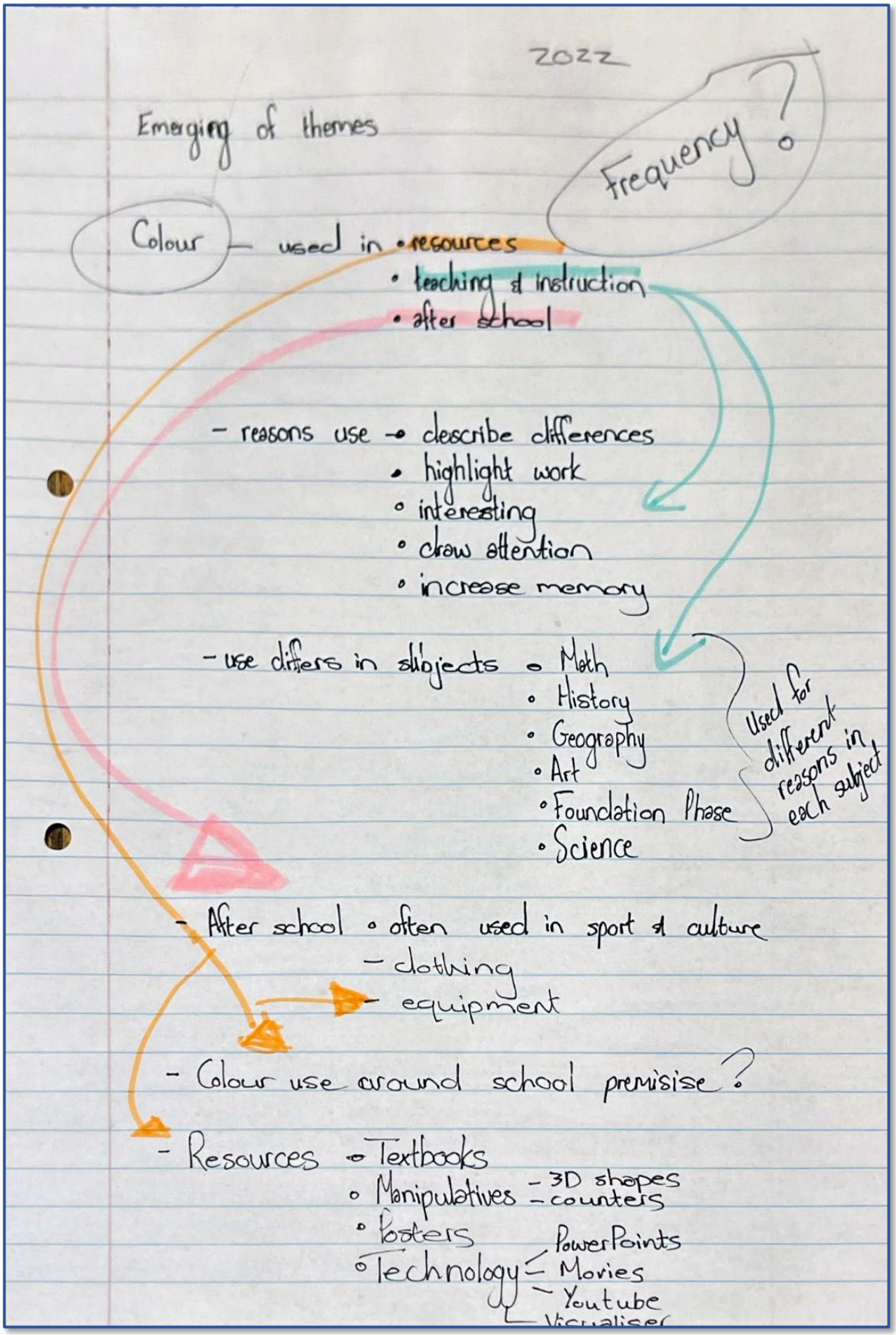




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Possible theme : 2022

Teachers experiences

6/9

Realisation

- 2/9 informed by child
- 3/9 child struggle see on board
- Geo map work
- Art black & white

} 4/9 teacher identify learner with ADD

≠

Practical ways they assisted these learners

challenges Support

Already part of other possible themes?



