# Risk factors associated with cyberbullying and mathematics achievement for Grade 9 South African learners

**by**

**Jenette Webb**

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**Supervisor: Prof Marien Graham**
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**AUGUST 2021**

**Declaration**

I, Jenette Webb, with student number 14032075, hereby declare that the dissertation, which I hereby submit for the degree Magister Educationis at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

Jenette Webb

31 August 2021

# Ethical Clearance Certificate

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

## Dedication

I dedicate this research to each and every learner who has suffered from cyberbullying with the wish that this research dissertation will help and support a lot more people on how to deal with, understand and support cyberbullying victims.

I dedicate this research to my niece, Andriëtte Moolman, who has been a victim of cyberbullying. I am proud of the woman you are today. I love and solute you.

“I not only have the right to stand up for myself, but I have the responsibility. I can’t ask someone else to stand up for me if I won’t stand up for myself. And once you stand up for yourself, you’d be surprised that people say, ‘can I be of any help?’” – Maya Angelou

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## Abstract

Cyberbullying has become a growing trend in the last decade as the anonymity of online platforms fuels easier ways to intimidate peers. This study investigated the association between being a victim of cyberbullying and Grade 9 mathematics achievement. The study aimed to identify the frequency of cyberbullying and associated risk factors (predictors) explored including, a) gender, b) parental involvement and expectations, c) school location and SES, d) teacher's qualifications, e) technology use, and f) confidence in mathematics ability. Bronfenbrenner's ecological model of micro-, meso-, exo- macro- and chrono-systems were utilised to interpret the way systems influenced cyberbullying and mathematics achievement. This study used secondary analysis, using the Trends in Mathematics and Science Study (TIMSS) 2019 South African data from the TIMSS questionnaires completed by the learners, teachers, and principals. The selected classes included 519 schools, 519 principals, 54 mathematics teachers and 20,829 learners in South Africa. TIMSS is a study with a two-stage stratified cluster sampling design. At the first stage, schools were sampled, and at the second stage, intact classes within schools were sampled. The IEA IDB Analyzer program was used to analyse the data; the software was specifically designed to work with complex sampling procedures, weights and multiple imputed achievement scores. The research showed that cyberbullying is a significant predictor of mathematics achievement. If a learner is at a higher risk of being a cyber victim, their mathematics achievement will decrease. The research highlights the risk of adolescent cyberbullying and provides recommendations, such as possible interventions, based on the findings.



**Key Terms:**

Cyberbullying, Grade 9 mathematics achievement, social media, Trends in International Mathematics and Science Study (TIMSS) 2019, risk factors

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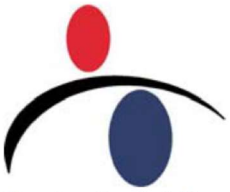

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**TO WHOM IT MAY CONCERN**

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## List of Abbreviations

| | |
|---|---|
| CAPS | Curriculum Assessment Policy Statement |
| CEA | Centre for Evaluation and Assessment |
| CEDV | Child Exposure to Domestic Violence Scale |
| CES-DC | Centre for Epidemiological Studies Depression Scale for Children |
| CJCP | Centre for Justice and Crime Prevention |
| DBE | Department of Basic Education |
| DME | Data Management Expert |
| DPC | Data Processing Centre |
| EDV | Exposure to domestic violence |
| FBI | Federal Bureau Investigation |
| GLSEN | Gay, Lesbian, and Straight Educational Network |
| HIC | High-income-countries |
| HIV/AIDS | Human immunodeficiency virus/ Acquired immunodeficiency syndrome |
| HSRC | Human Sciences Research Council |
| IBM Corp | International Business Machines Corporation |
| IEA | International Association for the Evaluation of Educational Achievement |
| IOL | Independent Online and Affiliated Companies |
| IRT | Item response theory |
| ISC | Internet Safety Campaign |
| ISCED | International Standard Classification of Education |
| LGBTI | Lesbian, gay, bisexual, transgender and intersex |
| LGBTQ | Lesbian, gay, bisexual, transgender and queer |
| LMIC | Lower-middle-income-countries |
| LO | Life Orientation |
| Max | Maximum |
| Min | Minimum |
| N | Sample size |
| NRSO | National Register for Sex Offenders |
| NSSF | National School Safety Framework |

| | |
|---|---|
| OVSA | Online Victimization Scale for Adolescents |
| PTSD | Post-traumatic stress disorder |
| PV | Plausible value |
| QIRC | Questionnaire Item Review Committee |
| SACE | South African Council of Educators |
| SADAG | South African Depression and Anxiety Group |
| SD | Standard deviation |
| SDA | Secondary data analysis |
| SE | Standard error |
| SES | Socio-economic status |
| SGB | School governing body |
| SPSS | Statistical Package for the Social Sciences |
| StatsSA | Statistics South Africa |
| TIMSS | Trends in International Mathematics and Science Study |
| UK | United Kingdom |
| UP | University of Pretoria |
| UMIC | Upper-middle-income-countries |
| USA | United States of America |
| VIF | Variance inflation factor |
| WHO | World Health Organization |

## Table of Contents

## List of Figures

## List of Tables

## Chapter 1: General Orientation

would you kill someone?
because you can.
not with a knife
a gun
or your own two hands.
the words you say
your devious ways
makes someone's life a living hell.
you called him gay
the poor thing, poor thing.
you called him weak
the poor thing, poor thing.
you pushed him beyond his limits.
his life was taken
his own two hands
murder can be invisible
its happened.
it can.
but you can change it. change your ways.
brush away the rainy days.
apologize
for those evil ways.
because in the end, it really pays.
and for all you poor things,
no more need for the sighs
i promise, promise that you will get by.
there really is no reason to die
you can always turn a ink blot, into a butterfly
by Teresa Motherway

## 1.1 Introduction

Cyberbullying is characterised by harmful online communication, including posting and blackmailing (often anonymously) a victim with hurtful and embarrassing material (Megan Meier Foundation, n.d.). As the Megan Meier Foundation (n.d.) notes, cyberbullying often consists of posting online messages, photos, or videos without asking the victim if it is okay to share private information. Kowalski et al. (2012, p. 509) define cyberbullying as "bullying through email, instant messaging, in a chat room, on a web page, or through a text message sent to a cell phone." Cyberbullying includes relational aggression (which could include spreading rumours, creating a false Facebook page to exclude the victim, deleting the victim from a friendship list or WhatsApp group, posting cruel messages or threats on a social network profile such as the victim's Facebook wall or story), social exclusion and gossiping (Chisholm, 2014).

The South African Trends in International Mathematics and Science Study (TIMSS) 2019 learner questionnaire contains 14 questions about bullying (verbal, physical, and technological) (Martin et al., 2020). There were only three questions concerning cyberbullying, which were a) sending nasty or hurtful messages online (BSBG14H), b) posting embarrassing information about the victim online (BSBG141), and c) sharing embarrassing photos of the victim online (BSBG14J). The current study used mathematics achievement data and scales from the questionnaires about the enjoyment of mathematics and confidence therein. The scales from the questionnaires which were utilised are a) Learner likes learning mathematics scale (BSDGSLM) and b) Learner confident in mathematics scale (BSDGSCM). The current study aimed to understand how certain variables from TIMSS 2019 questionnaires (specifically those for learners, teachers, and schools) are related to cyberbullying, which in turn, could influence learners' mathematics achievement. Ultimately, the purpose of the current study is to make recommendations to reduce the possibility of South African learners becoming a target of cyberbullying by understanding the risk factors. The current research shows how the variables listed above contribute to poor learner achievement in mathematics.

## 1.2 Problem Statement

According to Van der Werf (2014), bullying incidence is negatively correlated with academic performance in more than 57 countries from TIMSS 2011. It has been found that

there is a difference in the relationship between bullying and academic achievement depending on the level of achievement accomplished by a learner (Van der Werf, 2014). Digital technology has become the most prominent way people; specifically teenagers, communicate with each other in the 21st century (Chisholm, 2014). Chisholm (2014) and Jiménez (2019) stated that the problem with online communication is that learners can hide behind their anonymity for a long period, as opposed to traditional bullying where the victim and perpetrator were interacting face-to-face, and there is no anonymity. The primary communication of teenagers and young adults occurs through digital media, with Steil (2020) reporting that 97% of adolescents and young adults from the age of 18 to 29 globally are using instant messaging (WhatsApp) as their main form of communication. In addition, Abdelbarr (2021) found that 89% of people in South Africa aged 16 to 64 uses WhatsApp. The results also showed that an average of three hours and 10 minutes is spent on social media per day, with the following social applications being used most, WhatsApp (89%), YouTube (87%) and Facebook (83%). Learners can easily bully someone online by spreading rumours online, harassing the learner and posting embarrassing material or photos of the learner online to hurt and humiliate the learner (Chan et al., 2020). Wiederhold (2013) and Lenhart (2015), who studied patterns in internet behaviour, stated that it is the norm to "unfriend" someone from a social media application to hurt and embarrass the person.

The increasing use of digital technology has led to increased cyberbullying, as Wiederhold (2013) reported. As digital technology has grown, so has the use of social media, resulting in an increase in cyberbullying (Kritzinger, 2014). Kritzinger (2014) stated that, in many countries, online safety was getting serious attention and gave two detailed examples of the United Kingdom (UK) and Australia and the measures that they have taken. The UK and Australian governments implemented cyber-safety measures, educated learners, parents, and teachers on cyberbullying, and implemented laws specifically focusing on cyberbullying (Kritzinger, 2014). Section 2.6.2 in Chapter 2 discusses how a perpetrator can be punished in South Africa and the laws that can apply to cyberbullying. However, there are not many legal measures taken focusing specifically on cyberbullying in South Africa. Kritzinger (2014) found in an anonymous web-based South African survey of 225 girls and 278 boys ages 16 to 19 that more than 60% of learners spent more than three hours a day on their mobile phones. Kritzinger's (2014) study also showed that more than three quarters (82%) of the learners had internet access from their bedrooms, and 63% of learners admitted to accessing inappropriate internet material. The survey also showed that 93% of South African

learners believed in possible immediate dangers and threats associated with using the internet (Kritzinger, 2014).

The South African Depression and Anxiety Group (SADAG) (n.d.a) has identified an increase in calls to their suicidal helpline call centre. According to the World Health Organization (WHO), suicide is the fourth leading cause of death among teenagers who suffer from depression (WHO, 2021). According to the Independent Online and Affiliated Companies (IOL) (Mlamla, 2020), suicides have increased since 2020 as a result of COVID-19, which caused the postponement of matric results, long periods of school closures, social isolation, grief and trauma, and stress associated with online learning. Mlamla (2020) reported that two Grade 11 learners from the La Rochelle Girls High School in Paarl, South Africa died by suicide during the COVID-19 pandemic. Tshuma (2021) stated that 19 learners have committed suicide in South Africa over the last two years and 43 learners in the last four years. Cassey Chambers, operations director from SADAG, stated that a specific peak period for teen suicide has not been found (Tshuma, 2021). There are various reasons why teenagers could become depressed or suicidal, but they have found that the lead cause in suicide amongst adolescents was undiagnosed or untreated depression. A meta-analysis of 33 articles from 26 studies in 26 countries (including the United States of America [USA], Canada, Belgium, Australia, Netherlands, Taiwan, Hong Kong and South Korea) found that 32 articles mentioned that learners had suicidal behaviour. A total of 16 articles mentioned suicide attempts, and 27 mentioned suicidal ideation. Mateu et al. (2020) found that, when tested across different secondary schools in London, cyberbullied learners and perpetrators had significantly more post-traumatic stress disorder (PTSD) symptoms than their non-bullied peers. Thus, research indicates that learners who were either victims or perpetrators of cyberbullying experienced more PTSD, depression, suicidal thoughts and social isolation.

According to WHO (2019), suicides do not only occur in high-income countries but also in lower- and middle-income countries (LMICs). In fact, 78% of suicides occurred in LMICs in 2016 (WHO, 2019). WHO (2019) stated that the people most likely to be at risk for cyberbullying and suicide are indigenous peoples, migrants, refugees, prisoners and the lesbian, gay, bisexual, transgender and intersex (LGBTI) group. WHO (2019) stated that it is seen as an international taboo to openly discuss depression and suicide as a major public health problem; thus, to date, only 38 countries have implemented a national suicide prevention strategy.

As above mentioned, LMICs including South Africa (World Population Review, 2021) and upper-middle-income countries (UMICs) are at a higher risk of cyberbullying and suicide than high-income countries (HICs) (WHO, 2019). These countries, like South Africa, do not provide adequate programmes or have a national suicide prevention plan to prevent suicide attempts. In contrast with South Africa, a developing country (World Population Review, 2021), first world countries such as the UK provide a national created strategy against suicide (WHO, 2019). Mateu et al. (2020) and Anton-Erxleben et al. (2016), state that cyberbullying victimisation can lead to depression, which again can lead to suicide.

South Africa came second to last in the Grade 8 mathematics achievement despite participating at Grade 9 level, with a mean of 389 (*SE* = 3.2) on the TIMSS 2019 scale (Mullis et al., 2020). Singapore came first with an average of 616 in Grade 8 mathematics achievement. These results were problematic since South Africa tested a Grade 9 cohort due to our developing nature and poor achievement when participating at the Grade 8 level (Reddy et al., 2015). The current study aimed to identify the association between cyberbullying and mathematics achievement to enhance mathematics achievement by addressing social and emotional disadvantages due to bullying.

The TIMSS scale describes learners above 400 TIMSS points as having gained basic mathematical competence. Higher levels of achievement signify that learners can apply basics to complex situations and generalise their knowledge (Reddy et al., 2020). Reddy et al. (2020) stated that in the mathematics learning sample, only 1% of learners in South Africa reached the Advanced Benchmark, 3% reached the High Benchmark (over 550 TIMSS points), and 13% reached the Intermediate Benchmark (over 475 TIMSS points). Forty-one per cent (41%) of South African learners acquired basic mathematical knowledge, meaning that 59% of learners did not possess basic mathematical knowledge. These percentages show us that, in South Africa, basic mathematics knowledge still needs improvement (Reddy et al., 2020).

According to Mundbjerg et al. (2014), bullying in elementary schools was associated with lower academic achievement in ninth grade, and the effects were greater when bullying episodes were severe. As a result of this increase in bullying, learners were experiencing negative consequences to their education and quality of life; for instance, Van der Werf (2014) reports a decrease in school attendance, peer contact, and academic achievement due to bullying. Thus, the researcher aimed to identify how cyberbullying is associated with

mathematics in South Africa and what can be done to help increase South African learners' mathematics achievement by addressing bullying issues. The study aimed to identify the frequency of cyberbullying and associated risk factors (predictors) explored including, a) gender, b) parental involvement and expectations, c) school location and SES, d) teacher's qualifications, e) technology use, and f) confidence in mathematics ability. Looking at these risk factors could give us more insight to the role of these predictors regarding learners' mathematics achievement. Section 1.4 discusses each risk factor in more detail.

### 1.3 Aim and Objectives

The current study aimed to identify to what extent were various risk factors, such a parental involvement, school safety, genderand socio-economic factors (as identified by TIMSS), associated with cyberbullying and mathematics achievement.

The specific objectives of the current study were:

- To identify the association between self-reported cyberbullying and Grade 9 mathematics achievement as measured by TIMSS 2019.
- To identify to what degree is cyberbullying associated with the mathematics achievement of Grade 9 South African learners.
- To identify what were the risk factors associated with a higher reported frequency of reported cyberbullying, such as parental involvement and expectations, school safety and background variables, including demographic, gender and socio-economic factors.

### 1.4 Purpose of the Research

There is increasing awareness of cyberbullying among learners in South Africa (Cilliers & Chinyamurindi, 2020). The South African Department of Basic Education does not give schools much guidance regarding cyberbullying (Cilliers & Chinyamurindi, 2020). Mobile phones have become more affordable in Africa, so the rate of internet penetration has increased (Cilliers & Chinyamurindi, 2020). Mobile phones represent the most popular device for accessing the internet in South Africa. The number of internet users in South Africa in January 2021 was 38.13 million, of which 94.8% were mobile users (Statista, 2021a). Cyberbullying and inappropriate material are typical cyber-risks teenagers face, which can negatively impact their emotional and social wellbeing (Cilliers &

Chinyamurindi, 2020). Psychosocial adjustment is more likely to be poor for victims of cyberbullying as they are more likely to be socially isolated (Smit, 2015).

The current study aimed to identify the different risk factors associated with cyberbullying through quantitative secondary data analysis. Furthermore, the study aimed to examine the association between cyberbullying and Grade 9 mathematics achievement. The risk factors (predictors) explored were the following a) gender, b) parental involvement and expectations, c) school location and SES, d) teacher's qualifications, e) technology use, and f) confidence in mathematics ability. The current study utilised Bronfenbrenner's ecological framework (Bronfenbrenner, 1977) to guide the analysis and interpretation. The microsystem was explored by looking at the individual risk factors, the mesosystem by looking at the victim and perpetrator's relationships with their parents and peers and the exosystem by looking into the school location and SES, and how it influenced the learner.

The study also explored the frequency of cyberbullying in South Africa, as reported by Grade 9 learners. The risk factors (predictors) explored were the following a) gender, b) parental involvement and expectations, c) school location and SES, d) teacher's qualifications, e) technology use, and f) confidence in mathematics ability. Each of these risk factors is discussed in further detail below.

**a) Gender**

The current study considered the gender of learners, e.g. whether girls or boys were more cyberbullied, as indicated from the TIMSS 2019 results, and how this is ultimately linked to learners' mathematics achievement.

**b) Parents**

The influence of parental involvement and expectations on learners' mathematics achievement was investigated according to the results from TIMSS 2019, which is ultimately linked to learners' mathematics achievement.

**c) School location and SES**

The researcher looked at the school location and whether it affects learners' mathematics achievement, e.g. not enough resources, no online connection etc. The researcher also

focused on the socio-economic background of the school and how it may have influenced cyberbullying.

**d) Teacher risk factors**

The researcher focused on factors such as a teacher's qualifications and whether the teacher majored in mathematics. The researcher also wanted to know whether the learners understood the teacher and whether the teacher explained mathematics well. The researcher observed whether that might be associated with learners' mathematics achievement according to the results from TIMSS 2019.

**e) Technology use**

The researcher explored whether certain technological factors such as a) having a mobile phone, b) having an internet connection at home, and c) possessing a tablet or computer at home are associated with a learner being a cyber victim, which may be associated with learners' mathematics achievement.

## 1.5 Research Questions

The following section discusses the primary and secondary research questions for the current study.

### 1.5.1 Primary Research Question

To what extent are various risk factors, such a parental involvement, school safety, gender and socio-economic factors (as identified by TIMSS), associated with cyberbullying and mathematics achievement?

### 1.5.2 Secondary Research Questions

- What is the association between self-reported cyberbullying and Grade 9 mathematics achievement as measured by TIMSS 2019?
- To what degree is cyberbullying associated with the mathematics achievement of Grade 9 South African learners?
- What are the risk factors associated with a higher reported frequency of reported cyberbullying, such as parental involvement and expectations, school safety and background variables, including demographic, gender and socio-economic factors?

## 1.6 Key Theoretical Concepts

The following section discusses specific key concepts crucial for this study, including a) cybercrime, b) cyberbullying, c) social media d) Life Orientation curriculum, e) mathematics achievement, and f) school location.

### 1.6.1 Cybercrime

The official South African cybercrime website (Internet Safety Campaign [ISC] Africa, 2020) defines cybercrime as any form of criminal activity involving computers and the internet. This website mentions that cybercrime is also commonly referred to as computer crime, electronic crime, e-crime, netcrime and hi-tech crime.

Globally, cybercrime poses a very real threat and knows no borders, whether physical or virtual. According to Interpol (2021), cybercrime causes serious harm and poses genuine threats to victims. Despite advancement in technology, cybercrime continues to progress at an incredible rate. Interpol (2021) concluded that cyber perpetrators are becoming more agile and quick to exploit new technologies, adapt attacks using new techniques, and collaborate in ways we have not seen previously. Several criminal networks organise crimes around the globe, coordinating elaborate attacks within minutes, which is why cybercrime should be reported to the police (Interpol, 2021).

### 1.6.2 Cyberbullying

The official South African cybercrime website (ISC Africa, 2020) defines cyberbullying as the ongoing and deliberate exploitation of power in relationships by the constant misbehaviour verbally, physically, emotionally and/or socially through the internet intending to hurt or cause physical, social and/or psychological harm to humiliate, harass, intimidate and demean others. Cyberbullying is defined by the Oxford Learner's Dictionaries (2021) as the act of using messages on social media, emails, text messages etc., to frighten or upset somebody. The Cyberbullying Research Center defines it as the "wilful and repeated harm inflicted through the use of electronic devices" (Cyberbullying Research Center, n.d., para. 1). According to the Cyberbullying Research Center (n.d.), one of the biggest issues with cyberbullying is the anonymity of the perpetrator. A perpetrator could hide their identities online and thus harass the victim for a longer time than traditional bullying, leading to crueller and harsher abuse from the perpetrator on social media where

everybody could see and read it. According to Hills (2017), whose research focused on developing a law and policy framework for the effective regulation of cyberbullying in South African schools, cyberbullying is identified by:

- Online abuse and harassment
- Anonymity
- Usually occurs on social media platforms
- Uses electronic devices
- Occurs for a longer period than traditional bullying
- Repeated and hostile behaviour online

### 1.6.3 Social Media

Social media is defined by Obar and Wildman (2015) as online technology and applications, making use of the internet to share ideas, documents, pictures, videos and other information through virtual networks and media applications. Wolf et al. (2018) stated that social media is web-based social interactive applications that provide a learner with the opportunity to communicate, share and build relationships online. It gives learners quick access to electronic content, as well as sharing the content with other learners. Learners could engage with social media using a phone, tablet or computer (Obar & Wildman, 2015).

### 1.6.4 Life Orientation Curriculum

The DBE (2011) stated that the Life Orientation (LO) curriculum (see Annexure B) of the Curriculum Assessment Policy Statement (CAPS) refers to a compulsory subject that South African learners, from Grade R to 12, must take during school. It involves the holistic development of learners, including teaching skills, knowledge, awareness and values about important issues in life, including illness, e.g. Human immunodeficiency virus/Acquired immunodeficiency syndrome (HIV/AIDS), possible future careers, bullying and exercise. LO focuses on the social, intellectual, cognitive, academic and emotional growth and development of a learner. It equips a learner with tools on how to live purposefully and successfully in an ever-changing society.

### 1.6.5 Mathematics Achievement

Mathematics achievement in the current study refers to the scores that learners earned for their mathematics test in TIMSS 2019. Mathematics achievement is the outcome variable in

the current study. It focuses on how these scores correlate with predictors such as cyberbullying, parents and gender, to name a few, and how these results could be improved (Martin et al., 2020). Therefore, in the current study, achievement is defined as the score a learner earned for their TIMSS 2019 mathematics questionnaire. TIMSS was administered to Grade 8 learners in most countries (Grade 9 learners in South Africa; see Section 3.2 for the reasoning of this) in the following context domains:

- Number
- Algebra
- Geometry
- Data
- Probability

The TIMSS 2019 mathematics achievement data is able, in combination with context questionnaire scale data from Mullis and Martin (2017), to:

- Monitor global achievements at the system level
- Inform educational policy with the results
- Track policy changes or new policies
- Identify underperforming areas, and encourage curriculum
- Analyse the eighth-grade performance of the cohort that completed fourth grade in the previous cycle

In addition to learning about the circumstances of teaching and learning about learners' achievement in mathematics, Mullis and Martin (2017) collected invaluable data on learners' home and school contexts.

### 1.6.6 School Location and SES

Statistical South Africa (StatsSA) is the official statistical service of South Africa (Atkinson, 2014). In 2001, StatsSA investigated properly defining urban and rural regions. StatsSA (2003) categorised the geographical types in South Africa into urban formal, urban informal, rural formal, and tribal. The first two domains (urban formal, urban informal) are collectively regarded as "urban", while the last two domains (rural formal and tribal area) are collectively regarded as "rural" (see Table 2.1-1, StatsSA, 2003, p. 3). The following classifications, including those based on StatsSA classifications as well as more recent literature, are used by Atkinson (2014) for South Africa:

- Metropolitan formal, including large black and coloured townships joined to metropolitan areas
- Other urban formal: The non-metropolitan urban areas, such as secondary and tertiary towns, as well as many black and coloured townships
- Urban informal ("informal settlements"), which are often on the peri-urban fringe.
- Former homeland areas: This category is highly simplified since it contains a rural-urban continuum, including formal "dormitory townships" or "dense rural settlements" (but without any economically functional core), small towns, agricultural villages, and small farms
- Commercial agriculture: This category contains the rural industry settlement type, often, but not exclusively based on white-owned farms and black or coloured farmworkers (Atkinson, 2014, p. 5).

In the current study, the researcher used the school location as a predictor for learners' socio-economic status. The options for school location in the TIMSS 2019 school questionnaire (TIMSS & PIRLS International Study Center, 2018) were the following a) urban - densely populated, b) suburban – on fringe or outskirts of urban area c), medium-size city or town, d) small town or village, and e) remote rural. The current study had three response items for school composition based on the socioeconomic background (BCDGSBC), namely a) more affluent, b) neither more affluent nor disadvantaged, and c) more disadvantaged. According to the TIMSS & PIRLS International Study Center (2019a), based on principals' reports of the percentage of economically disadvantaged and economically affluent learners at schools, the TIMSS & PIRLS International Study Center (2019a) characterises schools based on their socioeconomic composition. As defined above, affluent schools have more than 25% of their learners coming from affluent homes, and disadvantaged schools have more than 25% of their learners coming from disadvantaged homes (TIMSS & PIRLS International Study Center, 2019a). It was determined that all other combinations were "neither more affluent nor more disadvantaged."

### 1.7 Research Design and Approach

Quantitative research is defined as selecting a specific sample to generate numerical data systematically and objectively to generalise the results to the population (Maree & Pieterssen, 2019). The researcher used a secondary data analysis research design (Mouton,

2001) by analysing secondary data (TIMSS 2019 learner, teacher and school questionnaires). Secondary data analysis (SDA) was used to test certain hypotheses about using the TIMSS 2019 survey (Mouton, 2001). According to Mouton (2001), an advantage of using SDA is that the researcher could be specific and explicit about the results and assumptions made from the data. Standard statistical procedures were used, including descriptive statistics and multiple linear regression. The researcher did not have a sampling frame since the data was already collected and analysed.