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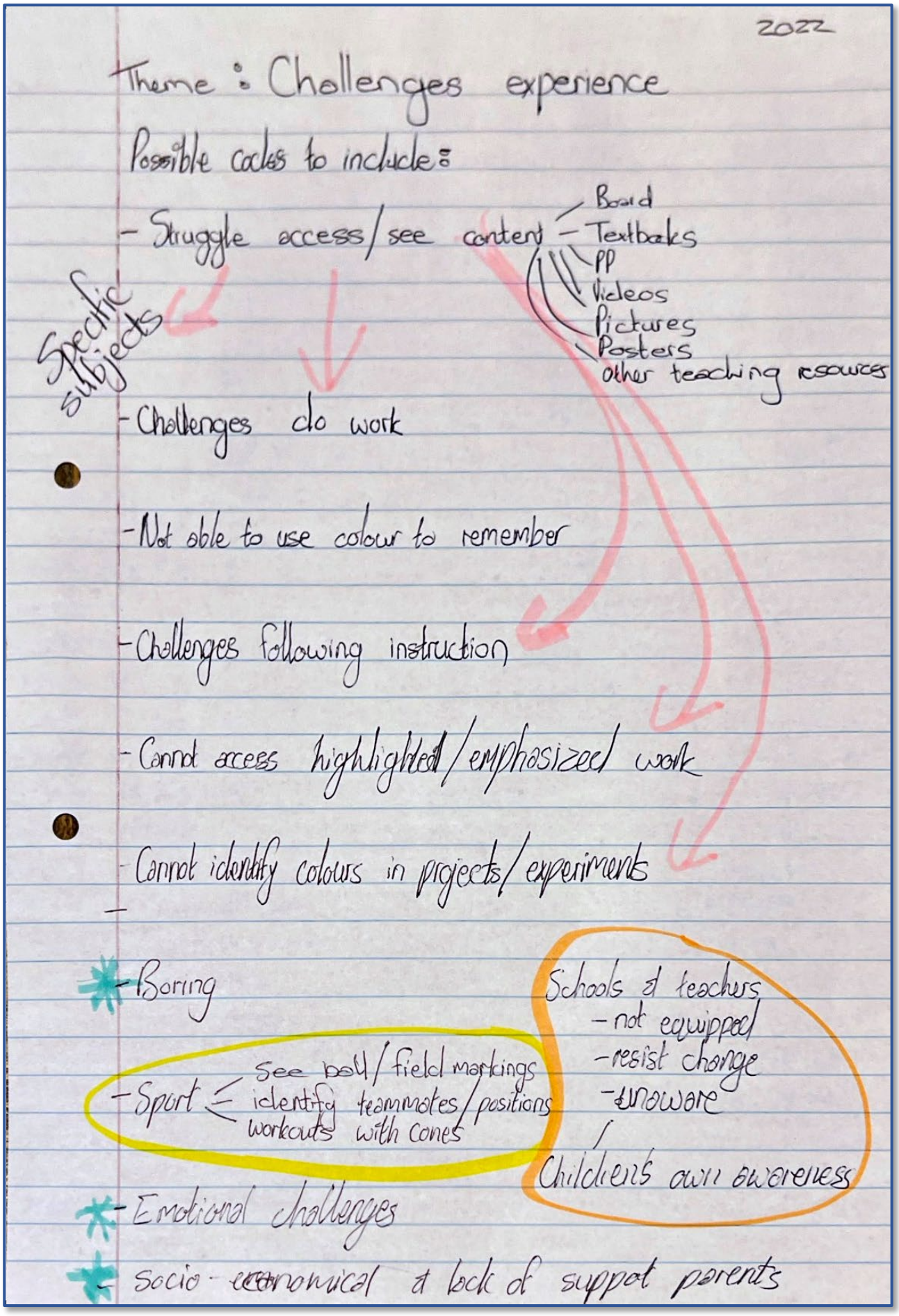




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**1 July 2022**

Today I had a meeting with my supervisor to discuss the timeline to submission. We discussed the layout of chapters and by when which chapters should be completed.

**12 November 2022**

I was a teacher for six years. During this period, I encountered learners with CVD several times. I recall how the one learner in my Grade 11 Math class asked me to not write in red as he could not see red. He had to ask me more than once.. When reflecting on my behavioural the time, I am embarrassed. I could have done better. I liked insight not only on CVD and limited vision, but also on how it impacts a child on several areas. Did my use of colour limit his learning? Did I maybe confuse him? Did it have a psychological impact on him? I wish I had known more at the time. When I think of the insight and understanding that my study has brought me and reflecting back on how it would have most likely changed my teaching, I truly hope that it will lead to a positive change for teachers.

## 2023

**15 January 2023**

I am applying to extend my PhD. There have been many obstacles over the past three years that have delayed my progress. In Mach 2020, the first year of my studies, COVID-19 and the national lockdowns had a negative impact on the progress of my studies. My personal journey of starting my own practice as an educational psychologist and becoming a mother in March 2021 also had a negative influence on my progress, as a lot of my time and attention shifted. Lastly, I struggled with finding schools willing to participate in my study and the low response rate to online questionnaires.

Currently, I mostly have writing up to do. I have completed my data collection and analysis and am busy with Chapter 4. I hope to finish Chapter 4 end of February, Chapter 5 end of April and Chapter 6 in May.

**4 February 2023**

This study has increased my awareness on my own use of colour. As an educational psychologist, I often work with children. This study has not only increased my awareness but changed my behaviour. I hope that through a teacher intervention it may lead to awareness and positive change for teachers as well.



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**23 February 2023**

Chapter 4 is a lot of work. There is a lot of data to report on. I still have to integrate my quantitative and qualitative data. The qualitative and quantitative data often correspond on the use of colour, challenges children with CVD experience and ways to support.

**12 March 2023**

I have finally started with Chapter 5. I have started to draw up a table to compare my data to the existing body of knowledge. My study often corresponds to existing knowledge on the use of colour and the possible impact of the use of colour.

**24 March 2023**

While comparing my data to existing knowledge I become more aware of the numerous ways in which children with CVD may be negatively impacted in the classroom. It is not only not being able to see colours but also struggling to follow instructions, challenges in sport and a possible psychological impact.



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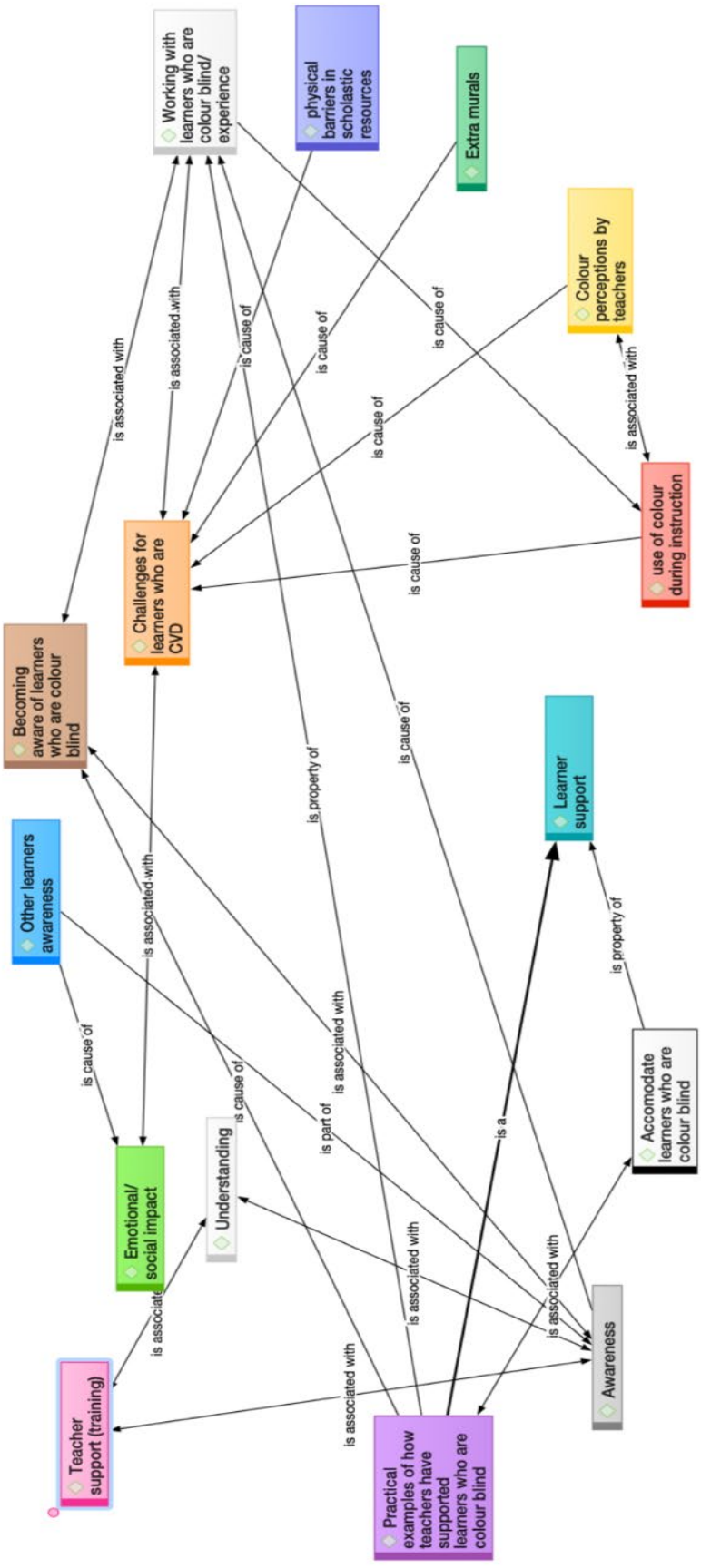
# Appendix C5 – Code networks identified using Atlas.ti