Positivism is defined as identifying explanatory associations or casual relationships using quantitative research, where empirically-based findings from large sample sizes were favoured (Maree, 2019). TIMSS 2019 consisted of 64 countries that participated and used questionnaires attaining the data (Martin et al., 2020). This dissertation made use of SDA using the TIMSS 2019 data.

The main characteristics of positivism include the following: (a) phenomenalism (knowledge is based on experiences without being humanly biased), (b) study of factual evidence (things which are observable and measurable), c) data should be credible and meaningful, and d) value key universal laws and rules to further explain the study's problem statement and the causation of the results (one event could influence the next event (Alharahsheh & Pius, 2020). With the positivist paradigm, the researcher focuses on objectives and observable facts (atomism) (Maree, 2019). In the current study, the researcher focused on the number of participants and the outcomes measured in numerical data (verification).

### 1.8 Target Population and Sampling

Sixty-four countries participated in TIMSS 2019. This study only considered data from South Africa. TIMSS 2019 made use of a two-stage stratified cluster sampling design, where schools were randomly selected from a sampling frame, and then a class within a school was selected (LaRoche et al., 2020). During the first stage, schools were sampled in proportion to the size and, in the second stage, the researchers selected one or more class(es) within the school based on the criterion (LaRoche et al., 2020). The selected classes included 519 schools, 519 principals, 54 mathematics teachers and 20,829 learners in South Africa (Reddy et al., 2020).

## 1.9 Data Collection

The TIMSS 2019 data was already captured in the Data Management Expert (DME) Program using a specific template to prevent data errors (Foy et al., 2020). Two different capturers captured the same data, and then the data was compared (Foy et al., 2020). The Human Science Research Council and the Data Processing Centre (DPC) monitored the capturing of data (Foy et al., 2020). The data was cleaned at the DPC in Hamburg, Germany (Foy et al., 2020). According to the HSRC, the TIMSS 2019 data in South Africa was collected in September 2019 and released on the 27th of January 2021 (HSRC, 2020).

During the scoring process, the HSRC used the following process: (a) they recruited scorers, (b) interviewed and assigned scorers to teams, (c) trained scorers, (d) tested the quality assurance of the scorers, (e) ran cross-country reliability scoring, and lastly (f) did a reliability (Foy et al., 2020). A quarter of all scored instruments were randomly quality-assured, and the reliability of the instruments was above .90 (Foy et al., 2020).

## 1.10 Data Analysis

The Statistical Package for the Social Sciences (SPSS) version 27 (International Business Machines Corporation [IBM Corp], 2020) and IEA IDB Analyzer (Foy, 2020) was used for data analysis as it was specifically designed to work with the multifaceted procedures of sampling, weighing and imputing multiple achievement scores (Foy et al., 2020). Unbiased estimates of learners' achievement scores and their relationship to the related variables can be provided using the TIMSS 2019 scaling methods, enabling descriptive and inferential statistics calculation. SPSS and the IEA IDB Analyzer was used.

In the TIMSS, a scale of Item Response Theory (IRT) was used because of the complexity of data collection and the importance of describing learners' mathematics achievement on an entirely representative scale (Von Davier, 2020). A latent regression population model and subsequent multiple estimations were used for TIMSS scaling to obtain the most reasonable values representing mathematics proficiency for all learners (Von Davier, 2020).

## 1.11 Value of the Research

There is a lot of speculation about the dangers of cyberbullying and how it influences learners' mathematics achievement; see, for example, Elbedour et al. (2020) and Navarro and Jasinski (2012). Although there has been much research on traditional bullying, there has been less focus on cyberbullying and its ramifications in South Africa. Cyberbullying is a problem because it is becoming more popular now since we are finding ourselves in a technological era. The current research is valuable as it gives information and statistics about how specific risk factors influenced Grade 9 South African learners' mathematics achievement. The current research focused on the repercussions of cyberbullying and recommendations on how to recognise the signs and symptoms of cyberbullying to avoid cyberbullying at school and home, including parental involvement and expectations and how to deal with peer group pressure. This dissertation motivated why there should be a legal framework developed on cyberbullying within a South African context.

## 1.12 Ethical Considerations

Ethics refers to the assurance of everything to occur in the right manner, with integrity in a consented manner (Israel, 2015). For ethical clearance, permission was requested to conduct the research from the Ethics Committee of the Faculty of Education from the University of Pretoria. The TIMSS 2019 data was publicly available from the 27th of January 2021 on the official TIMSS website (*TIMSS and PIRLS International Study Center*) (Mullis et al., 2020) and could be accessed by agreeing to its terms and conditions. All data, documents and information would be safely stored for a minimum of 15 years at the University of Pretoria. The research results would also be stored electronically, and a strong password will be created to protect the data.

## 1.13 Research Structure

Each chapter was outlined and addressed, as shown in Table 1.1.

**Table 1.1**
*Outline of the Research Dissertation*

| Chapter | Description |
|---|---|
| **Chapter 1** | **General orientation:** An overview of the background, problem statement aim and objective of the research, purpose of the research, research questions, key theoretical concepts, the value of the research and the methodology used. |
| **Chapter 2** | **Literature review:** Focuses on a review of the literature and outlines briefly how cyberbullying affects learners as found by various studies. It delves into how gender, school location and SES, parents, technology use, and confidence in mathematics play roles in cyberbullying and learners' mathematics achievement. |
| **Chapter 3** | **Research design and methodology:** In this chapter, the research onion (Saunders et al., 2009) is used as a portrayal of the journey that the researcher undertook in the research study focusing on the research philosophy, approach, methodological choice, strategy, time horizon and techniques and procedures used. |
| **Chapter 4** | **Findings and results:** This chapter focuses on the findings from SPSS and the IDB Analyzer. This chapter informs the reader of what was discovered in the research and relates the findings to the aim, objectives and research questions. |
| **Chapter 5** | **Conclusions and recommendations:** This chapter concludes the dissertation and recommends how learners can increase their mathematics achievement by, for example, decreasing their time on social media. |

## 1.14 Chapter Summary

Chapter 1 has given a general orientation about the research dissertation discussing the following topics: the background, the problem statement, the aim and objectives of the research, the purpose of the research, the research questions, some key theoretical concepts, the research design and approach. From Chapter 1, the reader should clearly understand what cyberbullying is and how it is defined. The reader should also know that the researcher used the TIMSS 2019 data and used a secondary data analysis approach. Key concepts were defined and explained as to how it is relevant in the current study. Chapter 1 also explained

the target population and sampling in the dissertation, the data collection procedure and data analysis, the value of the research, the ethical considerations, and the dissertation's structure.

## Chapter 2: Literature Review

### 2.1 Introduction

The act of cyberbullying is a form of violence (DBE, 2015). Violence can take many forms and is viewed and defined differently. Violence is often a result of dangerous acts and problematic behaviour. To assist all stakeholders in school safety, including provincial and district officials, South Africa developed the National School Safety Framework (NSSF). Teachers, school leaders, and members of the school governing body (SGB) can use the NSSF to identify risks and manage threats to learners and educators in schools (DBE, 2015). This programme aims to achieve safe school environments, prevent violence in schools, and better understand the causes of violence in schools. According to Saferspaces (2021, para. 4), the objectives of the NSSF are to:

- Assist the school in understanding and identifying all security issues and threats;
- Guide schools to effectively respond to identified security issues and threats;
- Create reporting systems and manage reported incidents appropriately; and
- Help the school to monitor its progress over time. (Saferspaces, 2021, para. 4).

The NSSF was formally approved by the Minister of Basic Education in 2015. According to the NSSF (South African Council of Educators, 2021, p. 18), violence includes:

- "Assault
- Fighting
- Traditional bullying
- Cyberbullying
- Corporal punishment
- Xenophobia
- Homophobia
- Sexual and gender-based violence
- Gang-related violence"

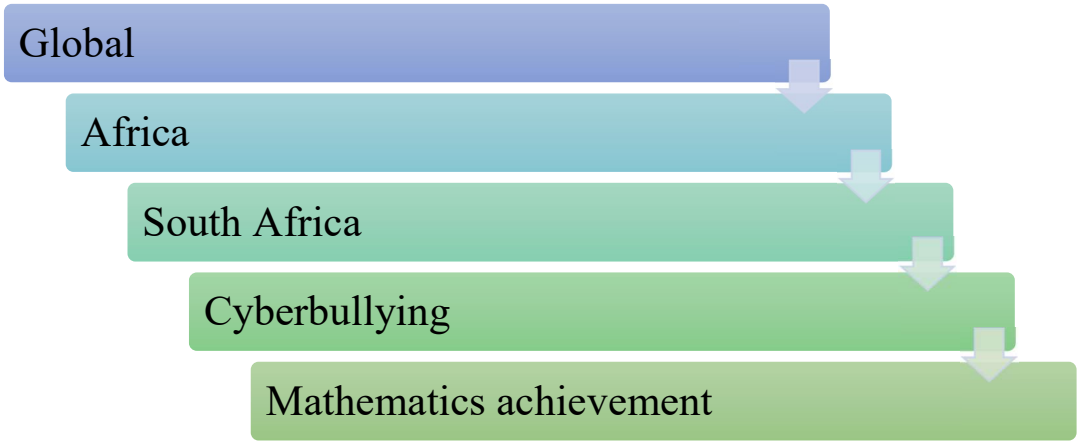
Safety is defined by the Department of Basic Education (DBE, 2015) as feeling safe in schools where social issues such as violence, drug use/abuse, sexual harassment, bullying and other criminal acts in schools are viewed as unacceptable (DBE, 2015). According to

the DBE (2015), a National School Safety Framework (NSSF) has been put forward to serve as a management tool for everyone in the school system, including the principal, district officials etc., responsible for school safety. According to Hemphill et al. (2015), Jiménez (2019) and The Adelphi Psych Medicine Clinic (2019), traditional bullying tends to escalate into cyberbullying, which can make a learner feel unsafe and vulnerable at school. The researcher explicitly focused on cyberbullying and how that could influence learners' mathematics achievement. The researcher made use of the TIMSS 2019 learner questionnaire with the following questions included in the cyberbullying index a) sending the victim nasty or hurtful messages online (BSBG14H), b) posting embarrassing things about the victim online (BSBG141), and c) sharing embarrassing photos of the victim online (BSBG14J). Cyberbullying is a form of violence and leads to learners feeling unsafe in schools, as Anton-Erxleben et al. (2016) stated. It can lead to school avoidance, depression, and anxiety, to name a few; thus, the more cyberbullying takes place, the more learners will feel unsafe in schools, which may be associated with learners' mathematics achievement.

## 2.2 Outline of Literature Review

Figure 2.1 shows how the researcher broke down the literature review by focusing on research globally, then looking at the African perspective and then the South African perspective on cyberbullying and learners' mathematics achievement.

**Figure 2.1**
*Outline of the Literature Review*




## 2.3 Types of Cyberbullying and It's Relationship to Mathematics Achievement

Definitions of cyberbullying were provided in Section 1.6.2; however, there are many other definitions than those provided in Section 1.6.2, some of which we explore here. Popovac

and Leoschut (2012) define cyberbullying as sending malicious content via SMS, text (when it's of a sexual nature, it is called sexting), online applications and social media. Through these channels, learners could view, participate in, or share content and trick other learners into providing their personal information. According to the South African Council for Educators (SACE), cyberbullying and online violence includes:

> • Sending rude, offensive or insulting messages
> • Posting cruel and hurtful rumours
> • Sending or posting personal or embarrassing secrets online
> • Posting online threats
> • Hacking messaging accounts and sending fake messages
> • Distributing naked or sexually explicit images without permission (SACE, 2021, p. 19)

Often, the perpetrators create fake profiles or lurk anonymously for months, thereby prolonging the victim's torture. By hiding behind anonymity on the internet, the perpetrator had access to power and, therefore, could harm others. As a result, victims may lose self-confidence, fall behind in schoolwork, feel anxious, depressed, or even suicidal (Popovac & Leoschut, 2012). According to Baldry et al. (2015), a cyberbullying attack could remain online or on any technological device indefinitely. Hence, the victim's emotional torture was prolonged since it was easier to share the attack. South Africa has seen increased cyber-victimization due to perpetrators hiding behind anonymity, Bauman et al. (2013) suggested.

### 2.3.1 Types of Cyberbullying

Cilliers and Chinyamurindi (2020), as well as Rachoene and Oyedemi (2015), specified eight types of cyberbullying that could take place online:

- **Flaming:** Online fights with another learner using vulgar and aggressive language. These fights could be anonymous or in a group chat that everybody could see.
- **Harassment:** Repeatedly sending embarrassing, nasty and cruel messages, pictures and other material to another learner.
- **Denigration:** "dissing" and sending untruthful information and pictures about another learner to embarrass and ruin the learner's reputation.

- **Impersonation (identity theft/masquerade):** Pretending to be another learner online and posting humiliating material and pictures to embarrass and ruin the other learner's reputation.
- **Outing:** Sharing learners' personal information, secrets, pictures or videos online to embarrass and hurt the learner.
- **Exclusion:** Excluding a learner intentionally from online group chats, activities, and communication to hurt and manipulate them.
- **Cyber-stalking:** Sending constant offensive messages to the victim with the intent to harm, embarrass, hurt, threaten or intimidate the person.
- **Trickery:** The perpetrator tricks the victim by assuring them that all information shared is private, but then threaten to expose and distribute the intimate and private information.

### 2.3.2 Relationship Between Cyberbullying and Mathematics Achievement

TIMSS 2019 showed that cyberbullying is negatively associated with learners' mathematics achievement (Mullis et al., 2020). Mullis et al. (2020) stated that learners who were never or almost never bullied had a higher mathematics achievement, with 63% of the learners stating they were never or almost never bullied.

Cyberbullying has a direct and negative impact on a learners' mathematics achievement. According to numerous researchers, including Peled (2019), Ferrara et al. (2018) and Hills (2017), cyberbullying could lead to the following:

- A negative mood
- Induced aggressive and suicidal behaviour
- Violence
- Self-awareness and low self-esteem
- Social isolation from group activities and other forms of social interaction
- Suicides or attempted suicides
- Depression
- Anxiety
- Low academic performance
- Physical harm including cutting
- Poor family relationships

- Substance abuse, including alcohol and drugs

Which in turn could lead to low academic performance due to reasons such as a) school avoidance, b) poor attendance, c) an inability to concentrate, d) negative attitudes towards school, e) lack of academic engagement, f) depression, g) reduced self-esteem, and h) physical health problems as stated by Anton-Erxleben et al. (2016).

According to a study done by Delgado et al. (2019) focussing on 548 Grade 5 and 6 primary school learners from Spain using two types of questionnaires namely a) self-description questionnaire and b) achievement goals tendencies questionnaire, it was found that cyberbullying could be directly linked to lower academic performance in mathematics. Delgado et al. (2019) focussed on a learner's social self-concept and academic goals and proved that having lower self-esteem was caution for being cyberbullied more often. The results indicated that more than half of the sample group were more likely of becoming cyberbully perpetrators if they did not have any specific academic learning goals. Delgado et al. (2019) stated that 65% of learners tended to become cyberbully perpetrators if they struggled with a language self-concept and how to communicate with others. The results also indicated that the more a learner's academic goals increased, the more cyberbullying decreased.

It is clear that a learner's self-concept, whether social or academic, is the main link between cyberbullying and a learner's mathematics achievement, as found by several researchers, including Delgado et al. (2019), Maxwell et al. (2017), Tustin et al. (2014) and the current study which is discussed more in-depth in Chapter 5.

## 2.4 Risk Factors Associated With Cyberbullying

The following sections focus on certain risk factors associated with cyberbullying as chosen by the researcher after examining the TIMSS 2019 learner, teacher and school questionnaires. In addition, the following sections (Sections 2.4.1 to 2.4.6) discuss how risk factors associated with cyberbullying affect learners' mathematics achievement. The risk factors (predictors) explored were the following a) gender, b) parental involvement and expectations, c) school location and SES, d) teacher's qualifications, e) technology use, and f) confidence in mathematics ability

### 2.4.1 Gender

The following sections focus on how gender plays a role in cyberbullying from a global, African and South African perspective.

#### 2.4.1.1 Global Perspective

According to several studies, girls tended to be at a higher risk for cyber victimisation than boys (Bayraktar et al., 2015; Holt et al., 2016; Kowalski et al., 2012). Bayraktar et al. (2015) who conducted an online survey in the Czech Republic with 2,092 learners aged 12 to 18 years, drew this conclusion. Another study by Holt et al. (2016) had similar findings in their self-reported questionnaire of 4,315 learners in primary and secondary schools in Singapore. Similar findings were also drawn by Kowalski et al. (2012), who found in their self-reported questionnaire of 3,767 learners from Grade 6 to 8 in the United States that girls were at a higher risk of being cyberbullied.

As Wang et al. (2019) found with 712 Chinese middle school learners, boys were more likely to bully others online and offline at school through traditional methods than girls. In their paper and pencil self-report questionnaire, Baldry et al. (2019) found that one out of every three male adolescents aged 13 to 20 felt victimised by cyberbullying, and one in four female adolescents felt victimised by cyberbullying and victimisation. Thus, these results found that boys were more often the bullies and girls more often the victims in the cyber and traditional bullying environment.

Jiménez (2019) found in his study where 4,756 Spanish 4$^{th}$-grade learners completed the TIMMS 2015 standardised survey that the percentage of girls being harassed on and offline was higher than boys. Male adolescents reported higher levels of bullying perpetration than female adolescents (Jiménez, 2019). The perpetuation of traditional school bullying and cyberbullying behaviour were positively correlated, with traditional bullying leading to cyberbullying. Male adolescents reported higher levels of bullying perpetration than female adolescents (Jiménez, 2019). Gualdo et al. (2015) and Mishna et al. (2018) have also shown that girls tend to be more at risk of cyberbullying but tend to be more involved with cyberbullying practices. The previous studies showed that female victims were often placed in the limelight where the perpetrator blamed, embarrassed and criticised the victim online.

A study conducted by Kasahara et al. (2019), with 303 participants in primary and secondary schools in the six districts of Belize aged 11 to 25, with 68 of the respondents being male and 235 being female, found that women accessed social media more than men, but women were also more likely to prevent certain people from accessing and viewing their social media content. Kasahara et al. (2019) also found that more male respondents (21%) were a victim of cyberbullying compared to females (13%). However, female respondents were more likely to report cyberbullying (Kasahara et al., 2019).

According to Hinduja and Patchin (2020), there is an increase in cyberbullying perpetrated against the lesbian, gay, bisexual, transgender and queer (LGBTQ) community, indicating that increased cyberbullying is based on learners' sexual orientation or gender identity. Hinduja and Patchin (2020) stated in a survey conducted in the USA by the Federal Bureau Investigation (FBI) that 1,445 LGBTQ learners had been cyber victims of hate speech, and 215 learners were targeted on their gender or gender identity. According to a report done in New York, USA, by the Gay, Lesbian, and Straight Educational Network (GLSEN), 70.1% of learners in the US were verbally harassed over their sexual orientation and 59.1% for their gender (GLSEN, 2017). Hinduja and Patchin (2020) stated in a survey done of 4,400 learners, selected at random, ages 11 to 17, that over twice as many LGBTQ learners have been cyberbullied as heterosexual learners (36.1% compared to 20.1%) in the USA.

From the information above, research has shown vast differences in cyberbullying in terms of gender; however, this does not appear to have influenced their mathematics marks as, according to Mullis et al. (2020), 26 of the 39 countries that participated in TIMSS 2019 had gender equity in average mathematics achievement. In seven countries, girls' outperformed boys and in another six countries, boys outperformed girls, but most countries generally had gender equity.

#### 2.4.1.2 African Perspective

Anton-Erxleben et al. (2016) found that cyberbullying was influenced by learners' academic achievement, gender, age, teachers' gender and experience, parents' education, socio-economic status (SES) and geographical location after investigating questionnaires of Grade 4 and 8 learners in Botswana, Ghana and South Africa using the TIMSS 2011 & PIRLS 2011 questionnaires of 36,602 participants aged 12 to 16. Furthermore, Anton-Erxleben et al.

(2016) stated that girls were more often the victims of cyberbullying in all of these countries, with boys more often being perpetrators of all forms of bullying.

In a study done by Akpunne et al. (2020), a total of 300 secondary school adolescents in Oshodi Isolo, in the Lagos metropolis, Nigeria, responded to the following scales: Child Exposure to Domestic Violence Scale (CEDV), Centre for Epidemiological Studies Depression Scale for Children (CES-DC) and Online Victimization Scale for Adolescents (OVSA). The results showed that male learners had higher mean scores of cyber victimisation, although female learners reported greater depression severity due to cyberbullying. In their study, Akpunne et al. (2020) showed that depression and cyberbullying had a significant association, with 26.7% of individuals experiencing racial discrimination online and 37% experiencing it vicariously. There was a positive correlation between exposure to domestic violence (EDV) and depression, as well as cyberbullying (Akpunne et al., 2020).

#### 2.4.1.3 South African Perspective

According to Tustin et al. (2014), female learners were more often victims of emotional and cyberbullying. Tustin et al. (2014) reported in the self-conducting survey done of Grade 8 to 12 learners (4,245 learners over 14 schools) in Gauteng and the Western Cape that 69.4% of emotional bullying and 18.6% of cyberbullying victims were female. Cyberbullying occurred more as female learners got older. Motswi and Mashegoane (2017) the same results with female learners being cyberbullied more often than boys found in their self-reported questionnaire of 324 secondary school learners in the Kgakotlou School in Limpopo Province.

Farhangpour et al. (2019) in their survey of 50 female adolescents and 30 male adolescents Grade 8 to 10 in a rural high school in Limpopo, found that almost three quarters (70%) of all girls participating in the survey experienced cyberbullying at least once a week, in comparison to around half (52%) of the male participants.

### 2.4.2 Technology Use

Sections 2.4.2.1 to 2.4.2.3 focus on how technology use plays a role in cyberbullying from a global, African and South African perspective. Definitions of social media were provided

in Section 1.6.3, and we link social media to cyberbullying through technology use in this section.

#### 2.4.2.1 Global Perspective

Rhee et al. (2021) define social media as creating new relationships online through electronic media and information technology. They state that cyberbullying and online sexual predation are where vulnerable learners were victimised within social media, causing the predator to feel powerful online and leaving the victim weak, embarrassed and helpless. Smit (2015) stated that cyberbullying was a major problem because, through social media, the perpetrator could stay anonymous and therefore, learners were more likely to be bullied online, where traditional bullying tactics and solutions would be ineffective. Smit (2015) stated that cyberbullying could not be dealt with in the same way as traditional bullying due to its distinct features; therefore, learners needed to adapt another way to learn about the causes and effects of cyberbullying in the education LO curriculum of CAPS.

Zuckerman (2020) stated that more than 44% of learners were on social media more than 180 minutes a day worldwide, with the statistics of being victims of cyberbullying being 42% on Instagram, 37% on Facebook, 31% on Snap Chat, 12% on WhatsApp, 10% on YouTube and only 9% on Twitter. Zuckerman (2020) stated that Latin America had the highest level of cyberbullying, with 76% of learners being cyberbullied, and the African continent was reported a 61% incidence of cyberbully victims.

Johnson (2021) stated that internet access and use increased by 34.6% worldwide from 2005 to 2019. In developed countries, internet access increased by 33.9%, in developing countries, internet access increased by 36.3%, and internet access increased by 18.1% in the least developed countries (Johnson, 2021). These statistics justified that increased screen time led to more people on social media and, therefore, a greater risk of being bullied online (Johnson, 2021).

An evaluation of 25 studies conducted between 2011 and 2019 in cybersecurity in education in Malaysia revealed that children should be able to defend themselves and assume their responsibilities when faced with possible cyber threats (Rahman et al., 2020). Furthermore, it is challenging to provide teachers training in cyber-safety instead of using restrictive tactics to ensure learners and their parents use the web safely at home (Rahman et al., 2020).

In addition to a lack of expertise and funding, schools face considerable challenges in promoting cybersecurity education (Rahman et al., 2020). Teachers do not possess adequate knowledge or expertise concerning cyberspace. There might be some challenges in implementing cybersecurity education at schools and government ministries (Rahman et al., 2020). Technology's rapid advancement creates new risks that require unique solutions. It may be difficult for teachers to stay abreast of the latest technologies, thus ensuring learner safety (Rahman et al., 2020).

#### 2.4.2.2 African Perspective

Agbeko and Kwaa-Aidoo (2018) stated that technology, with a focus on mobile technologies, were vehicles that enabled social interaction. Young learners used the internet, cell phones, social media platforms and instant messaging to communicate with friends, seek information and practice online social interaction. The learners used these forms of technology at home, at school, at friends' houses, and even at public libraries and other places with open Wi-Fi. The widespread access to technological tools has led to an increase in cyberbullying since the speed of online technology could spread rumours and humiliating pictures faster and to more people than word of mouth (Agbeko & Kwaa-Aidoo, 2018).

Mullis et al. (2020) stated that learners in Egypt, who made use of home educational resources, including Wi-Fi, mobile phone etc., had an average achievement of 437 ($SE$[1] = 10.2) on the TIMSS 2019 mathematics scale. In contrast, learners who only had a few resources had an average achievement in mathematics of 388 ($SE$ = 7.0). Thus, these results showed that learners would have an average drop of 49 marks on the mathematics questionnaire from TIMSS 2019 if the learner had fewer home educational resources (Mullis et al., 2020).

#### 2.4.2.3 South African Perspective

Kemp (2021) stated that 38.19 million people in South Africa accessed the internet in January 2021. Of this statistic, 25 million people were active social media users, increasing by 3 million people from 2020 to 2021. The number of active social media users in South Africa is equivalent to almost half (41.9%) of the country's population (Kemp, 2021).

[1] SE = Standard Error

Statista (2021b) found approximately 30.1 million active social media users in South Africa, with expected growth to 40.77 million active social media users by 2026. Tustin et al. (2014) conducted a study amongst four primary schools in Benoni, Gauteng (279 learners), and found that approximately a quarter of learners (20.5%) who had experienced cyberbullying reported that they now avoided all online social networking and media sites, while 36% of learners avoided chat rooms. The study reported that 11.9% of male learners and 18.6% of female learners reported being victims of cyber victimisation. Tustin et al. (2014) stated that cyberbullying occurred most with female learners aged 17 years and older, with 38.5% of female learners being cyber victims, whereas cyberbullying occurred more with male learners aged 15 years and older, with 42.7% male learners being cyberbully victims.