## Initial networks between codes



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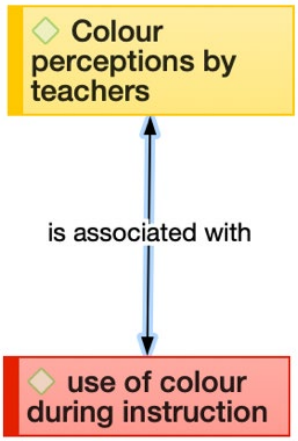
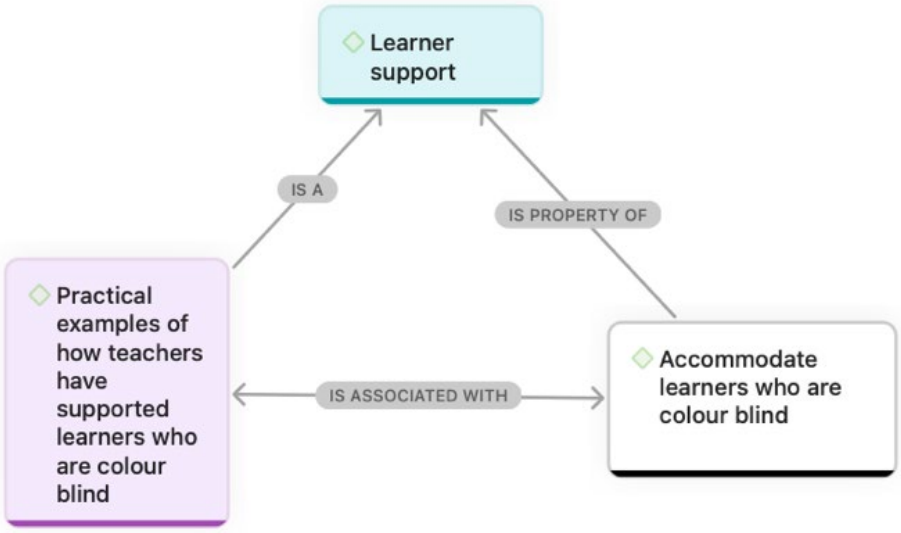
## Codes related to the use of colour