Mobile phones have made it easier for learners to engage in cyberbullying. E-mail, instant messaging, chat room exchanges, social media, website posts, digital messages and images sent to a cellular phone, or personal computer are the most common applications where cyberbullying occurs (Cilliers & Chinyamurindi, 2020). In addition to the individual being bullied, cyberbullying can negatively impact the school (Cilliers & Chinyamurindi, 2020).

### 2.4.3 Parents

Section 2.4.3.1 to 2.4.2.3 focus on how parents play a role in cyberbullying from a global, African and South African perspective.

#### 2.4.3.1 Global Perspective

According to Baldry et al. (2015), learners who were both perpetrators and victims of cyberbullying were more likely to have poor relationships with their parents. Parents might not have talked to their children about online safety, cyberbullying, and how to protect themselves online. Most cyberbully victims would not report the incident to anyone (De Lange & Von Solms, 2012). If the learner had to report the incident, 50% of the learners said they would prefer to talk to a friend, 40% would prefer to talk to a parent and only 2% to an educator (De Lange & Von Solms, 2012). There may have been a lack of parental oversight, usually in the form of few or no rules in behaviour or online activities (Kowalski et al., 2012). Popovac and Leoschut (2012) reported that in New Zealand, 52% of learners were not supervised when using the internet, and, in the USA, 41% of learners did not share any information with their parents. Only 14% of parents have caught their children doing

something with an electronic device they should not have been doing (Popovac & Leoschut, 2012).

Baldry et al. (2019) validated that boys had three times less parental supervision and guidance from their parents than girls. Boys had twice less supervision regarding online activities and online social media than girls. Thus, it made it easier for boys to access and be active online participants; it could therefore be argued that boys would be more likely to be perpetrators online (Baldry et al., 2019).

According to Garaigordobil and Machimbarrena (2017), a study done in North Korea with 1,993 Grade 5 and 6 learners (9 to 13 years old) found that parents of cyberbullying victims had higher parental stress and used more permissive educational styles that parents whose children were not cyberbullying victims.

As a parent, you may not realise your child is a victim of cybercrime because you don't know they are being targeted (Rahman et al., 2020). The need for parental involvement in cyberspace is often unknown to many parents. Rahman et al. (2020) stated that a child might be bullied through comments, insults, intimidation, harassment, abuse, or sexual exploitation. Regarding the latter form of bullying, statistics from the Royal Malaysian Police (PDRM) show that over the past two years, nearly 80% of rapes reported in Malaysia involved friendships made in the virtual realm through cyberspace, and most of the victims were under 18 years old (Rahman et al., 2020).

Van Tiel (2020) stated that perpetrators of cyberbullying could operate outside of the parents' view, making it more difficult to see, recognise and address cyberbullying, making it more difficult for parents to know if and when their children are being victimised because it is online. Van Tiel (2020) also stated that parents lack knowledge on internet usage, including social media platforms and cyberbullying, thus making it hard for their children to turn to them for support. Van Tiel (2020) also stated that only 38% of cyberbullying victims admitted to their parents being bullied online.

#### 2.4.3.2 African Perspective

According to Agbeko and Kwaa-Aidoo (2018), parents could be the main key to the solution since parents who monitored learners' online activities could reduce the probability of

getting bullied online by up to 50%. In the questionnaire distributed by Agbeko and Kwaa-Aidoo (2018) of learners aged 10 to 17 years of age in Ghana, the researcher found that only four out of 10 learners' parents knew which sites their children were visiting and what they were doing online. Learners from this survey stated that they believed it was important that parents know which sites you were visiting and what you were doing online, especially as you got older.

Wanjohi (2018) stated that because cyberbullying occurs online, sensitive information could be leaked; thus, learners must be cautious on social media and the personal information they post online. Wanjohi (2018) stated that this might be possible if parents can be more involved in their children's lives and online activities,

#### 2.4.3.3 South African Perspective

According to Govender and Young (2018), children who have grown up with authoritarian style parenting tended to display more cyberbullying behaviour due to parental rejection and lack of communication. Children from these households bullied others online to gain freedom, attention and a sense of supremacy which they lacked in their parental relationships. This statement agreed with Makri-Botsari and Karagianni's (2014) findings, which stated that cyberbullies raised by authoritarian parents were more likely to bully others online because they felt a greater sense of supremacy. This behaviour was attributed to a lack of attention, love and acceptance. Looking at the average achievement of Grade 9 learners in TIMSS 2019 by the frequency of parents checking up on their children doing their homework, results showed that learners achieved better mathematics marks when their parents were more involved (Reddy et al., 2020).

Reddy et al. (2020) stated that approximately one-third (34%) of parents in South Africa had post-secondary education, with almost a half (48%) of learners in fee-paying schools living in homes where at least one of the parents had a post-secondary diploma or degree. In contrast, and only 34% of learners in non-fee paying schools were living in homes where at least one of the parents had a post-secondary diploma or degree. Fee-paying public schools are defined as schools where the parent body determines the fees charged at the school (Dass & Rinquest, 2017). Non-fee paying public schools are not allowed to charge any fees but are allowed to raise extra funds through donations and "voluntary contributions" (Dass & Rinquest, 2017, p. 147). Dass and Rinquest (2017) state that if the school fees are more than

10% of a family's joint income, the family does not have to pay school fees from Grade R to Grade 9. According to Van Tiel (2020), this is problematic since some parents lack knowledge about using the internet, including why and how cyberbullying occurs.

In independent schools, learners scored much higher mathematically, whether the parent checked the homework or not. In most non-fee paying schools, the parents may not have had the capacity to check up on homework due to time constraints, other commitments and lack of understanding of the homework. Other socioeconomic disadvantages may also have contributed to the problem (Reddy et al., 2020).

### 2.4.4 Self-esteem

Sections 2.4.4.1 to 2.4.4.3 focus on how self-esteem plays a role in cyberbullying from a global, African and South African perspective.

#### 2.4.4.1 Global Perspective

According to Kowalski et al. (2012), the perpetrators of cyberbullying may have violated school rules more often and used bullying behaviour to justify their misconduct. Wang et al. (2014) and Adelphi Psych Medicine Clinic (2019) reported that cyberbullies could also be victims, which correlated with the TIMSS 2019 results where some of the victims turned into the perpetrators themselves (Reddy et al., 2020).

The Adelphi Psych Medicine Clinic (2019) reported that victims of cyberbully often retaliated due to the pain and suffering caused by the perpetrator, and therefore became cyberbullies themselves. Hemphill et al. (2015) found in a longitudinal study of 673 Australian learners aged 12 to 13 years that being a victim of traditional bullying correlated with cyber victimisation and the other way around. Hemphell et al. (2015) stated that if you were a traditional bully, you tended to bully other learners online as well. Modecki et al. (2013) have documented that cyberbullies developed an “early depressed mood”, seeking attention and control later in life. It could be treated; thus, bullying was a dynamic phenomenon wherein the “bully” also needed help. Cyberbullying and its impacts may be evident at an individual level in low self-esteem, family problems, academic problems, violence in the classroom, delinquent behaviour, and suicidal thoughts (Cilliers & Chinyamurindi, 2020).

According to Mullis et al. (2020), learners who were more confident in mathematics was associated with higher average mathematics achievement. Fifteen per cent of learners stated that they were highly confident in mathematics and obtained 562 on the TIMSS 2019 scale, which lay between high (550) and advanced (625) on the TIMSS 2019 international scale. Foty-two per cent (42%) of learners stated that they were somewhat confident in mathematics and scored 502 on the TIMSS 2019 international scale, which fell between intermediate (475) and high (550). Over 44% of the learners stated that they were not confident in mathematics and obtained only 456, which lay between low (400) and intermediate (475) on the TIMSS 2019 international scale (Mullis et al., 2020).

#### 2.4.4.2 African Perspective

According to Richardson and Fen Hiu (2018), South, Central, and West Africa were high-risk countries for cyberbullying. In a global comparative study of six international surveys (which included TIMSS 2015) that focused on learners between the ages of 11 to 15 in 145 countries, it was found that Botswana had the highest percentage of bullying with an 81% incidence, Ghana was second with 78% and South Africa third with 75%. Richardson and Fen Hiu (2018) stated it might be due to social-economic problems and poor health, which leads to lower self-esteem (Maxwell et al., 2017) since it impacts learners' psychological health and self-esteem.

In a study done by Akpunne et al. (2020), a total of 300 secondary school adolescents in Oshodi Isolo, Lagos, Nigeria responded to the following scales: Child Exposure to Domestic Violence Scale (CEDV), Centre for Epidemiological Studies Depression Scale for Children (CES-DC) and Online Victimization Scale for Adolescents (OVSA). The study from Akpunne et al. (2020) found that cyberbully victims tended to feel more depressed, had low self-esteem, tended to fail in school, had anger issues, avoided school, were anxious, and even had suicidal thoughts. Akpunne et al. (2020) also found that cyberbullying was extremely difficult on the victim and the whole family involved, which could contribute to even lower self-esteem.

#### 2.4.4.3 South African Perspective

Tustin et al. (2014) reported in the self-conducted survey done of Grade 8 to 12 learners (4,245 learners over 14 schools) in Gauteng and the Western Cape, 60% reported being victims of emotional and cyberbullying. Female learners between the ages of 15 and 16 were more likely to be victims of emotional bullying, with 74.8% of female learners being bullied emotionally. According to Tustin et al. (2014), cyberbullying had psychological effects on learners' self-esteem, leading to frustration, anger, embarrassment, sadness, shamefulness, and feeling powerless. Tustin et al. (2014) noted that any form of bullying was linked to lower self-esteem, suicidal thoughts, poor academic achievement, assaultive and even self-destructive behaviour such as substance abuse, criminal conduct and adolescent suicide.

Farhangpour et al. (2019) found in their survey of 50 females and 30 males in a rural high school in Limpopo (Grade 8 to 10) that 21% of the learners lacked self-confidence due to cyberbullying, 25% of the learners were depressed, 6% were frustrated, 15% were self-conscious, and 23% had suicidal thoughts. The survey also found that more than half of the participants (53%) began to skip school, and 11% of learners indicated behavioural changes, including not paying attention to schoolwork and joining gang groups to be less bullied at school.

### 2.4.5 Academic Achievement

Sections 2.4.5.1 to 2.4.5.3 focus on how poor academic achievement plays a role in cyberbullying from a global, African and South African perspective.

#### 2.4.5.1 Global Perspective

Academic achievement was a possible outcome linked to cyberbullying, considering the victims may have lacked focus and became detached from their schoolwork and academic responsibilities and felt depressed. Wang et al. (2014) found in their Ottawa-based Canadian study with 1,023 Grade 5 learners that cyber victimisation had a large and significant association with lowering school achievement. A negative association between cyberbullying and academic achievement was reported by Peled (2019). This statement agreed with findings from TIMSS 2019, which are discussed in more depth in Chapter 5. An online survey in the USA, involving 1,378 respondents of learners younger than 18 years old, reached the same conclusion. According to Finnish researchers Kowalski et al. (2014,

p1,115), the more time you spent online, the more at risk you were to be cyberbullied, which was called “risky online behaviour”. It was corroborated by several other researchers, including Sasson and Mesch (2017) and Baldry et al. (2019).

The TIMSS & PIRLS International Study Center (2019b) stated that learners who were bullied in any form had lower average academic achievement than learners who never or almost never experienced bullying in any form. According to the TIMSS & PIRLS International Study Center (2019b), 71% of Grade 8 learners have never or almost never been bullied in any form, and their average mathematics achievement was 496 on the TIMSS 2019 scale, which lay between the intermediate benchmark (475) and high benchmark (550) of TIMSS 2019. Almost a quarter (23%) of learners reported in TIMSS 2019 that they have been bullied about monthly in some form. Their average mathematics achievement was 482 on the TIMSS 2019 benchmark, which lay just above the intermediate (475) benchmark of TIMSS 2019. Only 6% of learners participating in the TIMSS 2019 reported being bullied about weekly, and their average academic achievement dropped to 428, which lay between low (400) and intermediate (475) on the TIMSS 2019 benchmark. It was clear from TIMSS 2019 that learners who were bullied weekly had a lower average mathematics achievement (The TIMSS & PIRLS International Study Center, 2019b).

#### 2.4.5.2 African Perspective

Anton-Erxleben et al. (2016) used two international questionnaires using the TIMSS 2011 & PIRLS 2011 questionnaires to look at bullying and cyberbullying of Grade 4 and 8 learners in Botswana, Ghana and South Africa. The study by Anton-Erxleben et al. (2016) found that around half of the learners were bullied either physically or through social media in all three African countries, negatively impacting their academic achievement. Anton-Erxleben et al. (2016) stated that in developing countries such as South Africa (World Population Review, 2021), bullying led to a) school avoidance, b) poor attendance, c) an inability to concentrate, d) negative attitudes towards school, e) lack of academic engagement, f) depression, g) reduced self-esteem, and h) physical health problems.

Mullis et al. (2020) stated that learners in Morocco who were cyberbullied never or almost never had an average achievement of 395 (*SE* = 2.9) on the TIMSS 2019 mathematics scale, in contrast with learners who were cyberbullied almost weekly. These learners achieved an average of 366 (*SE* = 3.4) on the TIMSS 2019 mathematics scale. This result means that if

a learner were cyberbullied almost weekly, learners' mathematics achievement would decrease with an average of 29 points on the TIMSS 2019 mathematics scale (Mullis et al., 2020). Hence, it is clear that cyberbullying does affect learners' mathematics achievement.

#### 2.4.5.3 South African Perspective

TIMSS 2019 found that all forms of bullying were prevalent at schools internationally and concluded that bullying affects learners' performance as learners divert their attention from learning to how to avoid being cyberbullied (Mullis et al., 2020). TIMSS 2019 showed that cyberbullying is negatively associated with learners' mathematics achievement (Mullis et al., 2020). Mullis et al. (2020) stated that learners who were never or almost never bullied had a higher mathematics achievement, with 63% of the learners stating they were never or almost never bullied. These learners' average mathematics achievement stood at 512 on the TIMSS 2019 scale (Mullis et al., 2020). The report also indicated that 8% of learners were bullied weekly and had an average mathematics achievement of only 451 on the TIMSS 2019 scale (Mullis et al., 2020).

In a rural high school in Limpopo, Farhangpour et al. (2019) found that cyberbullying affected the achievement of 50 females and 30 males in Grades 8 to 10. Due to the victimisation, almost one-third of the victims (32%) did not want to go to school anymore, and 34% considered quitting. Being a victim of cyberbullying also affect learners' grades. In addition to less participation in school from cyberbullied victims, 24% reported academic difficulties, and 35% had to repeat a grade because of the bullying (Farhangpour et al., 2019).

### 2.4.6 School Location and SES

The following sections focus on how the school's location and SES play a role in cyberbullying from a global, African and South African perspective.

#### 2.4.6.1 Global Perspective

Kowalski et al. (2014) stated that traditional bullying at schools led to cyberbullying. Cyberbullying was not a separate risky environment; instead, it was a forum used by perpetrators that extended the reach of the school grounds. According to Kowalski et al. (2014), learners reported less victimisation of emotional abuse and cyberbullying in schools where the climate was trusting and fair. In contrast, in schools where learners felt unhappy,

had no friends and could not open up, more bullying in all its forms occurred. These emotions could create frustration, anger and discomfort in learners, which may have caused the learner to act out through cyberbullying (Kowalski et al., 2014).

The Australian-wide study by Maxwell et al. (2017) found that learners' and teachers' perceptions of school climate impacted learners' academic achievement. Learners' emotional and behavioural outcomes are strongly influenced by school climate. In the long run, it impacts learners' psychological health and self-esteem (Maxwell et al., 2017). In addition to bullying and aggression, school climate also influences delinquency, alcoholism, and drug abuse. According to the research, predicting school climate can affect how much learners achieve academically (Maxwell et al., 2017).

Schools must teach learners critical digital literacy skills and guide and inform parents on how their children should use the internet at home (Rahman et al., 2020). Education in cybersecurity is intended to raise users' awareness of the potential risks they may encounter when using technology such as social media, chat, online games, email, and instant messages (Rahman et al., 2020). Rahman et al. (2020) emphasised that responsible online behaviour should be promoted, and educators need to communicate cybersecurity messages to learners.

Mullis et al. (2020) stated that schools highlighting academic success had higher average academic achievement. The results indicated that only 8% of Grade 8/9 learners in schools globally very highly emphasised academic success, almost half (49%) of learners in schools had a high emphasis on academic success, and 43% of learners in schools had a medium emphasis on academic success.

According to Mullis et al. (2020), learners with a higher sense of school belonging performed better academically, with 37% of Grade 8/9 learners globally having a high sense of school belonging, almost half (49%) of learners having some sense of school belonging and only 14% of learners having little sense of school belonging. These results showed that most learners felt connected and included at schools globally, but still, the percentage of cyberbullying globally was problematic and too high (Peled, 2019). The revised cyberbullying survey done of 638 Israeli undergraduate learners by Peled (2019) evaluated the frequency and media of cyberbullying perpetration. The research showed that more than

half (57%) of learners had experienced cyberbullying at least once or twice through different types of social media (Peled, 2019).

The TIMSS 2019 results also showed that the clarity of instruction from the teachers affected learners' average mathematics achievement. According to Mullis et al. (2020), 46% of Grade 8/9 learners had high clarity of instruction and obtained an average score of 504 on the TIMSS 2019 benchmark, which lay between intermediate (475) and high (550) on the benchmark. The learners with a moderate understanding of instruction (41% of learners) obtained an average score of 482 on the TIMSS 2019 benchmark, which also lay between intermediate (475) and high (550) on the benchmark. Lastly, 13% of learners reported low clarity of instruction and obtained an average of only 467 on the TIMSS 2019 benchmark, which lay between low (400) and intermediate (475) on the benchmark. The results showed a strong association between clarity of instruction and average mathematics achievement (Mullis et al., 2020).

#### 2.4.6.2 African Perspective

Agbeko and Kwaa-Aidoo (2018) from Ghana stated that the growing trend in technology use has increased cyberbullying to include posting embarrassing pictures of the learner without their permission or writing an anonymous cyber message to another learner. With the use of technology, rumours, embarrassing pictures and false, humiliating information were spread quicker than by word of mouth and could stay on the internet longer. The sense of school belonging among learners decreased since learners were scared of becoming cyber-victims. In the case of those who already were victims, many learners have started feeling embarrassed, scared or too depressed to go back to school since they did not know how to deal with the situation (Agbeko & Aidoo, 2018).

Both Anton-Erxeben et al. (2016) and Akpunne et al. (2020) stated that cyberbullying led to school avoidance and poor attendance in developing countries such as Ghana, Botswana, and Nigeria. Traditional bullying tends to spiral into cyberbullying; thus, learners were afraid of going to school, even if the perpetrator was anonymous. The victim felt exposed and ashamed of the rumours on social media and avoided school to avoid embarrassment and more physical confrontations (Anton-Erxleben et al., 2016).

#### 2.4.6.3 South African Perspective

In an environment where school bullying is more prevalent, Cilliers and Chinyamurindi (2020) stated that it could undermine a school's climate and negatively affect learners' achievement, safety, and school operations. This finding was also reached by Kowalski et al. (2014) (as discussed in Section 2.4.6.1). If learners do not feel safe at school, absenteeism and truancy rates may also increase. As cyberbullying is more prevalent in schools, the school may be affected by actions outside of school due to learners or teachers accessing the internet (Cilliers & Chinyamurindi, 2020). Cyberbullying is a problem that is well known within academic circles as Molluzzo and Lawler (2014) noted, but perceptions around preventing and resolving cyberbullying issues are lacking. Similarly, the study by Eskey et al. (2014) found that teachers reported knowing about cyberbullying and that they had experienced at least one incident of cyberbullying in the last year.

Cilliers and Chinyamurindi (2020) found in their survey of 150 student teachers working in primary and secondary schools across the Western Cape while studying education that most student teachers were aware of cyberbullying on the internet in general (84.6%) and specifically in the schools where they worked (78.0%). However, student teachers in South Africa are less likely to be aware of specific instances of cyberbullying (67.3%). Cilliers and Chinyamurindi (2020) assert that the lack of knowledge on the topic in South Africa indicates that the country's citizens and future educators need to be educated on the topic. In addition, most student teachers (92%) agreed that cyberbullying is a serious issue that should be addressed. Four out of five student teachers (45.4%) reported being victims of cyberbullying at some point in a study conducted by Cilliers and Chinyamurindi (2020).

According to Odendaal (2017), a negative school climate could be related to cyber victimisation, considering that there may have been less support from teachers, a lack of clear rules and a lack of school and class safety. Learners' peer groups had a big influence on cyberbullying, especially of the same sex. Learners with strong self-esteem could resist negative peer pressure since toxic friendships may have been associated with being bullied more often (Odendaal, 2017).
The school quality indicators addressed by TIMSS 2019 were:

- Features and demographics of the school

- Lack of mathematics resources affects instruction
- Academic success is the school's focus
- Perceptions of parents regarding the school
- An orderly and safe school environment
- Bullying and cyberbullying among learners
- The feeling of school belonging (Mullis & Martin, 2017).

## 2.5 Case Studies: Suicides by Bullying

As stated in Section 2.4.1.1 by Jiménez (2019), traditional bullying leads to cyberbullying. This section discusses a few case studies about types of bullying leading to suicides. A meta-analysis was conducted by John et al. (2018), including 33 articles from 26 independent studies from 1996 to 2017, to examine the relationship between cyberbullying and self-harm or suicidal behaviour of learners and people under the age of 25. A total of 25 articles identified a negative relationship between cyberbullying and self-harm or suicidal behaviour. This meta-analysis also showed that suicidal thoughts, suicidal behaviour, attempted suicide and self-harm were 95% more prevalent among learners who were victims of cyberbullying than learners who weren't victims of cyberbullying. This meta-analysis also showed that perpetrators were 95% more likely to have suicidal behaviour and ideation than non-perpetrators (John et al., 2018).

Another survey was done in the United States by Baiden and Tadeo (2020) of 14,603 learners aged 14 to18 in 2017 using the 2017 Youth Risk Behaviour Survey data to examine the relationship between victims of bullying and suicidal ideation amongst adolescents. The survey used a binary logistic regression model and reported that one out of ten learners were victims of traditional and cyberbullying. The survey also reported that learners who were victims of both cyber and traditional bullying had a 3.26 higher chance of experiencing suicidal ideation than other learners (Baiden & Tadeo, 2020).

It has been reported that over 100 cases of cyberbullying have led to suicide over the last two decades, including Jamel Myles (age 9), who committed suicide after he was bullied for being gay (Kacala, 2018). "Kill yourself" prompted Stephenie Johnson (age 12) to hang herself in the school bathroom after her classmates urged her to do so. After being hospitalised for four days, she died (Johnson, 2018). CBS News (2018) reported that Andrew Leach (age 12) hung himself in his garage at home after being revealed that he might be

bisexual. Learners at school kept making fun of him, and after other boys followed him into the bathroom one day, saying that "we're going to put hands on you. You are not going to make it out of this bathroom", he killed himself (CBS News, 2018). According to Lynch (2018), Gabriella Green (age 12) was bullied at school and on social media. Two female learners from her school confessed to bullying and stalking Gabriella. Gabriella declared to one of the bullies that she tried to hang herself, and the bully responded, "if you are going to do it, just do it". The two female learners were arrested after Gabriella hung herself in her closet with a dog leash (Lynch, 2018). Seven Bridges (age 10) committed suicide after being teased at school and online about his medical colostomy bag (Magness, 2019). On 21 April 2021, Luvuno Mavhunga (age 15) from the Mbilwi Secondary School in Limpopo, South Africa, committed suicide after another learner aggressively assaulted her in the school. The video of her being pugnaciously assaulted circulated various social media platforms while her schoolmates cheered, laughed and recorded the incident (Mayeza, 2021).

## 2.6 Disadvantages and Leading Consequences of Cyberbullying on Learners' Mathematics Achievement in South Africa

Sections 2.6.2 and 2.6.3 discuss the disadvantages and leading consequences of cyberbullying, respectively. The researcher established that very few laws in South Africa focused specifically on cyberbullying, but that does not mean the perpetrator should get away with it without any repercussions. The following discussion explains what a cyberbully perpetrator can be charged with and the motivations for additional cyberbullying laws (or stricter laws) to be brought into the South African law system.

### 2.6.1 Disadvantages of Cyberbullying in South Africa

As stated previously, cyberbullying is a form of violence. The Centre for Justice and Crime Prevention (CJCP) summarises the consequences of school violence succinctly as:

> Experience and exposure to violence in any environment at a young age increase the risk of later victimisation, as well as perpetration of violence and other antisocial behaviour. Schools, if considered holistically, are environments where children not only acquire scholastic knowledge, but also where they learn to know, to be, to do and to live together. Violence in schools impacts negatively on all these processes, creating instead, a place where children learn fear and distrust, where they develop distorted perceptions of

> identity, self and worth, and where they acquire negative social capital, if the violence and safety-related threats are not effectively managed. Thus, school safety is a fundamental precondition for learning rather than being an addition (CJCP, 2016, p. 6).

According to Khan (2017), suicide was the third-largest reason for unnatural deaths in South Africa. Social media was partly to blame, with perpetrators hiding behind their anonymity and enjoying the power of harassing others (Khan, 2017). There was a 9.5% suicide rate in South Africa in 2017, with 60% of the suicides due to depression (Khan, 2017). According to a worldwide Vodafone survey, it reported that South Africa's rate of cyberbullying was at 24%. This statistic placed South Africa fourth worst in the world (Khan, 2017). Liu et al. (2020) found that cyberbullying was significantly related to depression with a negative direct effect in a two-wave longitudinal survey of 661 Chinese junior high learners. Khan (2017) also found that cyberbullying led to clinical depression.

A study done by the Pew Research Center in the USA showed that 93% of learners between the ages of 12 and 17 would rather spend their time on social media than any other activity (Fuller, 2021). According to Ferrara et al. (2018), living in a technological era where technology improved every day, social media like Facebook, Instagram and Snapchat were easily accessible and contributed to being a public health concern (Fuller, 2021). Hills (2017) stated that although South African legislation protected a learner from being bullied physically (traditional bullying), South African legislation and policies provided little protection from being cyberbullied. The Cybercrimes Act (Act 19 of 2020), which was released on the 1st of June 2021, is discussed in more detail in Section 2.6.2, which contains certain legal consequences of cyberbullying, but the law is still unclear about whether this also applies to minors under the age of 18 (Cybercrimes Act, 2020).

Ferrara et al. (2018) stated that over 95% of American adolescents between the ages of 13 and 17 used the Internet, and over 81% of these learners used social media, which decreased academic performances. According to Ferrara et al. (2018), in Italy, more than half of the learners went onto social media at least once a day, and more than 22% of learners would log onto their preferred social media application more than ten times a day. Adolescent learners needed to focus on their social and emotional welfare, but social media left them socially vulnerable. Learners were not equipped to handle peer pressure positively and became distant and depressed (Ferrara et al., 2018).

### 2.6.2 Consequences for the Perpetrator in South Africa

Sections 2.6.2.1 to 2.6.2.1.4 discuss the legal consequences of cyberbullying for the perpetrator in South Africa, including what charges a perpetrator could be facing legally.

#### 2.6.2.1 Legal Consequences for the Perpetrator in South Africa

Badenhorst (2011) and Hills (2017) clearly stated that the perpetrator could be charged with the following offences in the case of cyberbullying:

- ***Crimen injuria*** – The unlawful, intentional and serious violation of the dignity or privacy of another person, such as embarrassing another person online by posting humiliating material publicly (Badenhorst, 2011)
- ***Assault*** – Any unlawful action or intentional omission that results in another person's bodily integrity being directly or indirectly impaired or inspires a belief of fear in another person that such impairment would be carried out, including actions such as spreading rumours about someone online or humiliating the person (Badenhorst, 2011).
- ***Criminal defamation*** - Unlawful and intentional publication of a matter concerning another, which tends to injure their reputation seriously. Defamatory photos, videos, or other materials such as written or verbal statements (Badenhorst, 2011) could play a part in this offence.
- ***Extortion–***Unlawfully and intentionally gaining an advantage. By putting the victim under pressure, the advantage is either granted patrimonially or non-patrimonially (Badenhorst, 2011). In addition to damages, the perpetrator could also be sued for defamation.
- **Sexual exploitation and grooming** – Threatening a person to obtain something from them, such as pornographic images (Hills, 2017).

##### 2.6.2.1.1 The Criminal Law (Act 32 of 2007)

The Department of Justice and Constitutional Development (2014) stipulated in Section 19 of the Criminal Law (Sexual Offences and related matters) Amendment Act 32, 2007 (Criminal Law -Sexual Offences and Related Matters-Act 32, 2007) that, a) any person exposing or displaying, b) having child pornography or, c) showing child pornography to a child is guilty of the offence of "Sexual exploitation and sexual grooming of children, exposure or display of or causing exposure or display of child pornography or pornography

to children and using children for pornographic purposes or benefiting from child pornography" (Criminal Law -Sexual Offences and Related Matters-Act 32, 2007, p26). Sending nude or semi-nude pictures, videos and or even suggestive messages via phone, email, chat rooms, websites, blogs, on social networks, or computers would fall under this specific criminal law (Smit, 2015). Consequently, any person possessing, sending or creating, producing or distributing child pornography and soliciting sexual pictures would be found guilty and may be sentenced to a fine or imprisonment or both (Smit, 2015). As a result of a conviction under this act, the offender's details could be added to the National Register of Sex Offenders (Criminal Law -Sexual Offences and Related Matters-Act 32, 2007). The victim of cyberbullying could apply at the nearest Magistrate's court for a protection order in terms of the Protection from Harassment Act (Act 17 of 2011). The Criminal Law (Act 32 of 2007) defines child pornography as the following:

> Any image, however created, or any description or presentation of a person, real or simulated, who is , under the age of 18 years, of an explicit or sexual nature, with the intention to stimulate erotic or aesthetic feelings or not, including any such image or description of such person (a) engaged in an act that constitutes a sexual offence (b) engaged in an act of sexual penetration (c) engaged in an act of sexual violation (d) engaged in an act of self-masturbation (e) displaying the genital organs of such person in a state of arousal or stimulation (f) unduly displaying the genital organs or anus of such person (g) displaying any form of stimulation of a sexual nature of such person's breasts (h) engaged in sexually suggestive or lewd acts (i) engaged in or as the subject of sadistic or masochistic acts of a sexual nature (j) engaged in any conduct or activity characteristically associated with sexual intercourse (k) showing or describing such person – (i) participating in, or assisting or facilitating another person to participate in being in the presence of another person who commits or (ii) in any other manner being involved in, any act contemplated in paragraphs (a) to (j) or (l) showing or describing the body, or parts of the body, of such person in a manner or in circumstances which, within the context, violate or offend the sexual integrity or dignity of that person or any category of persons under 18 or is capable of being used for the purposes of violating or offending the sexual integrity or dignity of that person, any person or group or categories of persons." (Criminal Law -Sexual Offences and Related Matters-Act 32, 2007, pp14).

#### 2.6.2.1.2 The Cybercrimes Act (Act 19 of 2020)

The Cybercrimes Act (Act 19 of 2020), which was released on the 1st of June 2021, state that if someone sends an online message which, a) provokes damage to property or violence, or, b) an online message which intimidates a person and threatens damage to property or violence and, lastly, c) to disclose specific messages which contain an intimate image by some form of electronic communications without the other person's consent, may be sentenced to a fine or imprisonment or both (Cybercrimes Act, 2020). The law is still unclear about whether this also applies to minors under the age of 18.

The Cybercrimes Act (Act 19 of 2020) states that any person may be sentenced to a fine or imprisonment or both (Cybercrimes Act, 2020) in the case of **''A''** who unlawfully and intentionally discloses, by means of an electronic communications service, a data message of an intimate image of a person **''B''**, without the consent of B, is guilty of an offence.
(2) For purposes of subsection (1) —
*(a)* **''B''** means —
(i) the person who can be identified as being displayed in the data message;
(ii) any person who is described as being displayed in the data message, irrespective of the fact that the person cannot be identified as being displayed in the data message; or
(iii) any person who can be identified from other information as being displayed in the data message; and
*(b)* **''intimate image''** means a depiction of a person —
(i) real or simulated, and made by any means in which —
*(aa)* B is nude, or the genital organs or anal region of B is displayed, or if B is a female person, transgender person or intersex person, their breasts, are displayed; or
*(bb)* the covered genital or anal region of B, or if B is a female person, transgender person or intersex person, their covered breasts, are displayed; and
(ii) in respect of which B so displayed retains a reasonable expectation of privacy at the time that the data message was made in a manner that —
*(aa)* violates or offends the sexual integrity or dignity of B; or
*(bb)* amounts to sexual exploitation.

(Cybercrimes Act, pp. 22)

If sexual exploitation or violations are committed, the perpetrator's name will also be entered on the National Register for Sex Offenders (NRSO) (Criminal Law -Sexual Offences and Related Matters-Act 32, 2007). In 2007 the NRSO was created by the Amendment Act no 32 of 2007 (SORMAA) (Criminal Law -Sexual Offences and Related Matters-Act 32, 2007), targeting any adults who have committed sexual offences against children or mentally disabled individuals. The Criminal Law -Sexual Offences and Related Matters-Act 32 (2007) stipulates that any person whose name is written down in the NRSO is not allowed to work with children or mentally disabled people or adopt their own children. Names of offenders who have been convicted of sexual offences in the NRSO stays there permanently.

#### 2.6.2.1.3 The Protection From Harassment Act (Act 17 of 2011)

The protection from harassment act (Act 17 of 2011) states under Section 3 (Consideration of application and issuing of interim protection order) that if a court is satisfied that there is enough prima facie (accepted as correct, until proven otherwise) evidence that the perpetrator is or has engaged in harassment, the victim can issue an interim protection order from the court (Protection from Harassment Act, 2011). “Harassment” is defined by the protection from harassment act (2011) as causing harm or a reasonable belief that the victim may be harmed unreasonably by a) following, watching, tracking or confronting the victim near a place the victim lives or works, b) engaging in verbal, electronic or any other communication with the victim by any means, whether or not a conversation occurs, and c) sending, delivering or causing the delivery of traditional or electronic mail, d) be evidence to sexual harassment of the victim (Protection from Harassment Act, 2011).

#### 2.6.2.1.4 The Child Justice Act (Act 75 of 2008)

The Child Justice Act (Act 75 of 2008) aims to establish a fair criminal law for children who have conflicts with the law and are accused of crimes (Child Justice Act, 2008). Laws apply to children under the age of 18 who lack the capacity to commit crimes and children outside the legal system who lack such capacity. Additionally, the law provides that criminal matters can be diverted, e.g. to be dealt with at a school level before becoming a legal issue (Child Justice Act, 2008). As part of Act 75 of 2008, other possible punishment options are described. Recuperative justice is established in the criminal justice system for children who

come into conflict with the law and matters related to it. Children in conflict with the law are entitled to specific protections, according to Act 75 of 2008 (Child Justice Act, 2008). According to the Child Justice Act (Child Justice Act, 2008, pp. 1-2), children in conflict with the law has the right to:

a) not to be detained, except as a measure of last resort, and if detained, only for the shortest appropriate period of time;
b) to be treated in a manner and kept in conditions that take account of the child's age;
c) to be kept separately from adults, and to separate boys from girls, while in detention;
d) to family, parental or appropriate alternative care;
e) to be protected from maltreatment, neglect, abuse or degradation; and
f) not to be subjected to practices that could endanger the child's well-being, education, physical or mental health or spiritual, moral or social development (Child Justice Act, 2008, pp. 1-2).

LegalWise South Africa (n.d.) states that perpetrators of cyberbullying would follow criminal procedures according to the Child Justice Act (2008). Learners under the age of ten did not have criminal capacity, thus could not be found guilty of any criminal offence, but these learners still had to face the consequences of cyberbullying. One of the consequences may be to send a child to therapy.

According to LegalWise South Africa (n.d.), there were certain civil remedies available for victims, including:

- According to the Protection from Harassment Act (2011) against cyberbullying at the Magistrate Court, a protection order could be obtained. Any child could apply for protection without assistance from a parent or guardian; however, it was advisable to consult with a reliable therapist or the learner's parents or legal guardian first to assist them in getting such an application (LegalWise South Africa, n.d.).
- Parents or legal guardians could decide to report the perpetrator to the school's governing body. A disciplinary hearing would be held according to the school's code of conduct, and the perpetrator would receive the correct punishment or even get suspended (LegalWise South Africa, n.d.).

## 2.7 Synthesis of Literature

South Africa indicated that 25% of parents have reported their child being a victim of cyberbullying in 2018 (Johannes, 2018). This study also showed that 45% of South African parents know of a learner who has been cyberbullied in their community (Johannes, 2018). Studies have shown that cyberbullying has increased worldwide due to the increase of online media and the anonymity of a perpetrator online. In conclusion, cyberbullying is a problem in South Africa, and parents can be a valuable part of the solution if knowing about cyber victims but need to be equipped to handle the situation.

Cyberbullying, which typically occurs through social media, affects learners emotionally, academically and socially (Badenhorst, 2011). Smit (2015) found that most learners do not understand the legal and psychological ramifications of cyberbullying until it may be too late. Popovac and Leoschut (2012) found that cyberbullying is dangerous and problematic due to the perpetrator's anonymity. It has been reported that more high school learners commit suicide because of cyberbullying than traditional bullying (Prinsloo, 2017). Schools with a healthier school climate– known as holistic excellence in a socioeconomic climate, such as Bronfenbrenner's ecological framework (Bronfenbrenner, 1977)–have fewer cyberbullying incidents and higher average achievement scores (Mullis et al., 2020).

A limit on this research dissertation is that the researcher is limited to only be looking at the association between cyberbullying and mathematics achievement, although it can be argued that cyberbullying has a holistic and academic effect on all subjects. This research dissertation focuses only on an educational discipline, not the psychological, law and policy or other specialised disciplines. Also, very few articles do adequate research on how cyberbullying can affect learners' mathematics achievement.

## 2.8 Theoretical Framework

Urie Bronfenbrenner (1917-2005) was the best known proponent of the contextual perspective. According to Bronfenbrenner (1977), the developing child was anchored in a range of complex and interactive systems in the environment. Bronfenbrenner's ecological theory was well developed during the 1970s and is still used in the 21st century. It involved five systems, namely: the microsystem, mesosystem, exosystem, macrosystem and chronosystem (the chronosystem was only brought in, in 1994 by Bronfenbrenner and Ceci

(1994) called it the bio-ecological model). Tudge and Rosa (2019) stated that each system looks at specific human development and individual-context relatedness, thus how an individual would relate to specific topics and in certain contexts, e.g. abuse. In 1994, Bronfenbrenner and Ceci (1994) extended Bronfenbrenner's ecological model to create a bio-ecological model which focuses specifically on the gene-environment interactions in human development. The model proposed assessments of mechanisms called "proximal processes" to capture genetic material (Bronfenbrenner & Ceci, 1994).

The researchers proposed that heritability is a deterministic process determined jointly by proximal processes and the environment in which these processes occur, and could be explained by the bioecological model (Bronfenbrenner & Ceci, 1994). Heritability can be defined as the degree to which genetic differences explain the traits of individuals (Bronfenbrenner & Ceci, 1994). The model addresses the problem of variation in heritability depending on the developmental outcome to be evaluated. Bronfenbrenner and Ceci (1994) stated that using the model; we could also evaluate how the genetically based individual differences are related to the absolute level of developmental functioning. The bio-ecological model corrects the main weakness of the established behavioural genetic paradigm, which ignores the extent to which potential is unrealised, the most serious and problematic problem of heritability (Bronfenbrenner & Ceci, 1994). The bio-ecological model is beneficial for the current study since it considers the learners' genetics and how these genetic differences explain the specific traits of each individual by especially focussing on the individual's development (e.g. the environment).

In Bronfenbrenner and Ceci's model from 1994, the chronosystem was also brought in, which was not in Bronfenbrenner's earlier models, which could be viewed as the time dimension. The chronosystem was brought in to explain the importance of how people and environments change and progress better (Bronfenbrenner & Ceci, 1994).

Based on Swearer and Espelage (2010) argument, equifinality (referred to as multiple paths to the same outcome) suggested that bullying had several different causes. Human behaviour was influenced by the reciprocal interaction between the individual, family, peer group, school, community, and cultural influences (Swearer & Espelage, 2010). Throughout the history of bullying and victimisation research, the notion that human behaviour is multiple-determinative and multiple-influenced has played a significant role (Bronfenbrenner, 1979).

To illustrate the importance of the chronosystem in Bronfenbrenner and Ceci's bio-ecological model, Swearer and Espelage (2010) gave the following example:

> A child (we'll call her Sarah) who is impulsive and who has a hostile attributional style lives in a family with a father who is a biologist who works in private industry and a mother who is a homemaker. Sarah's mother is very concerned about her daughter's social status and she wants her to have all the advantages that she didn't have growing up. Sarah goes to school in a middle-class community with a high emphasis on athletics. She is one of the star athletes, playing soccer, soft ball, and club swimming. In the community in which Sarah lives, athletics are highly valued and the girls on her soccer team enjoy high social status. The girls all have Facebook accounts, cell phones, and are typical adolescents, spending about four hours per day on their computers and cell phones. A new girl (we'll call her Beth) who is also a star athlete moves into the community. Sarah and her friends end up being relationally aggressive to Beth. As they tell the story, she "deserved" the bullying since her family bought the largest house in this community and she had an "attitude." What they failed to mention was that Beth tried out for the soccer team and was awarded a starting position over one of Sarah's friends, who had been on the team for three years. Sarah and her friend organized a Facebook campaign against Beth, who was devastated when she found out that her "friends" on the soccer team were spreading rumors that she was a lesbian. Her parents didn't understand what happened since Beth was always well liked and had been a star athlete and student throughout junior high and into her high school years. (Swearer & Espelage, 2010, p. 4)

Swearer and Espelage (2010) stated that if any of the variables in the example described above changed, bullying might not have taken place. As shown in the example above, Swearer and Espelage (2010) pointed out that the principle of equifinality would apply to bullying behaviour. Bullying could seldom be explained simply–it often arises as a consequence of complex psychological and social interactions that were developed in the chronosystem of Bronfenbrenner and Ceci's bio-ecological model (Swearer & Espelage, 2010).

In addition, when considering Figure 2.2, the **microsystem** is the child's immediate environment, which includes the learner itself. The researcher focused on learners' emotions towards mathematics, the gender of the learner etc. The **mesosystem** represents the relationships and reciprocal interactions between the different microsystems. These

microsystems included the learner's family, school, friends and the learner, which all influence the learner's holistic development. The current study examined the parents', teachers', and the school's role and the implications of cyberbullying on mathematics achievement. Therefore, what happens in one microsystem is likely to affect another microsystem (Swart & Pettipher, 2016). An example of this was the parents' active involvement in the child's school, which positively influenced the child's development. The study included the relationship between the learner and the parent, teacher, school and peer group.

The researcher also looked at whether learners' mathematics achievement was associated with the frequency of cyberbullying. The **exosystem** refers to the social environment in which the learner is not directly involved but which affects his development. These environments could be formal institutions, such as the parents' work environment, school environment, the media, religious and judicial institutions, availability of health care and social institutions or informalities such as social networks. If the parent worked long hours and is rarely home, the learner's development could be affected. The breakdown of exosystems could have detrimental consequences for a child – e.g. the influence of unemployment (Swart & Pettipher, 2016). This study focused very specifically on social media and the negative impact it had on the adolescent's life. The research also looked at the community, school and how this system affected cyberbullying. The **macrosystem** was the outer circle affecting the learner's development, i.e. cultures and subcultures, each with their value systems and ideologies in which the microsystem, mesosystem and ecosystem were embedded and thus played an indirect but significant influence on the child's development. It refers to the wider political and cultural influences affecting the child.

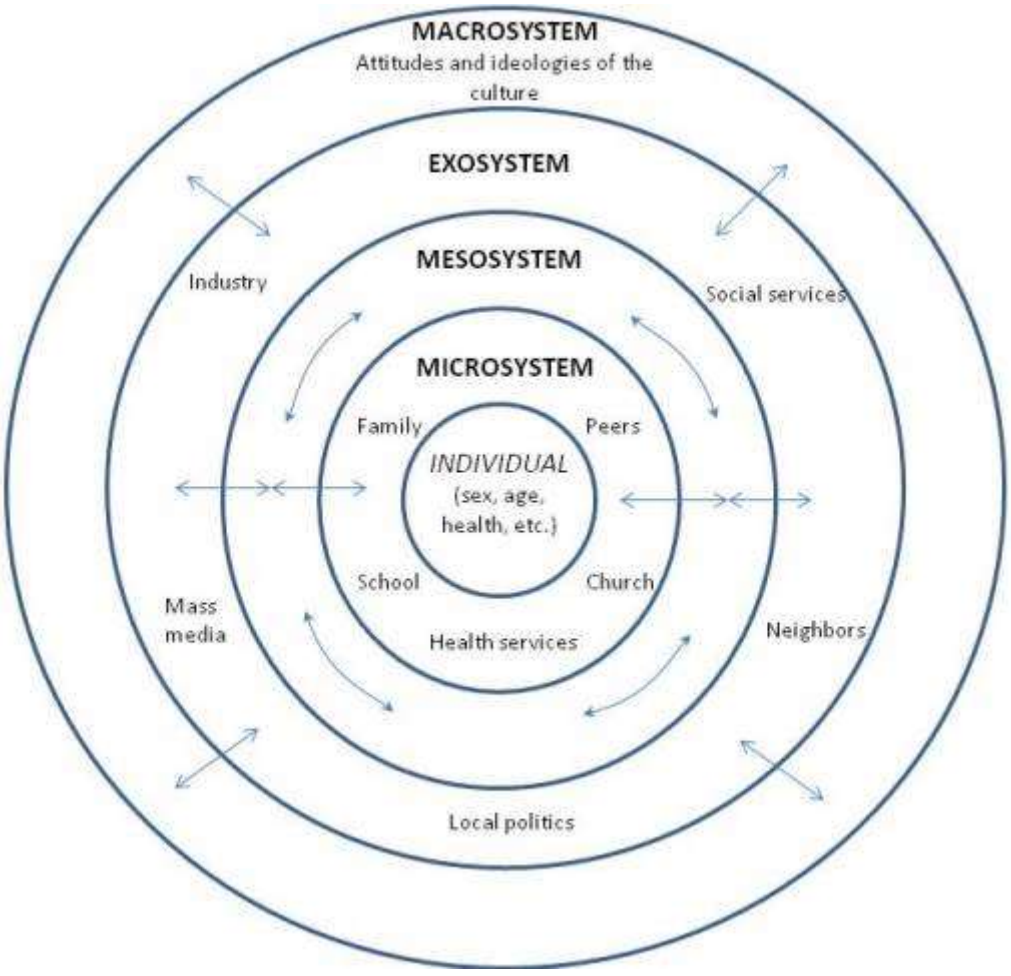
Looking into Bronfenbrenner's ecological framework helped distinguish different risk factors at various ecological levels and how learners, parents, and teachers could help prevent cyber (indirect)-bullying. Govender and Young (2018) stated that cyberbullying remained a problem in SA. Interventions could include rules in the classroom, addressing bullying and cyberbullying at home, training and equipping parents, teachers, and the school staff about all forms of bullying. Teachers needed resources to help both the victim and perpetrator and link the phenomenon to the LO curriculum of CAPS. Learners answered certain questions (see Annexure A) about cyberbullying in the TIMSS 2019, which the

researcher explored to understand why cyberbullying had become such a huge phenomenon and how it correlated with a learners' mathematics achievement.

Bronfenbrenner's ecological framework was a useful way to study the different aspects of cyberbullying by evaluating the various sections of the youth's complex behaviour, through looking at each system and why it could be a possible risk factor for cyberbullying individually. The researcher also looked closer at the macrosystem's risk factors and repercussions (Bronfenbrenner, 1977, 1979). When focused on Bronfenbrenner's ecological framework, the learner could be at risk on one of the four possible levels shown in Figure 2.2: the microsystem, mesosystem, exosystem, and macrosystem. These four systems were constantly changing in the chronosystem (Bronfenbrenner & Ceci, 1994).

**Figure 2.2**

*Bronfenbrenner's Ecological Theory of Development by Hchokr (2012) licenced under CC BY-SA 3.0*



## 2.9. Chapter Summary

This chapter focussed on the risk factors of cyberbullying and how they are associated with learners' mathematics achievement. The risk factors (predictors) explored were the following: a) gender, b) parental involvement and expectations, c) school location and SES, d) teacher's qualifications, e) technology use, and f) confidence in mathematics ability. In summary, this chapter discussed that both female and male learners were victims of cyberbullying, and more male learners were perpetrators of cyberbullying. Learners who had poor relationships with their parents, no communication or miscommunication with the parents and faced parental rejection tended to be more prone to cyberbullying than others.

The literature review has shown that cyberbully victims tended to feel depressed and suffer from suicidal thoughts and even self-destructive behaviour due to low self-esteem. The literature review further demonstrated that cyberbullying affected learners' academic achievement because learners lacked focus and often became detached from their schoolwork. Also, cyberbullied learners often had lower cognitive and affective empathy levels, thus struggling to fit in with their peer group. These learners struggled to recover from the rumours and pictures being spread rapidly on social media where the perpetrator could hide behind their anonymity.

This chapter also spoke out about true accounts of cyberbullying leading to adolescent suicides. It motivated why it was important to bring cyberbullying into the LO curriculum before a learner could receive a junior certificate (Grade 9), since the curriculum currently only focused on traditional (physical) bullying and not cyberbullying (see Annexure B). Due to new modern technology and the increasing rate of cyberbullying, the dissertation motivated why learners should know the symptoms, why cyberbullying occurs, the rights of a cyberbully victim, and the consequences of being a perpetrator.

This chapter emphasised that the researcher used Bronfenbrenner's ecological model as the theoretical model in the dissertation. The researcher focussed on the micro-, meso-, exo-, macro- and chrono-system of how cyberbullying was associated with South African learners' mathematics achievement marks during Grade 9. The researcher looked at the school, parents, teachers, their peers and the learner (individual) to examine the specific risk factors of cyberbullying and how it is associated with learners' mathematics achievement.

# Chapter 3: Methodology

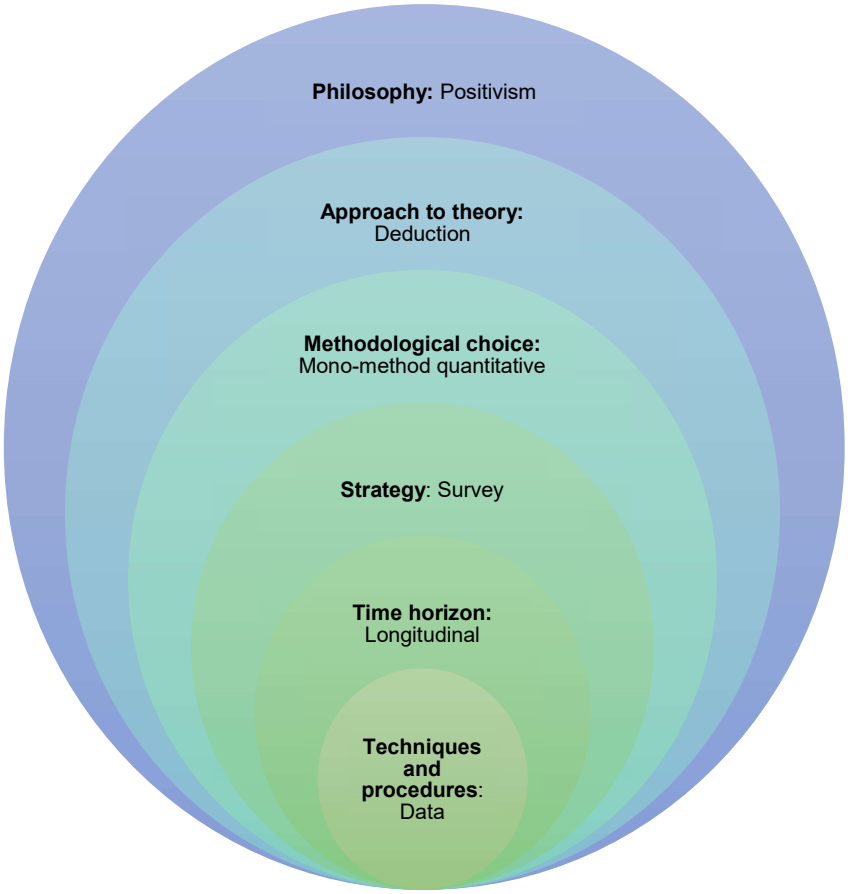
## 3.1 Introduction

In Chapter 3, the researcher looks at the methodological aspects of the dissertation and focuses on the research design and approach, the population, sample and instruments used in the dissertation. The data analysis and methods utilised to ensure validity and reliability are discussed.