## Codes in support of learners with CVD



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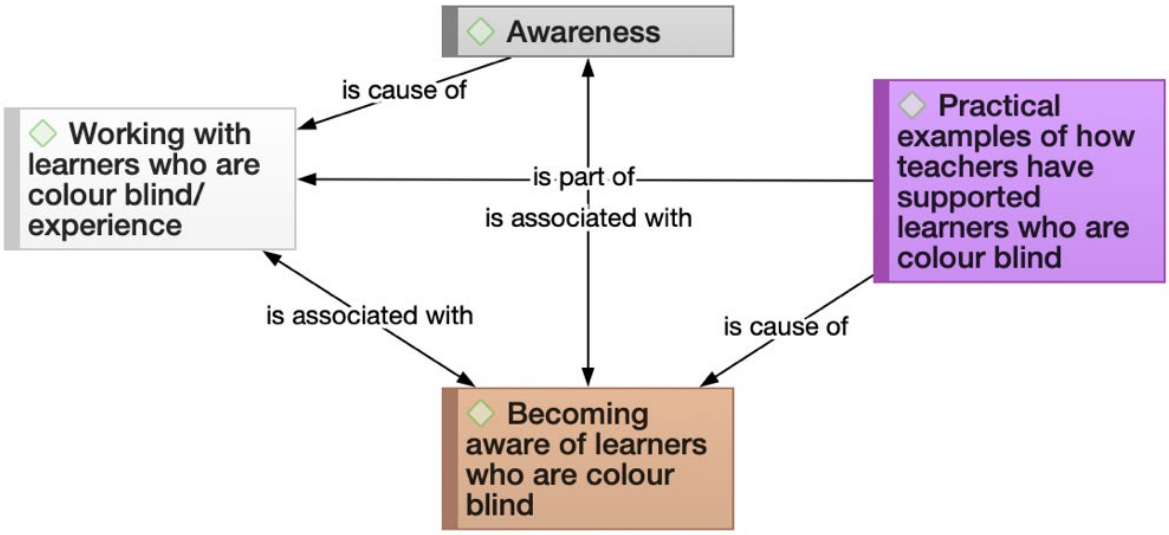
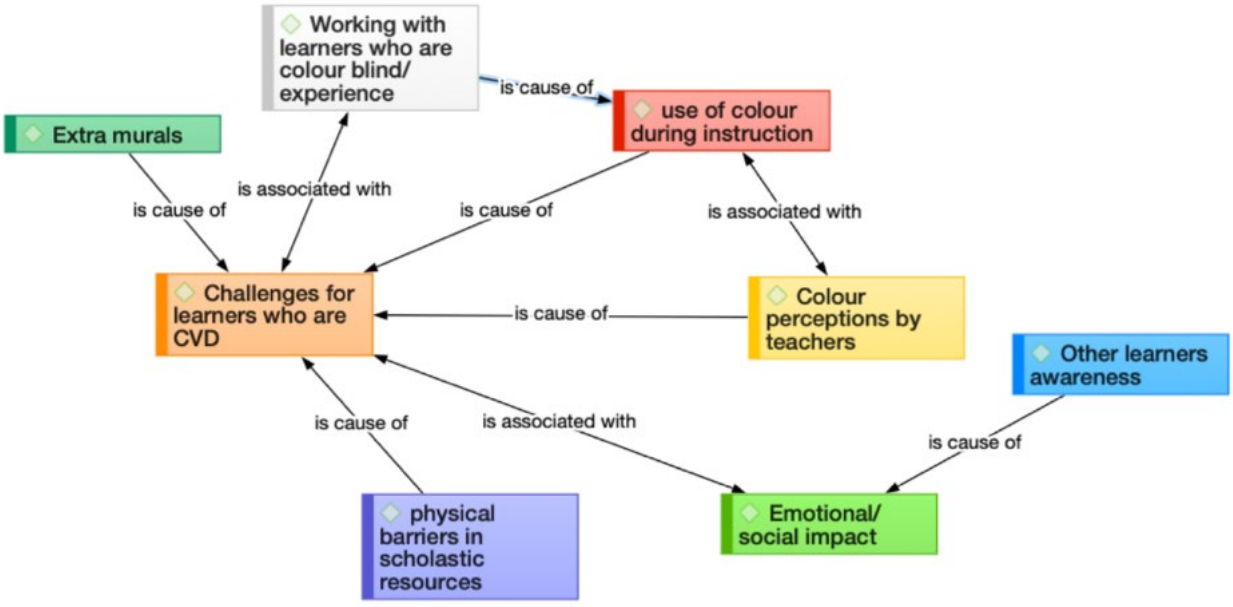
**Codes related to awareness of CVD and experiences teaching learners with CVD**




**Codes related to the challenges learners with CVD experience**



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