The dissertation used the research onion (Saunders et al., 2009) to guide all the methodological aspects. It consists of six layers: philosophy, approach to theory, methodological choice, strategy, time horizon, and the techniques and procedures followed in the dissertation, as shown in Figure 3.1. The name "research onion" was used as a metaphor as the researcher uncovered each layer of the onion, by naming and explaining each aspect within the research context. A detailed discussion of the approaches was followed in Figure 3.1. However, before the layout of the research onion is used as a guide for the structure of Chapter 3, it's important first to provide some details about TIMSS and secondary data analysis.

**Figure 3.1**

*Adapted Research Onion by Saunders and Tosey (2009) licenced under CC BY 3.0 (Zefeiti & Mohamad, 2015)*




## 3.2 TIMSS and Secondary Data Analysis

TIMSS is an established international mathematics and science assessment in the fourth and eighth grades globally (Mullis et al., 2020). The assessment is conducted every four years. The first assessment was conducted in 1999, making this the 7th cycle. In 2019, 64 countries participated, including Singapore (who came first in both mathematics and science in Grade 4 and 8, respectively), first-world countries such as China, and developing countries such as Botswana and South Africa. Table 3.1 shows all countries which participated in TIMSS 2019. Countries participated in TIMSS to compare each country's educational effectiveness on a global scale. TIMSS was directed by the TIMSS & PIRLS International Study Center at the Lynch School of Education at Boston College (Mullis et al., 2020).

**Table 3.1**

*Countries Participating in TIMSS 2019*

| **Countries** | | |
|---|---|---|
| Albania | Hong Kong SAR | New Zealand |
| Australia | Hungary | Northern Ireland |
| Armenia | Ireland | Norway |
| Azerbaijan | Islamic Republic of Iran | Oman |
| Bahrain | Israel | Pakistan |
| Belgium (Flemish) | Italy | Philippines |
| Bosnia and Herzegovina | Japan | Poland |
| Bulgaria | Jordan | Portugal |
| Canada | Kazakhstan | Qatar |
| Chile | Republic of Korea | Romania |
| Chinese Taipei | Kosovo | Russian Federation |
| Croatia | Kuwait | Saudi Arabia |
| Cyprus | Latvia | Serbia |
| Czech Republic | Lebanon | Singapore |
| Denmark | Lithuania | Slovak Republic |
| Egypt | Republic of North Macedonia | South Africa |
| England | Malaysia | Spain |
| Finland | Malta | Sweden |
| France | Montenegro | Turkey |
| Georgia | Morocco | United Arab Emirates |
| Germany | Netherlands | United States |

Research organisations, analysts, and researchers worldwide comprise the International Association for the Evaluation of Educational Achievement (IEA). As a result of the IEA's work, education is expected to improve worldwide (IEA, 2021). IEA studies involve more than 60 countries representing 100 different education systems (IEA, 2021). Since 1958, the IEA has conducted indices for mathematics, science (TIMSS), and reading (PIRLS), and they are based on global comparisons. Governments, educators, policymakers, principals, stakeholders, and others in the interests of educational development are the intended

beneficiaries of these large-scale comparative studies (IEA, 2021). The IEA has conducted over 30 comparative studies of educational achievement worldwide since its inception (IEA, 2021).

South Africa came second to last in the TIMSS 2019 in Grade 9 mathematics with a median score of 389 (*SE* = 2.3). A score above 450 was considered to exceed the lowest benchmark, and the median score is set at 500. The TIMSS scale ranges from 0 to 1,000 with a mean of 500. The benchmarks indicated learner mathematics abilities to identify what the learner has mastered and still needs to master (Mullis et al., 2020). When researching cyberbullying in a South African context, the TIMSS 2019 data was used. There were four TIMSS questionnaires, namely the learner, teacher, curriculum and school. TIMSS 2019 was conducted amongst Grade 8 and 9 learners around 64 countries globally, with 425,000 learners participating in the survey (Reddy et al., 2020). The IEA developed it to help compare learners' achievement in science and mathematics across borders (Reddy et al., 2020).

As stated in Section 1.2, South African learners tried participating on the Grade 8 level, but due to low performance changed the participants to Grade 9 learners (Reddy et al., 2015). LaRoche and Foy (2020) state that the South African government decided to assess learners at a higher grade to match the demands of the assessments better. In South Africa, as well as in the benchmarking provinces of Gauteng and Western Cape, the eighth-grade assessment was administered at the ninth-grade (LaRoche & Foy., 2020). TIMSS 2019 can be divided into low (under 400), intermediate (under 475), high (under 550), and advanced (under 625) benchmarks (Mullis et al., 2020). Only 5% of all countries achieved the advanced benchmark in Grade 8/9 mathematics achievement. South Africa did not reach the low benchmark. Almost 90% of countries (87%) reached the low benchmark, and 56% of the countries reached the intermediate benchmark.

Results by Mullis et al. (2020) showed that boys performed better than girls in Grade 8 mathematics achievement from all the countries participating in TIMSS 2019 (Mullis et al., 2020). According to this study, 14% of the learners enrolled with access to more resources scored at least 546 on the TIMSS 2019 mathematics scale, indicating higher mathematics achievement. On the TIMSS 2019 scale, learners with limited resources had an average achievement score of 433 points in Grade 8 mathematics. An average of 469 score points

was achieved by the schools that put a moderate emphasis on academic success in TIMSS 2019. This category is occupied by 43% of countries.

Items for analysis were drawn from the learner, teacher and school questionnaires as shown in Annexure A. The learner questionnaire consisted of nine forms of bullying which the learner could answer as follows, a) at least once a week, b) once or twice a month, c) a few times a year, and d) never. The researcher only used three of the nine bullying items due to the fact that only three focussed on cyberbullying (Reddy et al., 2020). The following cyberbullying items were used:

- Sent me nasty or hurtful messages online (BSBG14H)
- Posted embarrassing things about me online (BSBG14I)
- Shared embarrassing photos of me online (BSBG14J)

Secondary data analysis was used as the research design (Mouton, 2001). Secondary data analysis may be used to generate new research questions and verify previous findings. It can also be used to identify any information gaps (Johnston, 2017) on the specific subject of the research. In other words, a researcher uses existing data to answer new research questions to accomplish the purpose of the current study. Research studies often used SDA due to time, budget, or other constraints related to the studies. Due to the availability of data from TIMSS 2019, SDA was used for this study.

There are advantages to conducting an SDA, including saving time, effort and money to investigate the research problem, especially considering that the scope of the data collected would have been beyond the ability of the researcher's resources. According to Mouton (2001), an advantage of using SDA is that the researcher could be specific and explicit about the results and assumptions made from the data. Conducting an SDA helped the researcher comparing the data to new and previous research to investigate where there still might have been gaps and deficiencies on this specific topic. Disadvantages could include not having enough or all the information you may have needed to answer specific research questions (Cacciattolo, 2015).

### 3.3 Research Design and Approach

Starting with the outermost layer of the research onion, the research philosophy followed in the current study is positivism. A positivist approach would aim to study the scientific

method of human behaviour and to view this behaviour as objective truth in a social world (Maree, 2019). Therefore, the current study used self-reported data of Grade 9 learners who responded to the TIMSS 2019 survey. The numerical data was analysed and interpreted as an objective representation of the social world. With a positivist paradigm, the researcher focused on objective and observable facts (atomism) (Maree, 2019).

Moving inwards in the research onion, the researcher then focused on deduction. Quantitative research often uses a deductive data analysis strategy (Sefotho & du Plessis, 2018). Deductive data analysis works from a general point towards a specific finding (Sefotho & Du Plessis, 2018). In the current study, the researcher used a deductive method, as the generalisable data from TIMSS 2019 was used to draw specific conclusions about mathematics achievement and cyberbullying. The current study was based on SDA, which was the research design in this study, (Mouton, 2001).

A positivist paradigm directly links with the quantitative analysis methodology because positivism focuses on only one reality or truth. Thus, the study followed the positivist paradigm within a quantitative approach; in other words, the study's components were visible through using numerical results in the TIMSS 2019 for secondary analysis (Mullis & Martin, 2017). Quantitative research can be defined as selecting a specific sample to generate numerical data systematically and objectively to generalise the results to the population (Maree & Pietersson, 2019). The definition mentioned above was in line with this study's epistemological paradigm, which was positivism, since it used numerical results (Sefotho & Du Plessis, 2018). Therefore, the researcher studied the human behaviour of Grade 9 learners who wrote the TIMSS 2019 learner questionnaire and utilised the teacher and school questionnaire from TIMSS 2019 for numerical data. The teachers answered the teacher questionnaire, and the principals answered the school questionnaire. The results were studied objectively within the social world in terms of cyberbullying.

The researcher hypothesised that a learners' mathematics achievement would decrease the more cyberbullying took place due to the lack of focus, emotional instability, suicidal thoughts, absenteeism, truancy and a depressed mood, as stated by Kowalski et al. (2014) and Cilliers and Chinyamurindi (2020). The researcher also hypothesised that associated risk factors (predictors) which were explored including, a) gender, b) parental involvement and expectations, c) school location and SES, d) teachers' qualifications, e) technology use, and

f) confidence in mathematics ability, would be significant predictors of a learner's mathematics achievement.

### 3.4 Population

Maree (2019) stated that a population could be defined as a group of people, institutions, objects etc., which all had specific characteristics in common and were used by the researcher. Sixty-four countries participated in TIMSS 2019 worldwide, including Singapore, China, England, South Africa and Morocco. According to Mullis and Martin (2017), the TIMSS 2019 target for eighth grade learners should have been that which represents eight years of schooling, counting from the first year of the International Standard Classification of Education (ISCED) Level 1. A total of 8,340 public schools and 736 independent schools participated in TIMSS 2019 worldwide.

### 3.5 Sampling

The TIMSS 2019 used a stratified cluster sampling approach based on Grades 4 and 8, who represent either four or eight years of formal education, but South Africa chose learners in the fifth and ninth grade, due to South Africa's low performance in the previous rounds of TIMSS (Reddy et al., 2015). Maree (2019) defined a cluster sample as choosing several clusters (groups) at random, either having all elements included in the sample or using selected elements randomly. Intact class selection was made by selecting a school randomly from a sampling frame and a class from within that school. There were 519 schools, 519 principals, 543 mathematicians, and 20,829 learners in the South African sample (Reddy et al., 2020). For the South African samples, school type (public or independent), size (small or large), the language of the test (English or Afrikaans), and the number of Grade 5 and Grade 9 learners per school were stratified into categories.

### 3.6 Instruments

TIMSS 2019 consists of four questionnaires (on the Grade 8/9 level), namely the learner questionnaire (as well as an eTIMSS learner questionnaire), the teacher questionnaire, the school questionnaire and the curriculum questionnaire; the latter was not used by the researcher in the current study. During the questionnaire data-collection process, the respondents completed a questionnaire. The TIMSS test administrators and the researchers waited for the whole group of learners to finish when completing the learner questionnaire;

however, this same approach was not used for the school, teacher and school questionnaires. Teachers (teacher questionnaire) and principals (school questionnaire) completed their questionnaires on their own (Maree, 2019). Fieldworkers could help immediately if a learner did not understand a specific question from the learner questionnaire; thus, the response rate was optimum (Maree, 2019).

The disadvantages of questionnaires may have included that some teachers and principals did not return the questionnaires or returned them but did not complete them fully. The researcher had limited control over what happens in the field because of the use of secondary data, although there were quality assurers in the field (see Section 3.11 for a detailed discussion on the quality assurance of the TIMSS data). Thus, it can be concluded that there is evidence that the data was collected in a manner that could yield valid and reliable data (Maree, 2019).

### 3.7 Data analysis

A focus was placed on cyberbullying of Grade 9 South African learners and the frequency and different risk factors associated with cyberbullying. All these factors were linked with TIMSS 2019 learners' mathematics achievement (Sefotho & Du Plessis, 2018). The study was cross-sectional as TIMSS collects data once-off, and the same learners do not participate again.

The researcher made use of SPSS (IBM Corp, 2020) and the IEA IDB Analyzer (Foy, 2020) for data analysis. Descriptive statistics were calculated, and the IEA IDB Analyzer was used in conjunction with SPSS to run correlations and produce a multiple linear regression analysis where learner mathematics achievement was the outcome variable. The researcher used the IEA IDB Analyzer since it combines and analyses large scale assessments, such as TIMSS. It adjusts the standard errors correctly. The IEA IDB Analyzer can select more than one predictor variable, which the researcher uses in the study since more than one variable can be considered as a predictor of learners' mathematics achievement (Foy, 2020). The TIMSS sampling is multi-stage, clustered, and stratified. The plausible values (PVs) have to be combined with pooling algorithms and weighted for the sample, which cannot be handled correctly by SPSS and therefore, the IEA IDB Analyzer was used (Foy, 2020).

### 3.8 Scale Creation

Every four years, the questionnaire development team at the TIMSS and PIRLS International Study Center, working with the Questionnaire Item Review Committee (QIRC), develops new questions, topics, and syntax, as well as deleting outdated questions (Yin & Fishbein, 2020). During each cycle, the questionnaires are updated, and the trend scales are maintained (Yin & Fishbein, 2020). The IRT scales used by the TIMSS 2019 study were constructed using various variables and scales (Yin & Fishbein, 2020). Based on the learning context scales, learners were classified into regions corresponding to low, middle, and high construct values. Results were shown for each region's mathematics achievement.

TIMSS 2019 specifically used the Rasch partial credit model (Yin & Fishbein, 2020) for scaling methods. Yin and Fishbein (2020) stated that scales from TIMSS 2015 and TIMSS 2019 were linked to allow trend measurement on the background construct, but this research dissertation focuses only on TIMSS 2019.

After using the partial credit IRT model, the scale units were chosen so that two scale score points corresponded to the standard deviation of the distribution (Yin & Fishbein, 2020). The researcher used the learner questionnaire and created a cyberbullying scale with the following items used for a reliable construct: sent nasty messages, shared photos online and shared things online. The reliability coefficient was .712, which indicates that the scale is reliable (Field, 2018). The researcher created two cut points, as 70% to 80% of the learners reported never having experienced bullying online. The researcher coded the variables as 0 = *no cyberbullying* and 1 = *cyberbullying*. The same processes followed by the IEA described by Yin and Fishbein (2020) were used to create the cyberbullying scale.

The IEA developed scales for learner liking mathematics (BSDGSLM) and learner confidence in mathematics (BSDGSCM). As a result of its inclusion in TIMSS 2015, these items also provided the link between TIMSS 2015 and TIMSS 2019. Measured by nine statements about mathematics, these scales measure a) how learners like learning mathematics, and b) how confident they are about their abilities in mathematics. The scale used by Yin and Fishbein (2020) used reverse coding to recognise negative sentiments. Both the TIMSS 2015 and TIMSS 2019 scales used the same nine statements. Yin and Fishbein (2020) state that the learner confidence in the mathematics scale was created based on

learners' responses to nine items (Questions 19a to 19i in the learner questionnaire). The nine items and the scale cut scores are illustrated in Table 3.2, and the reader is referred to Yin and Fishbein (2020) for more in-depth information. For the current study, in Chapter 4, where the results and findings are discussed, only the categories "very much like learning mathematics", "somewhat like learning mathematics" and "do not like learning mathematics" are utilised.

**Table 3.2**

*The Learner Confidence in Mathematics Scale*

| | How much do you agree with these statements about mathematics? | | | | |
|---|---|---|---|---|---|
| | | Agree a lot | Agree a little | Disagree a little | Disagree a lot |
| BSBM19A | 1) I usually do well in mathematics | | | | |
| BSBM19B | 2) Mathematics is more difficult for me than for many of my classmates [R] | | | | |
| BSBM19C | 3) Mathematics is not one of my strengths [R] | | | | |
| BSBM19D | 4) I learn things quickly in mathematics | | | | |
| BSBM19E | 5) Mathematics makes me nervous [R] | | | | |
| BSBM19F | 6) I am good at working out difficult mathematics problems | | | | |
| BSBM19G | 7) My teacher tells me I am good at mathematics | | | | |
| BSBM19H[T] | 8) Mathematics is harder for me than any other subject [R] | | | | |
| BSBM19I[T] | 9) Mathematics makes me confused[R] | | | | |
| | | Very confident | Somewhat confident | Not confident | |
| | Scale cut scores | 12.1 | 9.5 | | |

[R] Reverse coded

Yin and Fishbein (2020) also stated that the learner likes learning mathematics scale was created based on learners' responses to nine items (Questions 16a to 16i in the learner questionnaire). The nine items and the scale cut scores are illustrated in Table 3.3, and the reader is referred to Yin and Fishbein (2020) for more in-depth information. For the purposes

of the current study, Chapter 4 where the results are findings are discussed only the categories “very confident”, “somewhat confident” and “not confident” are utilised.

**Table 3.3**

*The Learner Likes Learning Mathematics Scale*

| | How much do you agree with these statements about mathematics? | | | | |
|---|---|---|---|---|---|
| | | Agree a lot | Agree a little | Disagree a little | Disagree a lot |
| BSBM16A | 1) I enjoy learning mathematics | | | | |
| BSBM16B | 2) I wish I did not have to study mathematics[R] | | | | |
| BSBM16C | 3) Mathematics is boring [R] | | | | |
| BSBM16D | 4) I learn very interesting things in mathematics | | | | |
| BSBM16E | 5) I like mathematics [R] | | | | |
| BSBM16F | 6) I like any schoolwork that involves numbers | | | | |
| BSBM16G | 7) I like to solve mathematics problems | | | | |
| BSBM16H[T] | 8) I look forward to mathematics class[R] | | | | |
| BSBM16I[T] | 9) Mathematics is one of my favourite subjects | | | | |
| | | ◄ | ——— | ——— | ► |
| | | Very confident | ▲ Somewhat confident | ▲ | Not confident |
| | Scale cut scores | | 12.1 | 9.5 | |

[R] Reverse coded

The IRT calibration and scoring procedure used for trend scales are the same as for context scales (Yin & Fishbein, 2020). In the TIMSS 2019 assessment cycle, item parameters for the nine items were evaluated using a logit scale unique to the TIMSS 2019 assessment cycle, the Rasch partial credit model (Yin & Fishbein, 2020). The Rasch logit scale scores were then calculated following calibration using weighted maximum likelihood estimation based on these estimated item parameters, and as a result, learners scores were put on this 2019 logit metric (Yin & Fishbein, 2020). Although similar, the TIMSS 2019 logit metric is not identical to the TIMSS 2015 logit metric, especially for the scales with items modified or new items added. Therefore, the TIMSS 2019 scores needed to be adjusted to the 2015 metric to allow for trend linking (Yin & Fishbein, 2020).

### 3.9 Regression Analysis

To address the first secondary research question, "*What is the association between self-reported cyberbullying and Grade 9 mathematics achievement as measured by TIMSS 2019?"*, multiple linear regression modelling was utilised. Multiple linear regression allows the researcher to predict the continuous variable (overall learners' mathematics achievement) based on the predictor variables (for example, the cyberbullying scale) to establish if there are any relationships between being a cyber victim and learners' mathematics achievement (Field, 2018). The researcher included the coefficient of determination ($R^2$), which is the squared correlation of the values of the predictor outcomes as observed in the data (the amount of variance explained by all the predictors for the outcome variable).

The researcher used descriptive statistics and multiple linear regression. Access to SPSS was obtained through the university since the University of Pretoria (UP) has a campus-wide UP licence for SPSS, and the IEA IDB Analyzer is available to download for free from the IEA's website. The model included the following predictors:

- Sex of the learner
- School location
- School composition by socioeconomic background scale
- Learner confident in learning mathematics scale
- Learners like learning mathematics scale
- Parental involvement
- Parental expectations
- Teacher majored in mathematics
- Teacher formal education completed
- Possess computer/tablet
- Home internet connection
- Possess cellular phone
- Cyberbullying reported

The regression coefficient can indicate a positive or negative relationship depending on whether it is preceded by a minus (-) or plus (+) sign (Field, 2018). A few factors were

selected which could possibly be associated with the dependent variable (achievement in mathematics) with multiple linear regression, which offers more detail about the dependant variable due to the existence of more independent variables in the formulation.

Some key assumptions of multiple linear regression include: a) there should be a linear relationship between the dependent and independent variable, b) multivariate normality, which means that continuous variables are normally distributed, c) a lack of multicollinearity, which means that the independent variables should not be highly correlated with each other, and d) homoscedasticity, which means that the variance of residuals should be the same at each level of the independent variable (Field, 2018).

## 3.10 Assumptions of Multiple Linear Regression

The researcher investigated the assumptions from the multiple linear regression, including the linear relationship between the predictors and outcome variables, multivariate normality for residual values, multicollinearity, auto-correlation and interpretation of regression outputs.

### 3.10.1 Linear Relationship Between Predictors and Outcome Variable

Most of the predictors had small or moderate correlations with the outcome variable (see Table 3.4). However, *Gender, Like Learning Mathematics scale, Teacher majored in Mathematics, Teacher education level* and *owning a cellular phone* did not have a statistically significant correlation with the outcome variable (plausible values).

**Table 3.4**
*Correlations Between Outcome Variable and Predictors for Multiple Regression Model*

| | Correlation coefficient | *p* | *N* |
|---|---|---|---|
| Sex of learners | -.032* | <.001 | 20,920 |
| School location | .350* | <.001 | 20,471 |
| School composition by socio-economic background | .330* | <.001 | 17,536 |
| Learner confident in mathematics scale | .243* | <.001 | 20,571 |
| Learner likes learning mathematics scale | .083* | <.001 | 20,661 |
| Parental involvement | .135* | <.001 | 20,642 |
| Parental expectations | .148* | <.001 | 20,636 |
| Teacher majored in mathematics | .002 | .951 | 20,438 |
| Teacher formal education completed | .065* | <.001 | 19,329 |
| Computer/tablet | .225* | <.001 | 20,643 |
| Home internet connection | .267* | <.001 | 20,361 |
| Cellular phone | .071* | <.001 | 20,688 |
| Cyberbullying | -.248* | <.001 | 20,620 |

*$p$<.05

The predictors that were not correlated with the outcome variable were retained due to the theoretical framework and to control for crucial background factors.

### 3.10.2 Multivariate Normality for Residual Values

The normality of the residual values was investigated using the Kolmogorov-Smirnov test and the Q-Q plot, shown in Table 3.3 and Figure 3.5, respectively.

**Table 3.5**

*Normality of Residual Values for Multiple Regression Analysis*

| Kolmogorov-Smirnov[a] statistic | *df* | *P* |
|---|---|---|
| .006 | 14,735 | .200* |

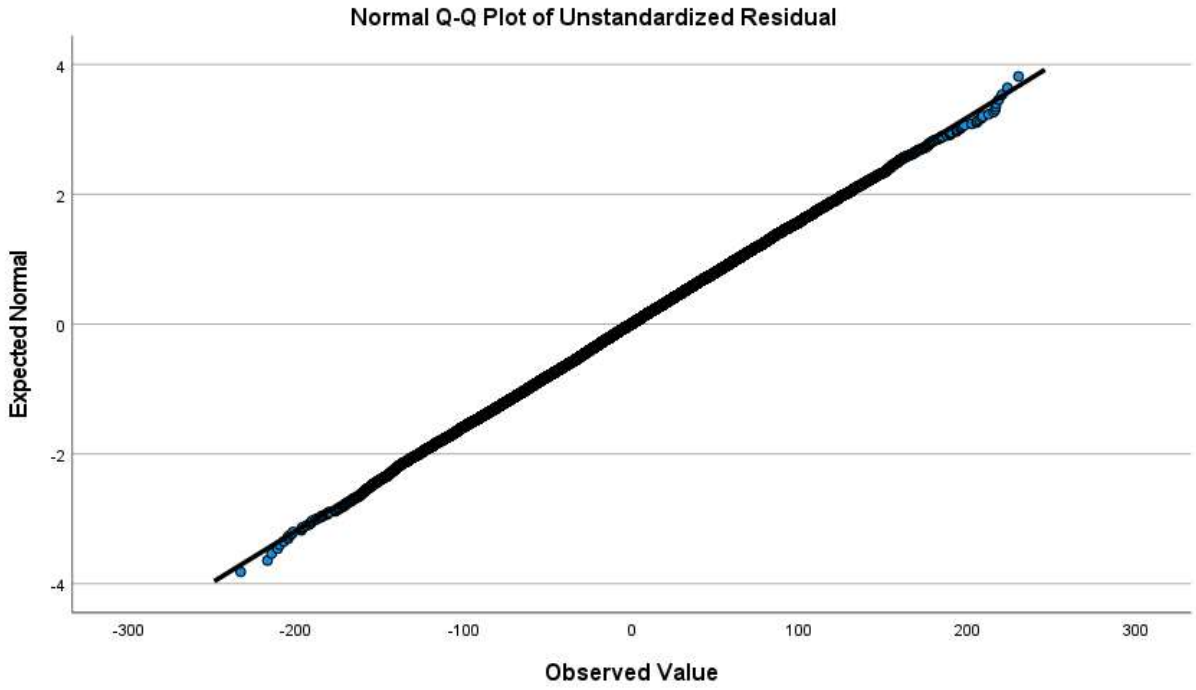
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The residual values were normally distributed, as shown by the non-significant result (*p*=.200) and the Q-Q plot in Figure 3.2. The multivariate normality for residual values held for the analysis.

**Figure 3.2**

*Q-Q Plot of the Residual Values*




### 3.10.3 Multicollinearity

Multiple regression can be characterised by multicollinearity when predictor variables are overly correlated with each other (Field, 2018). A predictor value can therefore predict another predictor value, and over-prediction undermines the independence of a predictor (Field, 2018). The variance inflation factor (VIF), which indicates whether predictors are overly correlated, the VIF statistic should have a value of higher than 1 (Field, 2018). The VIF values higher than 1 indicate a moderate correlation. VIF values lower than 1 state no

correlation, and VIF values higher than 5 state a high correlation (Field, 2018). All VIF values for the predictors are higher than 1, with sex of learners being the lowest with 1.011 and the learners like learning mathematics scale being the highest with 1.339. Tolerance values are viewed as a useful tool for identifying multicollinearity. SPSS measures the VIF, which indicates whether a predictor is strongly correlated with the other predictor(s), as well as the tolerance statistic, which is the reciprocal of VIF (1/VIF) (Field, 2018). Tolerance values should be between 0 and 1 (Field, 2018). Field (2018) states that if the tolerance value is below .2, it can indicate a possible problem and above 1 can be viewed as being biased. Good tolerance lies between .7 and .9 (Field, 2018). In the current study, no tolerance values of the predictors are below .2, with learners like learning mathematics scale being the lowest with .747 and the sex of learners being the highest with .989. Thus, the assumption of no multicollinearity held for the current study. The tolerance and VIF values are shown in Table 3.6.

**Table 3.6**
*Collinearity Statistics for Multiple Linear Regression Predictors*

| Predictor | Tolerance | VIF |
|---|---|---|
| Sex of learners | .989 | 1.011 |
| School location | .911 | 1.098 |
| School composition by socio-economic background | .832 | 1.202 |
| Learner confident in mathematics scale | .758 | 1.319 |
| Learners like learning mathematics scale | .747 | 1.339 |
| Parental involvement | .824 | 1.214 |
| Parental expectations | .866 | 1.154 |
| Teacher majored in mathematics | .982 | 1.019 |
| Teacher formal education completed | .986 | 1.014 |
| Computer/tablet | .839 | 1.192 |
| Home internet connection | .846 | 1.183 |
| Cellular phone | .921 | 1.086 |
| Cyberbullying scale | .974 | 1.027 |

### 3.10.4 Auto-correlation

The Durbin–Watson test was used to detect the presence of auto-correlation. Thus, the Durbin-Watson test was used to test the assumption of independent errors when cases have a significant structure (Field, 2018). The Durbin-Watson statistic depends on the number of predictors in the model and the number of interpretations, but as a general rule, values less than 1 or higher than 3 is problematic (Field, 2018). The final value of 1.431 was well within the range of 1 to 3. Thus, the assumption of independent errors held for the analysis.

### 3.10.5 Interpretation of Regression Outputs

The adjusted R-squared will be used to show the amount of variance explained by the predictors. R-squared is also known as the coefficient of determination (Field, 2018), and it views the proportion of variance from one variable to the next variable (Field, 2018).

The unstandardised regression coefficients (*β)* are interpreted on the TIMSS scale, where 40 score points are a year of schooling, almost half a standard deviation. Less than 10 score points are considered minor or trivial (Ólafsson et al., 2014). A statistically significant predictor of multiple linear regression is indicated by the *t-value* being less than -1.96 or greater than +1.96.

The standard error is interpreted as a measure of the statistical accuracy of an estimate, equal to the standard deviation of the theoretical distribution of a large population of such estimates (Field, 2018). If the researcher had to draw several samples from the population, each sample would have a different mean (Field, 2018). The standard error tells the reader how widespread the sample means are around the average population (TIMSS 2019 dataset).

## 3.11 Quality Criteria: Reliability and Validity

Sections 3.11.1 and 3.11.2 discuss the reliability and validity of the current study and what quality measures were taken to ensure high reliability and validity.

### 3.11.1 Reliability

Heale and Twycross (2015) state that reliability refers to the degree to which results from an instrument are consistent. Mullis et al. (2017) evaluated the reliability of context questionnaires after field tests for TIMSS 2019. To obtain reliable scores and results across

the various countries that participated, consistency was extended beyond the instruments used, how each classroom operated, how the learners responded to the questionnaire, and how the instrument was scored. Mullis and Martin (2017) reported that the TIMSS 2019 questionnaire contained enough items to provide the researcher with valid and reliable data, even in the case of some missing data. When examining the items from the questionnaire, LaRoche et al. (2020) found that the TIMSS 2019 evaluation took an exceedingly long time to ensure the quality of reliability of the findings. Scoring and assessment took place within each nation and across borders to make the results more reliable. As for this study, Cronbach's alpha using SPSS was computed to check reliability, i.e., if the items fit well together to form new scales. Cronbach's alpha could be defined as measuring internal validity by checking how closely a set of items were as a group. As the inter-item correlation increased, so would Cronbach's alpha (Maree, 2019). A Cronbach's alpha value of .70 or greater has been accepted as a reasonable indication of the reliability of a scale (Field, 2018). However, a Cronbach's alpha value of .60 or greater is generally accepted by researchers in the social sciences (Ghazali, 2008).

The Cronbach's alpha reliability coefficient of the items in the TIMSS 2019 *learner confident in mathematics scale* equals .78, which indicates acceptable reliability. The Pearson's correlation of *Learners confident in mathematics scale* together with mathematics achievement equals .26, which indicates a moderate significant mathematics achievement correlation (Yin & Fishbein, 2020). The Cronbach's alpha reliability coefficient of the items in the TIMSS 2019 *learner bullying scale* equals .84, which indicates good reliability. The Pearson's correlation between *learner bullying* and *learners' mathematics achievement* equals .24, which indicates a moderate relationship (Yin & Fishbein, 2020). Cronbach's alpha reliability coefficient and principal components analysis of the items in the TIMSS 2019 *Learners like learning mathematics* equals .89, which indicates reliability. The Pearson's correlation between *learners like learning mathematics* and mathematics achievement equals .11, which indicates a lack of relationship (Yin & Fishbein, 2020).

Learners' responses to the achievement items for TIMSS 2019 assessment had to demonstrate the following elements of Bloom's taxonomy: knowledge, application, and reasoning in mathematics, required for each item to receive praise (Cotter et al., 2020). Learning outcomes were continually compared across borders and over time by evaluating learners' answers to ensure consistency. Due to these reasons, TIMSS made sure that the

scoring of learners' responses to TIMSS achievement items was valid (Cotter et al., 2020). As an added reliability measure, TIMSS 2019 used latent regression scaling. However, it also used available learner context data to make sure learners imputed scores were accurate (Foy et al., 2020).

TIMSS 2019 used a matrix-sampling approach that involved packaging the entire assessment group of mathematics items at each grade level into a set of 14 learner achievement booklets, enhancing the reliability since learners next to each other would not have the same booklet. Each learner completed only one booklet. Each anchor item appeared in two booklets, providing items for linking together the learner responses from the various booklets (Mullis & Fishbein, 2020).

Several steps put in place to ensure high scoring reliability. The steps included a) finding scorers who were knowledgeable about the language of assessment, b) teams of three researchers in each with expertise in Afrikaans and English went through extensive international training, and c) team leaders received training which enabled them to do quality assurance on test papers of their team scorers to ensure consistent scoring. The IEA Trend Scoring and Reliability software was used by the scorers (Howie et al., 2017).

A data calendar for each item in the questionnaire was created by the TIMSS & PIRLS International Study Center staff. It included the percentage of learners responding to each possible item response and the corresponding average mathematics achievement of each learner (Mullis & Fishbein, 2020). As well as creating scale summaries for context questionnaires, the staff calculated whether items were appropriate for scaling using the one-parameter item response theory (Rasch) model. Mullis & Fishbein (2020) measured scale reliability, one-dimensionality, and their relationship to achievement.

In TIMSS 2019, LaRoche et al. (2020) described implicit stratification as the method used. Within each explicit stratum, the stratification involved sorting the schools according to a predictor for stratification. It was a simple and highly effective way of guaranteeing a proportionate representation of learners across implicit strata using implicit strata combined with systematic sampling. Using implicit stratification to correlate implicit stratification variables with learner mathematics achievement also improved the quality of achievement estimates (LaRoche et al., 2020).

### 3.11.2 Validity

Validity can be either internal or external. The definition of internal validity is the degree to which a study has established that its result is due solely to its treatment, ruling out any other explanation. There was a strong correlation between cyberbullying and mathematical achievement among learners. Thus, learners' mathematical achievement could rise if cyberbullying was reduced. According to Maree (2019), external validity could be described as how generalisable the results are to all populations. TIMSS 2019 randomly selected schools according to strata in each country worldwide; thus, the results are designed to be generalised.

In addition to fieldwork, valid comparisons of learner achievement between and within countries were conducted during TIMSS 2019. Content validity refers to the extent to which the instrument covered the particular content that it was supposed to measure (Maree, 2019). TIMSS 2019 attempted to measure global mathematics and science achievement. The questionnaires, offering a holistic view of mathematics and science (Mullis et al. 2020), were geared towards learners, teachers, and the curriculum.

According to Maree (2019), construct validity is determined by how well a given instrument measures different construct items. TIMSS 2019 used four different questionnaires, namely the learner, teacher, curriculum and school questionnaire with various topics including achievement, parental involvement and expectations, school and teacher involvement, resources, discipline problems, bullying in and outside of school etc. The researcher investigated the construct validity of the scales created by assessing the factor loadings and reliability coefficients.

Validity was supported in TIMSS & PIRLS by adhering to the best assessment design throughout the process of development and implementation (Cotter et al., 2020). Validity was done by a) clearly defining the target construct, which was to be measured by specifying each item that needed to be measured, b) creating and indicating standards for each item and test forms, and c) making sure test specifications were met by the assessments. Below is a broad overview of the process to help clarify the assessment goals and data provided (Cotter et al., 2020).

- Identifying and prioritizing content and skills that will be measured in the assessment frameworks for mathematics and science
- Developing achievement items that meet assessment specifications outlined in frameworks and scoring guides for constructed response items
- A field test will be conducted to evaluate the measurement properties of the item pool and practice the procedures for calculating the score as well
- Choosing items for the new cycle based on the results of the previous field tests and trends from previous cycles
- It is essential to train participants to calculate the quality of answers to construct response items (Cotter et al., 2020, pp. 1.4-1.5).

The population of the target group was not adjusted for by TIMSS 2019. The two population sizes (before and after the sample was chosen) were compared to test the validity of the sampling procedure. A similar amount of sampled population matches the stated population size (Johansone, 2020).

The HSRC set up National Quality Control Monitors to oversee the administration processes of TIMSS in 10% of sampled schools. An international Quality Control Monitor was selected and trained by the international TIMSS team to oversee the administration in 29 schools in South Africa to ensure validity (Reddy et al., 2020).

The IEA provided an extensive scoring guide for marking the assessments. Five per cent of booklets were marked twice to ensure consistency among scorers. To increase the validity of the questionnaires, they were translated into other languages (Reddy et al., 2020). Missing value analysis was conducted to address concerns caused by incomplete data. Moreover, the researcher examined the correlation matrix between the predictor variables to determine whether or not multi-collinearity existed before performing the statistical analysis.

### 3.12 Conclusion

The chapter outlined the methodological aspects of the dissertation and focused on the research design and approach, the population, sample and instruments used in the dissertation by utilising the research onion from Saunders et al. (2009). The dissertation

focused on why South Africa came second to last in the Grade 8/9 mathematics achievement scores, with only a mean score of 389 on the TIMSS 2019 scale (Mullis et al., 2020). The scale creation and data analysis were discussed, including the regression outputs and methods chosen to ensure validity and reliability. The researcher made use of a positivism approach since data can be factually analysed and scientifically verified. The research methodology of SDA was employed since data from TIMSS 2019 was available and could be used. A total of 8,340 public schools and 736 independent schools participated in TIMSS 2019 worldwide. The South African implementation of TIMSS 2019 assessed 519 schools, 519 principals, 543 mathematics teachers and 20,829 learners in South Africa. TIMSS 2019 made use of a two-stage stratified cluster sampling design of Grade 4 and 8 who represented either four or eight years of formal schooling. However, South Africa chose fifth and ninth graders to match their curricula better due to low achievement in previous cycles (Reddy et al., 2020). The research instruments included the learner, school and teacher questionnaires in the TIMSS 2019 and the mathematics assessment, which were accessed in January 2021.

The research dissertation used deductive data analysis, working from a holistic viewpoint towards a specific viewpoint (Maree, 2019). SPSS and the IEA IDB Analyzer were used for data analysis. TIMSS 2019 used a variety of variables and scales. The scales were created using IRT scaling methods (Yin & Fishbein, 2020). The researcher used descriptive statistics and multiple linear regression for data analysis. The researcher investigated the assumptions for the multiple linear regression, including the linear relationship between the predictors and outcome variables, multivariate normality for residual values, multicollinearity, auto-correlation and interpretation of regression outputs. The quality criteria used for the study included validity and reliability. To ensure reliability, the TIMSS 2019 made use of the latent regression scaling approach and used the available learner context data in the process to ensure learners imputed scores (Foy et al., 2020). Thus, TIMSS 2019 met high-quality criteria standards. It was concluded that validity was supported in TIMSS & PIRLS by adhering to the best assessment design throughout the process of development and implementation (Cotter et al., 2020).

# Chapter 4: Results and Findings

## 4.1 Introduction

The research questions were divided into key concepts to address the research aims of the study. The current chapter firstly presents the descriptive statistics for individual items and variables that did not form a scale. After that, the descriptive statistics of the predictors and outcome variables used in the multiple linear regression analysis are shown. This chapter shows the multiple linear regression model's results to quantify the association of the predictors with learners' mathematics achievement, the statistical significance, and the size of the association. The chapter also contains a profile of learners who report cyberbullying, showing which groups are more likely to say they experienced the phenomena.

## 4.2 Descriptive Statistics

Figure 4.1 shows the gender distribution of learners in the study.

**Figure 4.1**
*Sex of Learners*

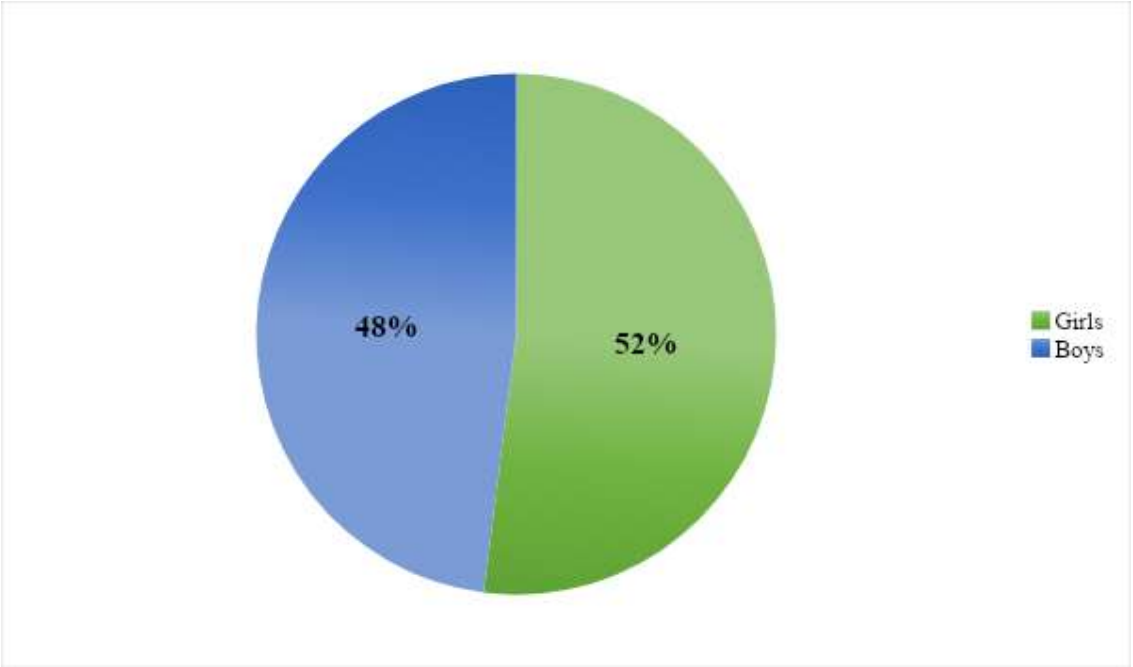



Figure 4.1 shows that over half (52%) of the learners participating in TIMSS 2019 in South Africa were girls (ITSEX). There were slightly more girls than boys.

Figure 4.2 indicates whether a learner had internet access at home or a computer/tablet at home.

**Figure 4.2**
*Technology use Items*

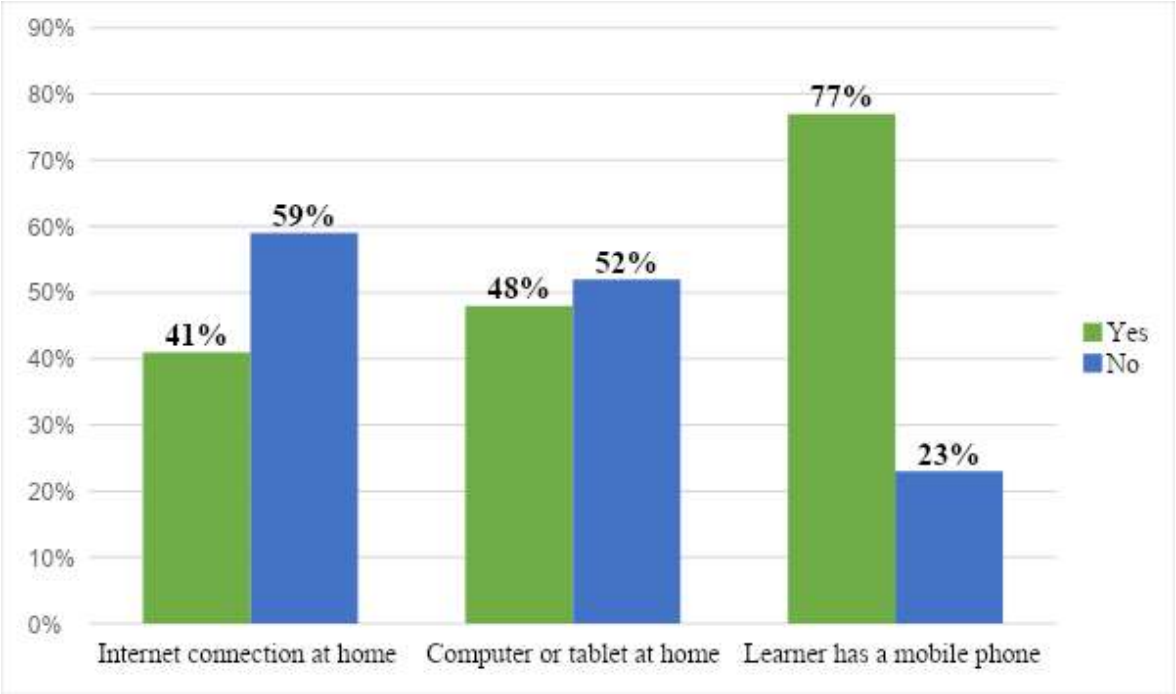



Figure 4.2 shows that only 41% of the learners had access to the internet at home (BSBG05D). Learners of the last-mentioned group may still access the internet from other locations, e.g. school, mobile phones and public spaces. Most schools' internet connections are password protected and being monitored. Most of the learners (77%) had a mobile phone and may be accessing the internet and chat apps through their phones.

Figure 4.3 shows different parental items of the study, such as how involved parents were, their commitment and support of learner achievement and their expectations.

**Figure 4.3**
*Parents Items as Completed by Teachers*

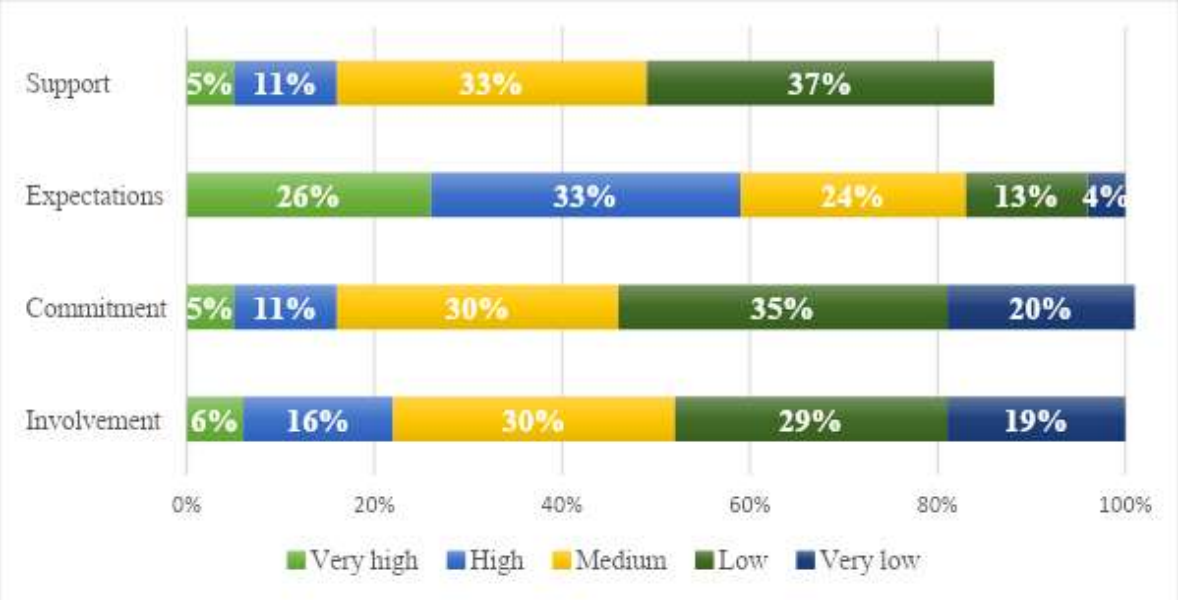



Figure 4.3 showed that approximately a quarter (26%) of parents had very high expectations for their child's academic achievement (BTBG06G) according to teachers. Most parents had *high* or *very high* expectations, but teachers reported lower rates of involvement, commitment and support from parents (5-15% said *very high* or *high*). Teachers said that only 16% of parents reported being *very high* or highly supportive of academic achievement (BTBG06H). Agbeko and Kwaa-Aidoo (2018) indicate that parents may reduce cyberbullying, but this would require involvement, commitment and supportive parents. Figure 4.4 shows the specific cyberbullying items used in the study and the results of each variable.

**Figure 4.4**
*Cyberbullying Items*

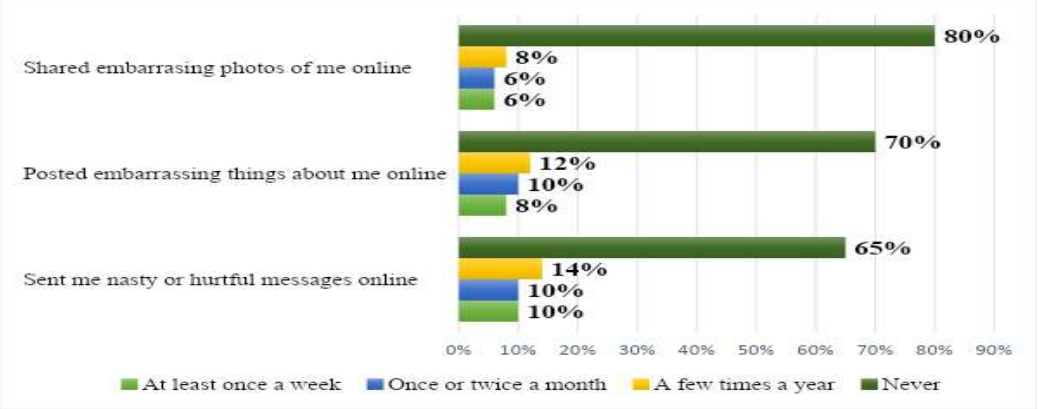


Figure 4.4 shows that approximately three quarters (70%) of learners said other learners *never* shared things online about them (BSBG14I). Most of the learners (80%) said no one shared photos of them (BSBG14J). Almost two-thirds of learners (65%) said no one sent them nasty messages (BSBG14H). Approximately 20-30% of learners reported some experiences with cyberbullying. Figure 4.5 shows mathematics achievement items on whether a learner enjoys and understands mathematics and the mathematics teacher.

**Figure 4.5**
*Mathematics Achievement Items*

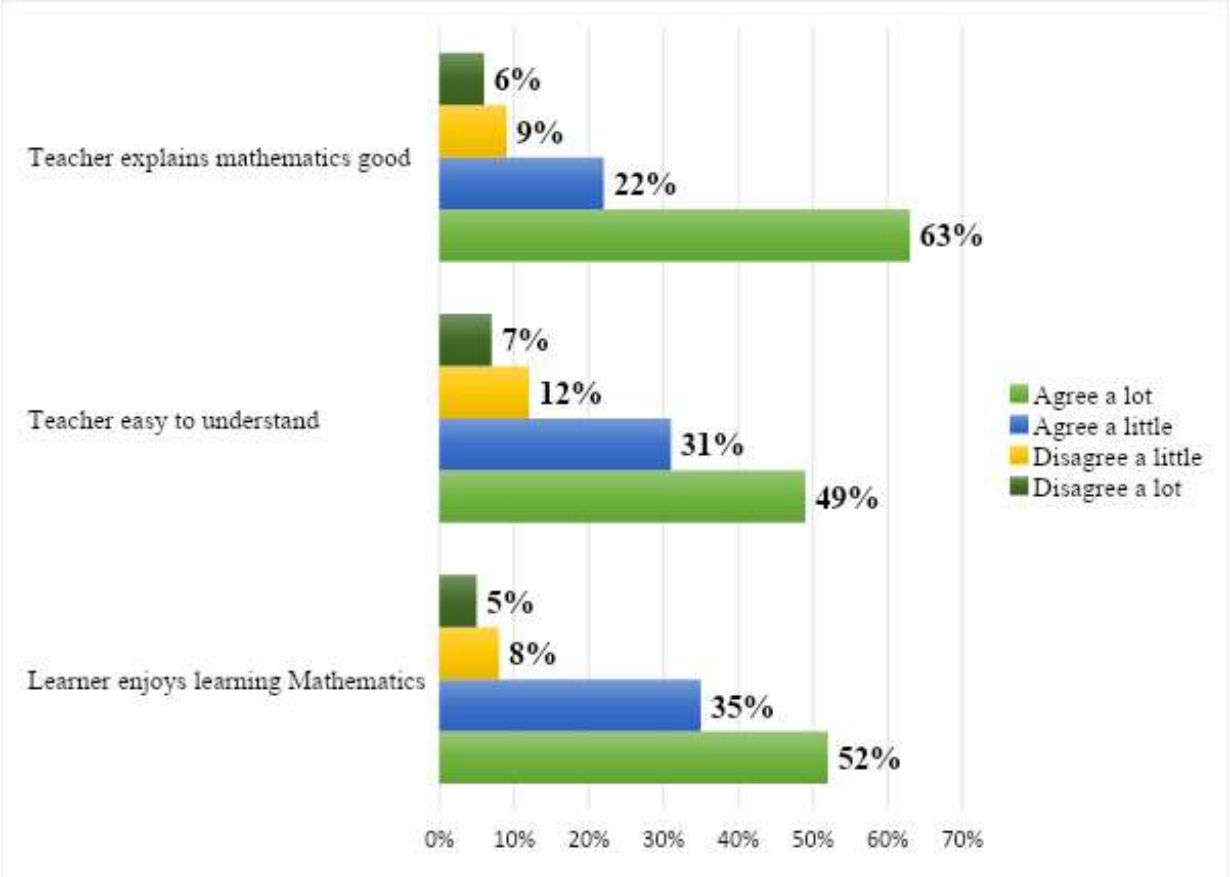



Figure 4.5 also shows that 63% of learners agreed a lot that the teacher explained mathematics well, and almost half (49%) of learners indicated that they *agree a lot* with understanding the teacher.

In Figure 4.6, only 7% of learners said they felt very confident in their mathematics abilities. Figures 4.5 and 4.6 show that 19% of learners did not like mathematics, with 19% of learners

indicating that they understood the teacher only a little or not at all. Figure 4.6 shows reported attitude to learning mathematics.

**Figure 4.6**
*Mathematics Achievement Items*

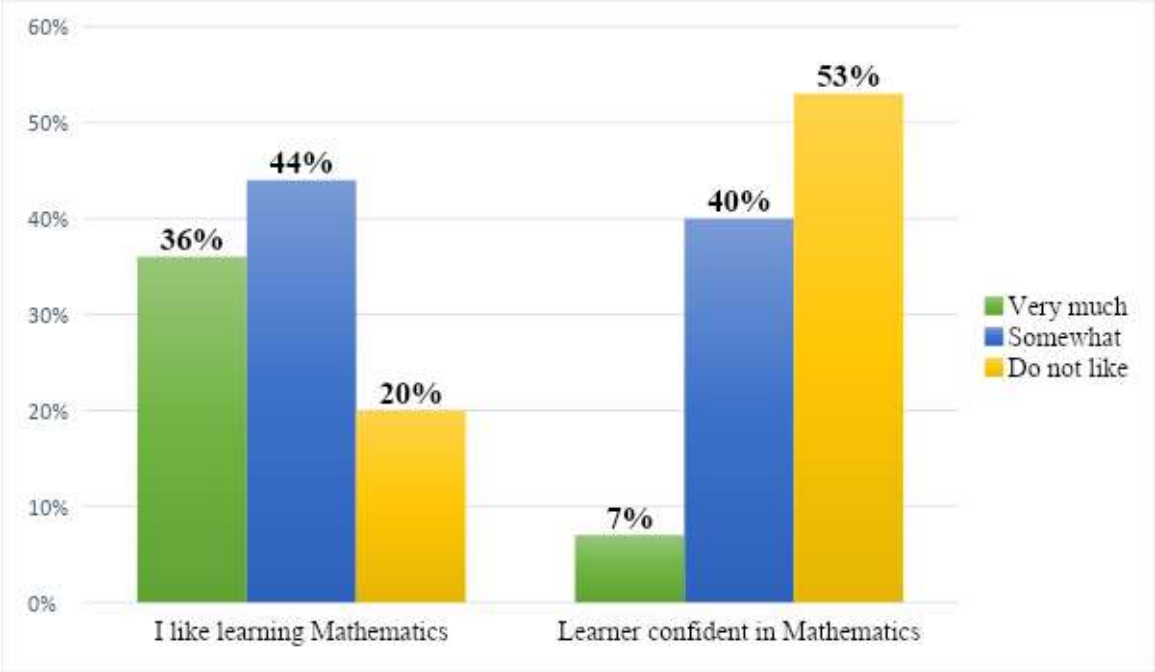



Figure 4.6 shows that although most learners said they *somewhat like* (44%) and *very much like* learning mathematics (36%), only 7% of learners were very confident in mathematics (BSBGSCM). Figure 4.7 shows the teachers' qualification levels and whether or not they possess qualifications to teach mathematics.

**Figure 4.7**
*Teacher Majored in Mathematics and Mathematics Education*

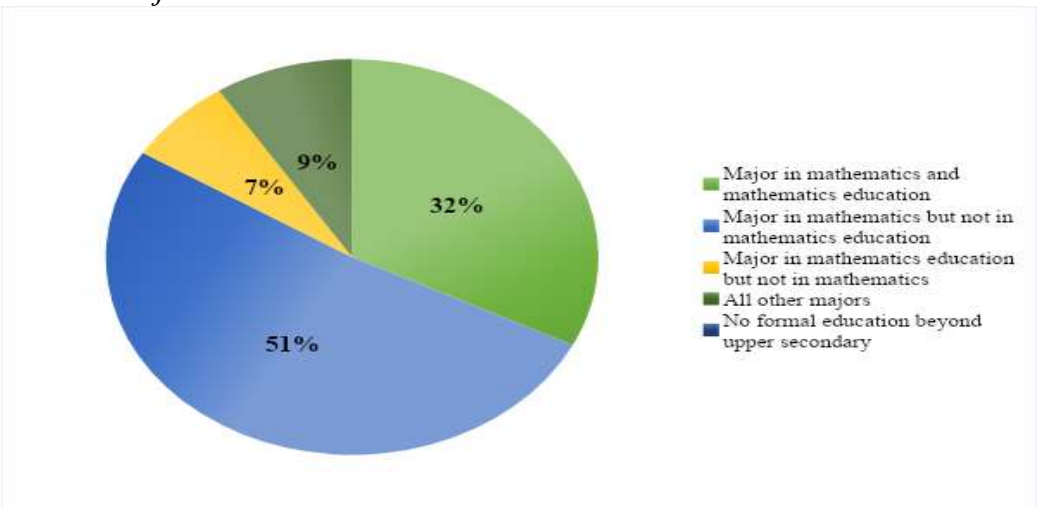


Figure 4.7 shows that most teachers possessed a bachelor's degree in education, but more than a fifth (20%) of teachers did not possess the required qualification. Approximately half (51%) of the teachers studied mathematics, but not mathematics education (BTBG05A). Figure 4.8 shows how far teachers studied and the levels completed by the teacher.

**Figure 4.8**

*Teacher's Education Completed Item*

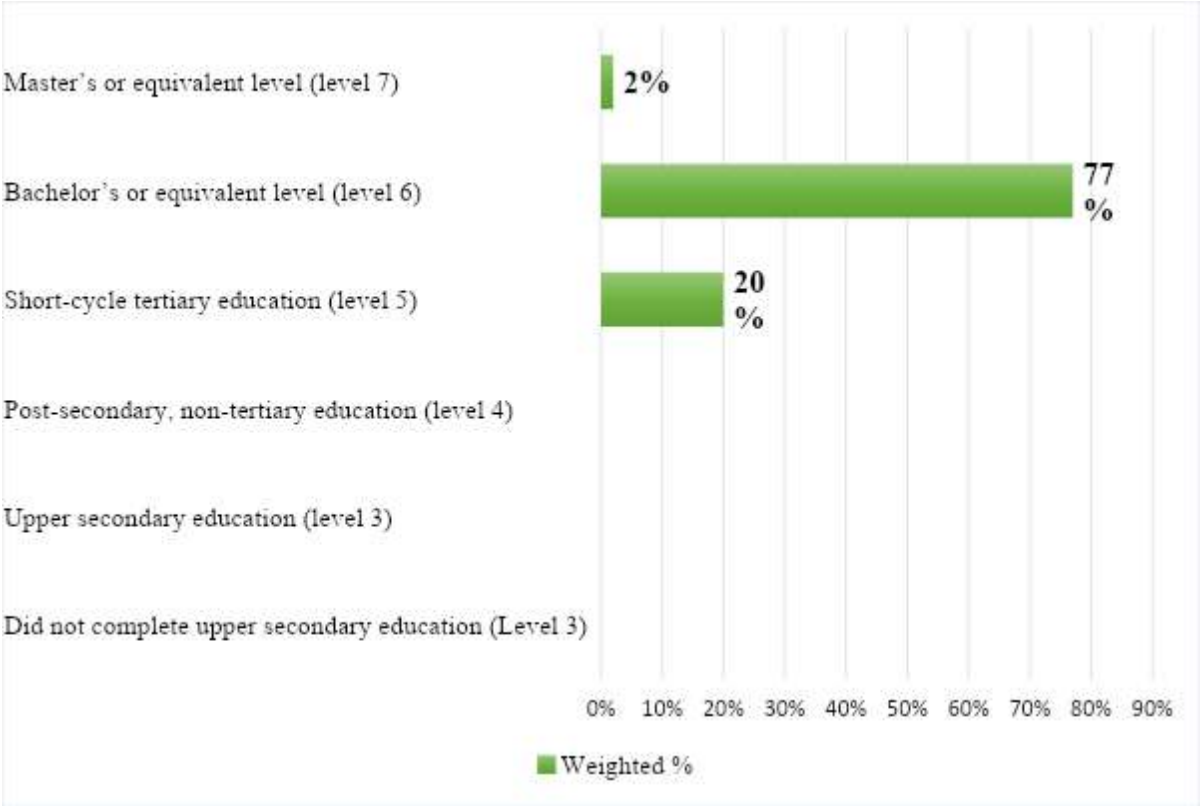



Figure 4.8 shows the results of teachers who did and did not complete tertiary education (BTBG04). Figure 4.8 shows that approximately three quarters (77%) of teachers are equipped with a bachelor's or equivalent degree, but not necessarily in teaching mathematics, as indicated by Figure 4.7. These statistics mean that over 20% of learners receive mathematics education without a teacher having the associated degree. Figure 4.9 shows the school location items regarding where the learners' school is located.

**Figure 4.9**
*School Location Item*

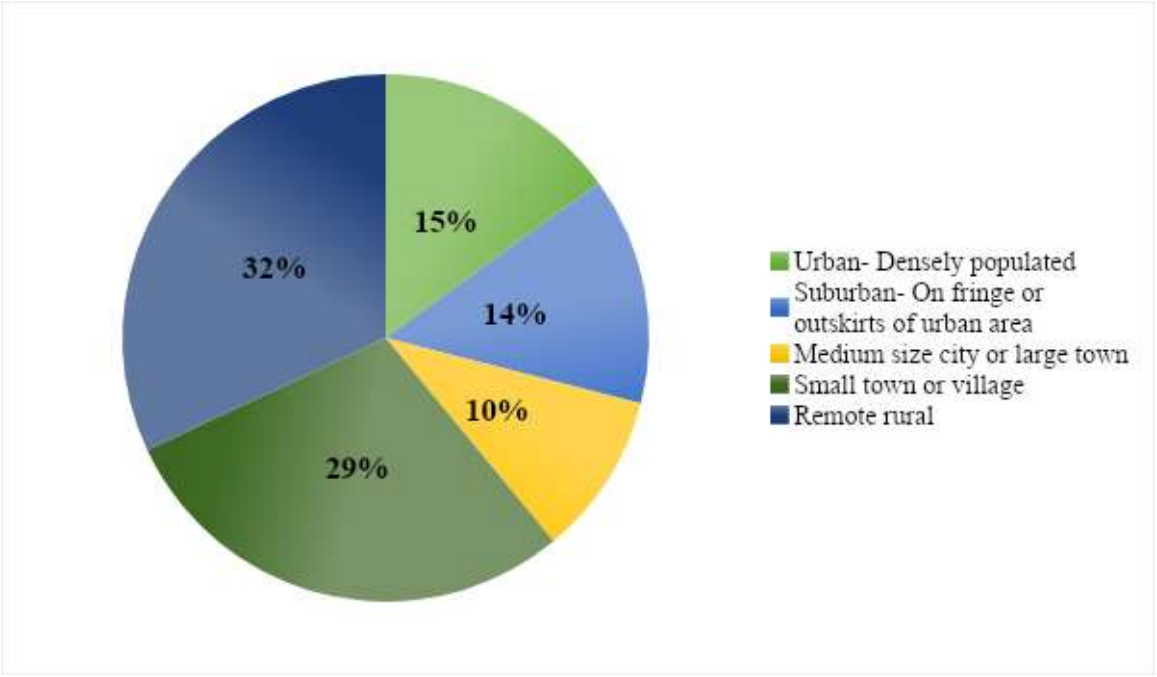



Figure 4.9 shows that approximately a third (32%) of learners had school in remote rural areas (BCBG05B). It showed that more than half (50%) of learners attended a school in small towns, villages or other rural areas. Figure 4.10 shows the school's composition by socioeconomic background.

**Figure 4.10**
*School's Composition by SES Background*

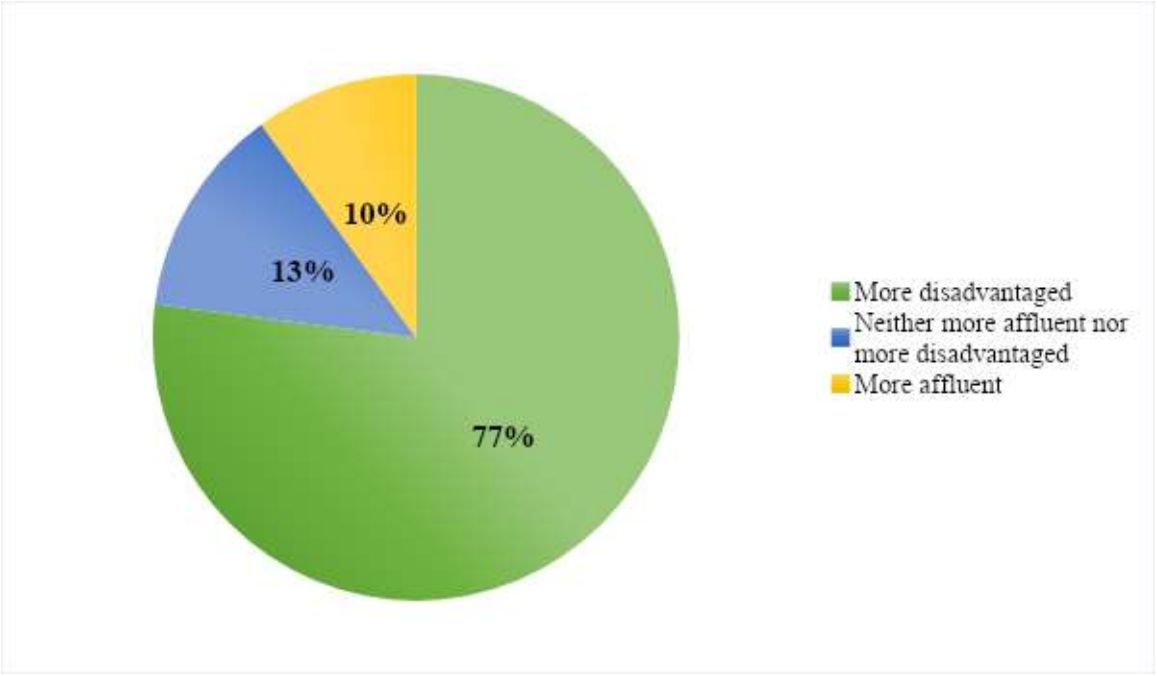


Figure 4.10 shows that 77% of learners came from a more disadvantaged backgrounds according to the principals. Only 10% of the learners came from affluent backgrounds.

Figure 4.11 shows the TIMSS 2019 mathematics scores for the outcome variable, i.e. the mathematics achievement of the three lowest achieving countries compared to the top three countries to provide context.

**Figure 4.11**
*Achievement of the Three Lowest Achieving Countries Compared to the top Three Countries on the TIMSS 2019 Mathematics Scale*

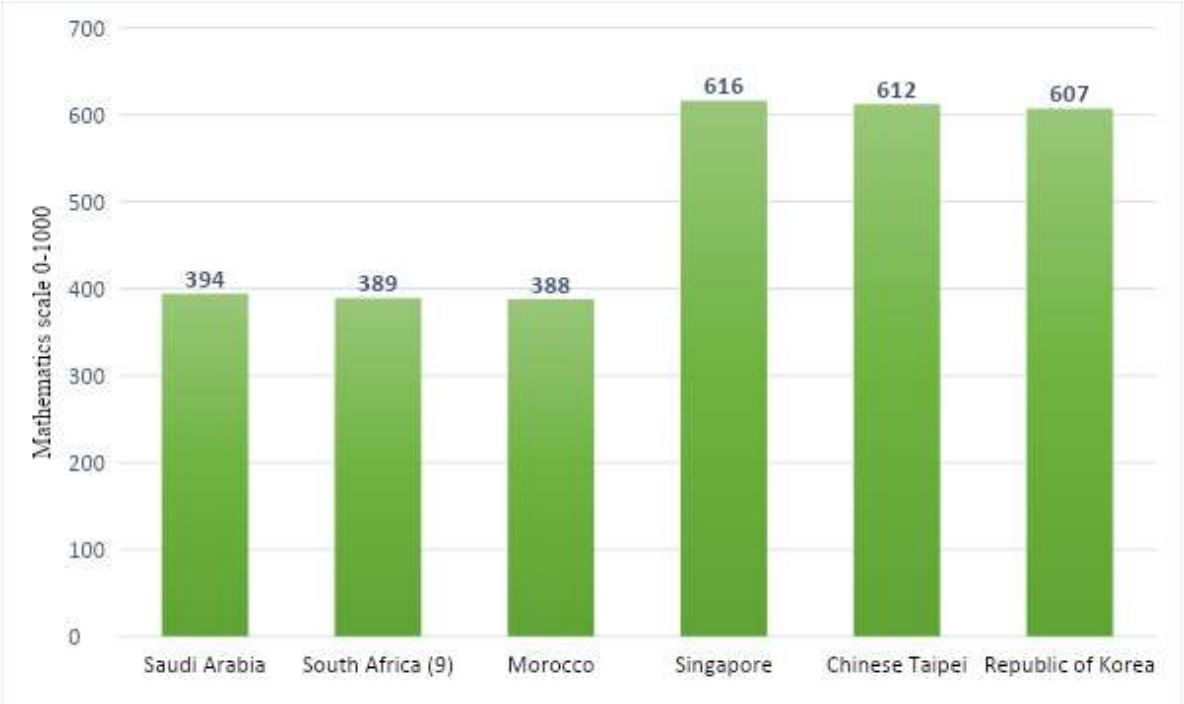



Figure 4.11 shows when the three lowest achieving countries are compared to the top three performing countries, South Africa is shown to be 227 points behind Singapore who came first. This statistic means that South Africa is more than two and a half years behind Singapore on the TIMSS 2019 international scale for mathematics achievement despite testing learners a year older than the other countries.

### 4.3 Profile of Learners Reporting Cyberbullying

Table 4.1 shows a cross-tabulation of learners who are more likely to report being cyberbullied.

**Table 4.1**

*Learner Characteristics Cross-tabulated with Self-reports of Being Cyberbullied*

| Variable | Category | No cyberbullying | Cyberbullying |
|---|---|---|---|
| Sex of learners | Female | 69% | 31% |
| | Male | 65% | 35% |
| School location | Remote rural | 56% | 44% |
| | Small town or village | 65% | 35% |
| | Medium size city or large town | 71% | 29% |
| | Suburban | 77% | 23% |
| | Urban–densely populated | 72% | 28% |
| School composition by socio-economic background | More disadvantaged | 66% | 34% |
| | Neither more affluent nor more disadvantaged | 72% | 28% |
| | More affluent | 74% | 26% |
| Learners confident in mathematics scale | Not confident in mathematics | 66% | 34% |
| | Somewhat confident in mathematics | 67% | 33% |
| | Very confident in mathematics | 81% | 19% |
| Learners like learning mathematics scale | Do not like learning mathematics | 69% | 31% |
| | Somewhat like learning mathematics | 64% | 36% |
| | Very much like learning mathematics | 71% | 29% |
| Parental involvement | Very low | 66% | 34% |
| | Low | 68% | 32% |
| | Medium | 69% | 31% |
| | High | 65% | 35% |
| | Very high | 72% | 28% |
| Parental expectations | Very low | 63% | 37% |
| | Low | 63% | 37% |
| | Medium | 67% | 33% |
| | High | 69% | 31% |
| | Very high | 69% | 31% |
| Possess computer/tablet | No | 66% | 34% |
| | Yes | 69% | 31% |
| Home internet connection | No | 65% | 35% |
| | Yes | 71% | 29% |
| Cellular phone | No | 71% | 29% |
| | Yes | 67% | 33% |

Table 4.1 shows that more boys (35%) reported cyberbullying than girls (31%). The Literature showed that more female learners report being cyberbullied internationally, but this may not be true for South Africa. More cyberbullying was reported by learners who lived in a rural area or small village/town when compared to their urban and suburban counterparts. Fewer affluent learners (26%) reported cyberbullying compared to disadvantaged learners (34%). The researcher assumed that more cyberbullying would take place in schools in the urban and suburban areas, where there is more internet access and higher SES. Thus, why are there more cyberbullying in remote rural areas with a lower SES? The higher results in lower SES areas may be due to learners' access to smartphones, which would give disadvantaged learners internet access.

Not being confident in mathematics was associated with cyberbullying, with 34% of learners who were not confident reporting being cyberbullied when compared to only 19% of confident learners reporting cyberbullying. A lack of confidence could be associated with cyberbullying since some perpetrators tease and bully others for not being as academically inclined as them.

The more a learner liked learning mathematics, the less the learner reported being cyberbullied. Table 4.1 showed that 71% of learners who very much liked learning mathematics did not get cyberbullied, but the difference between those who liked mathematics and those who did not is very small, with only a 2% difference. Table 4.1 also showed that 34% of learners who had very low parental involvement were cyberbullied, with 32% of learners who had low parental involvement being cyberbullied. There is a difference between those with very low parental involvement when compared to those with very high parental involvement, but the categories in the middle do not show a clear pattern. The literature predicted low parental involvement can contribute to being cyberbullied more often. Learners who had high parental involvement, was the highest group to be cyberbullied, with 35% of the learners stating they were cyberbullied, which could be due to a lack of a linear relationship between the variable and being cyberbullied.

Learners who had parents with low or very low expectations had a higher risk of being cyberbullied, with more than a third (37%) of learners stating they were cyberbullied. Table 4.1 showed that 34% of learners who did not possess a computer/tablet at home were still being cyberbullied, with approximately a third (31%) of learners who did possess a

computer/tablet at home not being cyberbullied. Also, approximately a third (35%) of learners were cyberbullied without having an internet connection at home, whereas, of the learners who did possess an internet connection at home, only 29% were cyberbullied. Lastly, almost a third (29%) of learners said they did not have a cellular phone but were still being cyberbullied. The question remains, where and how do victims get cyberbullied, if they do not possess an internet connection, a cellular phone or tablet or computer at home? It may be that even when a learner does not have a cell phone, they may be using a parent or sibling's phone. Children are resourceful and may find alternative ways to access the internet or chat applications.

It should be noted that self-report measures always have the potential for under or over-reporting since not every learner may have wanted to admit to being cyberbullied. The findings show how South Africa may differ from other countries, since the research showed the opposite of what the literature revealed internationally. From this data, more boys were bullied than girls, cyberbullying took place in more rural areas than in urban areas, cyberbullying increased, even if the learner had high parental involvement, as learners' socioeconomic background improved, cyberbullying decreased and lastly, learners who did not have access to the internet, a cellular phone or a tablet/computer reported being more cyberbullied than those who did.

### 4.4 Multiple Linear Regression Analysis and Interpretation

Table 4.2 shows the selected items from the learner, teacher and school questionnaires and the re-coding. Table 4.2 explains a) the number of the question from the questionnaire, e.g. Q1, b) which factor each item will have an influence on, e.g. gender, c) from which questionnaire it came, e.g. learner questionnaire, d) what the question was from the questionnaire, e.g. are you a girl or a boy, e) the item code, e.g. ITSEX, f) the possible response options from the questionnaire, e.g. girl or boy, g) possible response items re-coded by the researcher, and h) creating of scales or collapsing of categories to create new scales and shorter plausible answers than in the questionnaires.

**Table 4.2**

*Selected Items From the Learner, Teacher and School Questionnaires and the Re-coding*

| Questionnaire and item | Variable and item code | Question from the questionnaire | Response options | Response options re-coded | Creating of scales or collapsing of categories |
|---|---|---|---|---|---|
| Learner Q1 | Sex of learners ITSEX | Are you a girl or a boy? | 1. Girl<br>2. Boy | 1. Girl<br>2. Boy | None |
| Learner Q5a | Tablet at home BSBG05A | Do you possess a computer or tablet at home? | 1. Yes<br>2. No | 1. No<br>2. Yes | The item was re-coded so that it went from the least to the most. |
| Learner Q5d | Internet connection BSBG05D | Do you possess internet connection at home? | 1. Yes<br>2. No | 1. No<br>2. Yes | The item was re-coded so that it went from the least to the most. |
| Learner Q5e | Cellular phone BSBG05E | Do you possess a mobile phone? | 1. Yes<br>2. No | 1. No<br>2. Yes | The item was re-coded so that it went from the least to the most. |
| Learner Q14h to j | Cyberbullying scale BSBG14H to BSBG14J | During this school year, how often have other learners from your school:<br>h) sent me nasty or hurtful messages online<br>i) posted embarrassing things about me online<br>j) shared embarrassing things about me online | 1. At least once a week<br>2. Once or twice a month<br>3. A few times a year<br>4. Never | 1. Never<br>2. A few times a year<br>3. Once or twice a month<br>4. At least once a week | The item was re-coded so that it went from the least to the most.<br><br>Q14h, Q14i and Q14j were combined to create a cyberbullying scale.<br>The item was re-coded so that it went from the least to the most. |
| Learner Q16a to i | Learner likes learning mathematics scale BSDGSLM | How much do you agree with the statement about learning mathematics:<br>a) I enjoy learning mathematics<br>b) I wish I did not have to study mathematics<br>c) Mathematics is boring<br>d) I learn many interesting things in mathematics<br>e) I like mathematics<br>f) I like any schoolwork that involves numbers | The learner had 3 possible answers namely (see Table 3.3):<br>1. Do not like learning mathematics<br>2. Somewhat like learning mathematics<br>3. Very much like learning mathematics | 1. Do not like learning mathematics<br>2. Somewhat like learning mathematics<br>3. Very much like learning mathematics | For details on this scale, the reader is referred to Section 3.8, Table 3.3 and the discussion on Table 3.3.<br>1. Do not like learning mathematics<br>2. Somewhat like learning mathematics<br>3. Very much like learning mathematics |

| Questionnaire and item | Variable and item code | Question from the questionnaire | Response options | Response options re-coded | Creating of scales or collapsing of categories |
|---|---|---|---|---|---|
| | | g) I like to solve mathematics problems<br>h) I look forward to mathematics class<br>i) Mathematics is one of my favourite subjects | | | |
| Learner Q19 a-i | Learner confident in mathematics scale BSDGSCM | How much do you agree with the statement about learning mathematics: I am confident learning mathematics.<br>For each of the following questions:<br>a) I usually do well in mathematics<br>b) Mathematics is more difficult for me than for many of my classmates<br>c) Mathematics is not one of my strengths<br>d) I learn things quickly in mathematics<br>e) Mathematics makes me nervous<br>f) I am good at working out difficult mathematics problems<br>g) My teacher tells me I am good at Mathematics<br>h) Mathematics is harder for me than any other subject<br>i) Mathematics makes me confused | The learner had 3 possible answers namely (see Table 3.2):<br>1. Very confident in mathematics<br>2. Somewhat confident in mathematics<br>3. Not confident in mathematics | 1. Not confident in mathematics<br>2. Somewhat confident in mathematics<br>3. Very confident in mathematics | For details on this scale, the reader is referred to Section 3.8, Table 3.2 and the discussion in Table 3.2.<br>4. Not confident in mathematics<br>5. Somewhat confident in mathematics<br>6. Very confident in mathematics |

| Questionnaire and item | Variable and item code | Question from the questionnaire | Response options | Response options re-coded | Creating of scales or collapsing of categories |
|---|---|---|---|---|---|
| Learner Q18b | Mathematics lessons from teacher BSBM17B | How much do you agree with the statement about your mathematics lessons: My teacher is easy to understand | 1. Agree a lot<br>2. Agree a little<br>3. Disagree a little<br>4. Disagree a lot | 1. Disagree a lot<br>2. Disagree a little<br>3. Agree a little<br>4. Agree a lot | The item was re-coded so that it went from the least to the most. |
| Learner Q18f | Mathematics lessons from teacher BSBM17D | How much do you agree with the statement about your mathematics lessons: My teacher is good at explaining mathematics | 1. Agree a lot<br>2. Agree a little<br>3. Disagree a little<br>4. Disagree a lot | 1. Disagree a lot<br>2. Disagree a little<br>3. Agree a little<br>4. Agree a lot | The item was re-coded so that it went from the least to the most. |
| Teacher Q6e | Parental involvement according to teacher BTBG06E | How would you characterise parental involvement for learner achievement | 1. Very high<br>2. High<br>3. Medium<br>4. Low<br>5. Very low | 1. Low<br>2. Medium<br>3. High | The item was re-coded. The response items were converted to:<br>1. Low<br>2. Medium<br>3. High<br>'Very low' and 'Low' were grouped together and 'high' and 'very high' were grouped together. |
| Teacher Q6g | Parental expectations according to teachers BTBG06G | How would you characterise parental expectations for learner achievement | 1. Very high<br>2. High<br>3. Medium<br>4. Low<br>5. Very low | 1. Low<br>2. Medium<br>3. High | The item was re-coded. The response items were converted to:<br>1. Low<br>2. Medium<br>3. High<br>'Very low' and 'Low' were grouped together and 'high' and 'very high' were grouped together. |
| Teacher Q4 | Teacher formal education completed BTBG04 | What is the highest level of formal education you have completed? | 1. Did not complete upper secondary education (Level 3)<br>2. Upper secondary education (level 3) | 1 Post-secondary or lower<br>2 Short-cycle tertiary education<br>3 Bachelor's or higher | The item was re-coded. The response items were converted to:<br>1. Post-secondary or lower<br>2. Short-cycle tertiary education<br>3. Bachelor's or higher<br>The response items for 'did not complete upper secondary education (level 3)' and 'upper secondary education (level 3)' were left out as |

| Questionnaire and item | Variable and item code | Question from the questionnaire | Response options | Response options re-coded | Creating of scales or collapsing of categories |
|---|---|---|---|---|---|
| | | | 3. Post-secondary, non-tertiary education (level 4)<br>4. Short-cycle tertiary education (level 5)<br>5. Bachelor's or equivalent level (level 6)<br>6. Master's or equivalent level (level 7) | | both stood at 0%. 'Bachelor's or equivalent level (level 6)' and 'masters or equivalent level (level 7)' were grouped together. |
| Teacher Q5 | Teacher majored in mathematics | During your <post-secondary> education, what was your major or main area(s) of study? | 1. Major in mathematics and mathematics education<br>2. Major in mathematics but not in mathematics education<br>3. Major in mathematics education but not in mathematics<br>4. All other majors<br>5. No formal education beyond upper secondary | 1. No<br>2. Yes | The item was recoded. The response items were converted to:<br>1. No<br>2. Yes<br>Either you majored in mathematics education or you did not. |
| School Q5b | School location | Which best describes the immediate area in which your school is located? | 1. Urban- Densely populated | 1. Remote rural<br>2. Small town or village<br>3. Medium size city or large town | The item was re-coded so that it went from the least to the most. |

| Questionnaire and item | Variable and item code | Question from the questionnaire | Response options | Response options re-coded | Creating of scales or collapsing of categories |
|---|---|---|---|---|---|
| | | | 2. Suburban- On fringe or outskirts of urban area<br>3. Medium size city or large town<br>4. Small town or village<br>5. Remote rural | 4. Suburban- On fringe or outskirts of urban area<br>5. Urban- Densely populated | |
| School Q3 | SES | Approximately what percentage of learners in your school have the following backgrounds?<br>1. Came from more disadvantaged homes<br>2. Came from more affluent homes | a) 0-10%<br>b) 11-25%<br>c) 26-50%<br>d) More than 50% | 1. More disadvantaged<br>2. Neither more affluent nor more disadvantaged<br>3. More affluent | The item was re-coded. The response items were converted to:<br>1. More disadvantaged<br>2. Neither more affluent nor more disadvantaged<br>3. More affluent |

Table 4.3 shows the descriptive statistics for each independent variable (predictor) used in association with learners' mathematics achievement. In Table 4.3, *N, Min*, *Max, Mean* and *SD* represent the sample size, minimum, maximum, mean and standard deviation, respectively. Recall that some categories were collapsed for the predictors, as shown in Table 4.2. For example, teacher education, where some categories had too few responses, was collapsed into a) post-secondary or lower, b) Tertiary education, and c) Bachelor's degree or higher (see BTBG04 in Table 4.2).

**Table 4.3**
*Descriptive Statistics of Predictors and the PVs*

| Variable | *N* | *Min* | *Max* | *Mean* | *SD* |
|---|---|---|---|---|---|
| School location | 14636 | 1 | 5 | 2.93 | 1.445 |
| SES | 14636 | 1 | 3 | 1.33 | .660 |
| Learner confident in mathematics scale | 14636 | 1 | 3 | 1.54 | .636 |
| Learner like learning mathematics scale | 14636 | 1 | 3 | 2.13 | .738 |
| Parental involvement according to teacher | 14636 | 1 | 3 | 1.70 | .758 |
| Parental expectations according to teacher | 14636 | 1 | 3 | 2.42 | .744 |
| Teacher majored in mathematics | 14636 | 1 | 2 | 1.82 | .381 |
| Teacher formal education completed | 14636 | 2 | 3 | 2.80 | .403 |
| Computer/tablet | 14636 | 1 | 2 | 1.55 | .498 |
| Home internet connection | 14636 | 1 | 2 | 1.45 | .498 |
| Cellular phone | 14636 | 1 | 2 | 1.80 | .401 |
| Cyberbullying scale | 14636 | 1 | 2 | 1.31 | .464 |
| 1st plausible value mathematics | 14636 | 155 | 744 | 409 | 80 |
| 2nd plausible value mathematics | 14636 | 163 | 737 | 409 | 80 |
| 3rd plausible value mathematics | 14636 | 123 | 786 | 408 | 81 |
| 4th plausible value mathematics | 14636 | 167 | 777 | 406 | 82 |
| 5th plausible value mathematics | 14636 | 163 | 755 | 408 | 81 |

The results show that the minimum of the PVs is very low, with the minimum PVs for mathematics ranging from 123 to 167 across the five PVs on the TIMSS 2019 international benchmark. Table 4.3 also showed that the maximum of the PVs is high, with the maximum PVs for mathematics ranging from 737 to 786 across the five PVs on the TIMSS 2019

international scale, above the highest benchmark. These values indicate that some learners in South Africa are on an international level regarding mathematics achievement. On average, South Africa had plausible mathematics achievement values ranging between 406 and 409 with an *SD* of 80 to 81 points, accounting for two whole school years. The South African data shows that we have a very heterogeneous population, i.e. that the quality of education varies widely in the country. South Africa should aim to reduce the *SD* between the highest and lowest achieving learners in mathematics since some learners differ in achievement by over two years.

Tables 4.2 and 4.3 work together to show the possible response items and how they were re-coded using the IDB IEA Analyzer. Thus, looking at Table 4.3, the sample size (*N*) of all items were 14,636 learners. At the "*Home internet connection*" predictor, the minimum possible response option was 1 (*no*) and the maximum response option a 2 *(yes*). From Table 4.2, the reader can see which items were not re-coded. For illustration, consider the predictor "Teacher majored in mathematics", Table 4.2 shows that the item was re-coded from six response options to three response options.

Table 4.4 contains the adjusted *R*-squared (coefficient of determination) derived from the model. The $R^2$ represents the proportion of the variance the independent variables explains in terms of the outcome variable.

**Table 4.4**
*Coefficient of Determination (R-Squared)*

| *R*-square | *R*-square (*SE*) | Adjusted *R*-square | Adjusted (*SE*) | *R*-square |
|---|---|---|---|---|
| .39 | .02 | .39 | .02 | |

From Table 4.4, it can be seen that the independent variables accounted for 39% (.39 × 100) (*SE*=.39) of Grade 9 South African mathematics achievement. The model explained approximately 39% of the variance in mathematics achievement, a moderate and significant amount.

In Table 4.5, the unstandardised regression coefficients, their *SEs* and statistical significance are reported. In the current multiple linear regression the $\beta$-values are fixed. For the multiple

linear regression model, dummy coding was used. Dummy coding is used so that nominal variables can be included in regression models. The mean of the reference category is used in the constant for comparison. Take the "learner likes learning mathematics' scale as an example. The categories were 1 = *do not like learning mathematics*, 2 = *somewhat like learning mathematics* and 3 = *very much like learning mathematics*. In Table 4.5, it can be seen that only the two highest categories are reflected, as they are compared against category 1 = *do not like learning mathematics*, which is now reflected as part of the constant.

**Table 4.5**
*Multiple Linear Regression Model of Independent Variables Influence on TIMSS 2019 Mathematics Achievement*

| Predictors | *β* | *SE* | *t*-values |
|---|---|---|---|
| Constant | 312 | 9.99 | 31.25* |
| Boys | -5 | 1.85 | -2.88* |
| Small town or village | 19 | 5.78 | 3.32* |
| Medium city or town | 39 | 8.77 | 4.85* |
| Suburban | 52 | 7.99 | 6.77* |
| Urban | 42 | 7.32 | 6.05* |
| Neither more affluent nor disadvantaged | 23 | 6.75 | 3.76* |
| More affluent socio-economic background | 50 | 10.39 | 5.22* |
| I am a little confident learning mathematics | 20 | 1.68 | 11.72* |
| I am a lot confident learning mathematics | 76 | 3.74 | 18.90* |
| Learner likes learning mathematics somewhat | 3 | 2.67 | 0.99 |
| Learner likes learning mathematics very much | 7 | 3.34 | 2.23* |
| Medium parental involvement for learner achievement | 6 | 6.01 | 0.95 |
| High parental involvement for learner achievement | 9 | 6.29 | 1.52 |
| Medium parental expectations for learner achievement | 16 | 5.76 | 2.82* |
| High parental expectations for learner achievement | 20 | 5.50 | 3.65* |
| Teacher majored in mathematics and mathematics education | 7 | 6.23 | 1.13 |
| Teacher's level of formal education completed | 4 | 6.33 | 0.70 |
| Possess computer/tablet at home | 15 | 2.04 | 7.37* |
| Possess internet connection at home | 25 | 2.48 | 10.65* |
| Possess mobile phone | -1 | 2.31 | -0.32 |
| Cyberbullying reported | -27 | 1.72 | -15.10* |

*Significant if $t < -1.96$ or $t > +1.96$

Table 4.5 shows how many score points the specific variable would increase or decrease on the TIMSS 2019 scale from 0 to 1,000 if only that specific independent variable played a role in the outcome variable (mathematics achievement). Thus, Table 4.4 shows that if a learner lived in a suburban area compared to a rural area, their mathematics achievement could increase by as much as 52 points, which was statistically significant (*SE* = 7.99; *t* = 6.77). If a learner reported being cyberbullied, their mathematics achievement would decrease with as much as a significant 27 points (*SE* = 1.72; *t* = -15, 10). If a learner is very confident in their mathematics ability, they could achieve as much as 76 score points (*SE* = 3.74; *t* = 18.90) more on the TIMSS scale, almost two additional years of schooling compared to learners who were not confident at all. If a learner comes from a more affluent socioeconomic background, their mathematics achievement could increase by as much as 50 points (*SE* = 10.39; *t* = 5.22). Whether you are a boy or a girl is considered trivial on learners' mathematics achievement, since Table 4.5 shows if you are a boy, you will only lose 5 points on the TIMSS scale. Possessing a mobile phone is also considered trivial since you lose only 1 point for not possessing a mobile phone. However, if you do possess an internet connection at home, your mathematics achievement score is likely to increase by 25 points (*SE* = 2.48; *t* = 10.65) on the TIMSS scale. A teacher's level of formal education completed and whether a teacher majored in mathematics and mathematics education were not significant or large predictors of mathematics achievement. Table 4.5 shows the statistical significance of the *t*-value. If the values are between $t < -1.96$ or $t > +1.96$, the *t*-value is statistically significant, meaning that the results are unlikely to occur randomly, but instead are more likely to be attributable due to a specific cause (independent variable). Table 4.5 shows that all predictors' variables are statistically significant except for:

1. Learner likes learning mathematics a little (*t* = 0.99).
2. Medium parental involvement for learner achievement (*t* = 0.95).
3. High parental involvement for learner achievement (*t* = 1.52).
4. Teacher majored in mathematics and mathematics education (*t* = 1.31).
5. Teacher's level of formal education completed (*t* = 0.70).
6. Possess mobile phone (*t* = -0.32).

## 4.5 Conclusion

Chapter 4 showed the findings and results in the current study by considering the descriptive statistics profile of learners reporting cyberbullying and the multiple linear regression analysis and interpretation of predictors' influence on learners' mathematics achievement. In this chapter, the descriptive statistics showed that more than half (52%) of the learners in the study were boys. The results also showed that more than three quarters (77%) of learners possessed a mobile phone, although over half (52%) did not possess a computer or tablet at home. Over half (59%) of learners do not have access to the internet at home.

Most teachers reported that parents have very high parental expectations of their learners' mathematics achievement, with almost a quarter (24%) of teachers saying that parents had very high expectations, but in contrast with this, only 5% of teachers said that parents were very supportive and committed to their children's mathematics achievement (as shown in Figure 4.3).

From the bullying scale, 10% of learners stated that nasty or hurtful messages were being sent to them weekly. On the other end, over three quarters (80%) of learners indicated that it has never happened that embarrassing photos of them were shared online, while 70% stated that is never happened that embarrassing things of them were posted online. Almost half of the learners (49%) stated that teachers were easy to understand, and over half (52%) of learners agreed *a lot* that the learner enjoyed learning mathematics. Almost a quarter (20%) of learners *do not like* learning mathematics, but over half (53%) of learners felt *very confident learning mathematics.* Almost a third (32%) of teachers majored in both mathematics and mathematics education, with more than three quarters (77%) of teachers having a bachelor's or equivalent level qualification. Almost a third (32%) of learners lived in remote rural areas, with 29% living in small towns and villages. More than three quarters (77%) of learners received school in more disadvantaged socioeconomic areas rather than in affluent socio-economic areas (as shown in Figure 4.10 and defined in Section 1.6.6).

From the profile of learners who reported cyberbullying, it was found that over a third of boys (35%) reported being cyberbullied, with slightly fewer girls (31%) reporting cyberbullying. The profile showed that cyberbullying occurred in more disadvantaged areas than affluent socio-economic areas. Almost half (44%) of learners in rural areas reported

cyberbullying, and over a third (35%) of learners in small towns and villages reported cyberbullying. Linking with the previous findings, over a third (34%) of learners reported being cyberbullied in areas with a disadvantaged school composition. Over a third (34%) of learners who did not feel confident in mathematics stated that they were cyberbullied, and 37% of learners with very low parental expectations stated that they were cyberbullied. The results also showed that more than a third (34%) of learners who did not possess a computer or tablet at home were being cyberbullied, more than a third (35%) of learners who do not have access to the internet at home were being cyberbullied, and almost a third (29%) of learners who do not possess a mobile phone, were being cyberbullied.

The multiple linear regression model reported *t*-values, which can be interpreted as $t < -1.96$ or $t > +1.96$, indicating that the predictor is statistically significant. For example, if a learner lived in a suburban area compared to a rural area, their mathematics achievement could increase by as much as 52 points which was statistically significant (*SE* = 7.99; *t* = 6.77). If a learner reported being cyberbullied, their mathematics achievement would decrease with as much as a significant 27 points (*SE* = 1.72; *t* = -15.10). If a learner is very confident in their mathematics ability, they could achieve as much as 76 score points (*SE* = 3.74; *t* = 18.90) more on the TIMSS scale, almost two additional years of schooling compared to learners who were not confident at all. The model explained approximately 39% of the variance in mathematics achievement, a moderate and significant amount. Some predictors did not have a significant relationship with mathematics achievement including a) learner likes learning mathematics a little (*t* = 0.99), b) medium parental involvement for learner achievement (*t* = 0.95), c) high parental involvement for learner achievement (*t* = 1.52), d) teacher majored in mathematics and mathematics education (*t* = 1.31), e) teacher's level of formal education completed (*t* = 0.70), and f) possess mobile phone (*t* = -0.32).

The regression model predicted a moderate and significant amount of variance and predictors which were both significant and had small to large associations included– predictors such as being a boy or girl (*t* = -2.88), living in small towns or villages (*t* = 3.32), feeling a lot confident in mathematics (*t* = 18.90), possessing a tablet/computer at home (*t* = 7.37), possessing internet connection at home (*t* = 10.65) and reporting cyberbullying (*t* = -15.10) to name a few.

# Chapter 5: Recommendations and Conclusions

## 5.1 Introduction

The current study investigated how cyberbullying was associated with learners' Grade 9 mathematics achievement. The following section discusses the findings and results by linking them with the primary and secondary research questions, the theoretical framework and the specific risk factors discussed in the literature review (Chapter 2). This chapter summarises the research, strengths and limitations of the current study, recommendations for further research and reaches a conclusion.

## 5.2 Summary of the Research

The primary research question was: *To what extent are various risk factors, such a parental involvement, school safety, gender and socio-economic factors (as identified by TIMSS), associated with cyberbullying and mathematics achievement?* The researcher found that most predictors had a significant relationship with learners' mathematics achievement, including a) gender, b) parental expectations, c) school location and SES, d) confidence in mathematics, and e) technology use. Teachers' qualifications were not a significant predictor of learners' mathematics achievement.

Regarding gender, although there was statistical significance, it was shown that if you were a boy, your mathematics achievement would only decrease by as much as 5 points on the TIMSS 2019 international benchmark. Regarding parental expectations, the results showed that teachers who said parents had high expectations were associated with a mathematics achievement increase of 20 (SE = 5.50; t = 3.65) points on the TIMSS 2019 international benchmark. Regarding school location, the results showed that learners with more affluent socioeconomic backgrounds' mathematics achievement would increase on average with 50 (*SE* = 10.39; *t* = 5.22) points on the TIMSS 2019 international benchmark. The results also showed that learners living in suburban areas' mathematics achievement would increase on average by 52 points (*SE* = 7.99; *t* = 6.72), and learners living in urban areas' mathematics achievement would increase on average by 42 (*SE* = 7.32; *t* = 6.05) points on the TIMSS 2019 international benchmark. Regarding confidence in the ability to do mathematics, the results showed that learners who felt confident learning mathematics would have an average

increase of 76 (*SE* = 3.74; *t* = 18.90) points on the TIMSS 2019 international benchmark. Regarding technology use, the results showed that learners' mathematics achievement would increase by 15 (*SE* = 2.04; *t* = 7.37) points on the TIMSS 2019 international benchmark if the had a computer/tablet at home and learners' mathematics achievement would increase on average by 25 (*SE* = 1.72; *t* = -15.10) points on the TIMSS 2019 international benchmark if they had internet connection at home.

The first secondary research question asked: *What is the association between self-reported cyberbullying and Grade 9 mathematics achievement?*. The current study's findings revealed that cyberbullying has a significant negative association with learners' mathematics achievement. The second secondary research question was: *To what degree is cyberbullying associated with mathematics achievement of Grade 9 South African learners?* The study revealed that if a learner was cyberbullied, their mathematics achievement would decrease on average with 27 (*SE* = 1.72; *t* = -15.10) points on the TIMSS 2019 international scale, a moderate and significant association.

The last secondary research question was: *What are the risk factors associated with a higher reported frequency of reported cyberbullying, such as parental involvement and expectations, school safety and background variables, including demographic, gender and socio-economic factors?* The risk factors (predictors) that were taken into consideration were as follows: a) gender, b) parental involvement and expectations, c) school location and SES, d) teacher's qualifications, e) technology use, and f) confidence in mathematics ability. Discussed below is how the question was addressed with the predictors from a-e, answering the last secondary question.

a) **Gender:** It was found that over a third of boys (35%) reported being cyberbullied, and 31% of girls reporting cyberbullying.
b) **Parental expectations:** The results indicated that more than a third (37%) of learners who had parents with very low parental expectations (according to teachers) stated that they were cyberbullied.
c) **School location and SES:** The profile showed that cyberbullying occurred in more disadvantaged areas. Almost a half (44%) of learners in rural areas reported cyberbullying, and over a third (35%) of learners in small towns and villages reported

cyberbullying. Linking with the previous finding, over a third (34%) of learners reported being cyberbullied in areas with a more disadvantaged school composition.

d) **Teacher's qualifications:** The results showed that over 20% of learners receive mathematics education without a teacher having the associated degree and another 20% of teachers who did not possess the required qualification. The teacher qualification items (a) teacher majored in mathematics and mathematics education, and b) level of formal education completed, tested non-significant and thus were not included in the final model.
e) **Technology use:** The results also showed that more than a third (34%) of learners who did not possess a computer or tablet at home were being cyberbullied, more than a third (35%) of learners who did not have access to the internet at home were being cyberbullied and almost a third (29%) of learners who did not possess a mobile phone were being cyberbullied.
f) **Confidence in mathematics ability:** Over a third (34%) of learners who did not feel confident in mathematics stated that they were cyberbullied.

### 5.3 Reflections on the Conceptual Framework

When the results are interpreted through the lens of Bronfenbrenner, the researcher can conclude that the **microsystem** plays the biggest role in learners' mathematics achievement. Looking at predictors lead to findings such as:

1. If learners felt more confident learning mathematics, learners' achievement would increase.
2. The descriptive statistics showed that more boys (35%) reported being cyberbullied (Finding 3 in Section 5.4.3 discusses gender in more detail).

Both genders could experience negative effects on their academic achievement due to cyberbullying, as also found in the literature review by Mateu et al. (2020). The **microsystem** is crucial for boosting learners' confidence in their ability to do mathematics and could increase achievement since the findings showed that learners who are confident in their abilities is the strongest predictor of learners' mathematics achievement (Finding 2 explains this in more detail below.) with an average increase of 76 points on the TIMSS 2019 benchmark if the learner enjoys learning mathematics. This finding makes sense as those who do well in mathematics are more confident. Learners who struggle to achieve in the subject are likely those with low confidence.

Looking at the **mesosystem**, the effect of variables such as the role of parents is unclear based on the findings from the current study, possibly due to a) social desirability responding, b) parents play a less important role at that age than previously assume, and/or c) the problem might be due to the reduced sample size or that teachers cannot accurately gauge parental involvement for an entire class. Agbeko and Kwaa-Aidoo (2018) stated that parents could be the main key to the solution since parents who monitored learners' online activities could reduce the probability of getting bullied online by up to 50%. The multiple linear regression model showed that cyberbullied learners had a decrease of 27 points in mathematics achievement on the TIMSS 2019 benchmark. Thus, more research needs to be done on the relationship between parents' involvement and learners' achievement.

Looking at the **exosystem**, variables such as school location and SES played a role in cyberbullying. The results showed that learners who lived in rural areas with more disadvantaged backgrounds were more likely to report cyberbullying than learners in urban and suburban areas with more affluent backgrounds. These results may indicate that SA needs interventions and child helplines in areas with more disadvantaged social and economic statuses. Technology use plays a significant positive role in learners' mathematics achievement. More cyberbullying was reported if learners did not have an internet connection, computer or tablet at home. The question remains, how are learners being cyberbullied if they do not possess an internet connection or a computer/tablet at home? The findings indicate avenues for future research. The results indicated that more than three quarters (77%) of learners possessed a mobile phone, but unfortunately, the results were not statistically significant about whether it does influence learners' mathematics achievement or not. The **exosystem** should be investigated further on how a lack of technology use increases cyberbullying, which has a negative effect on learners' mathematics achievement, and what could be done to help with this issue, e.g. free Wi-Fi at rural and more disadvantaged schools being monitored.

Looking at the **macrosystem**, the researcher concluded that there are no laws and policies in SA against cyberbullying amongst learners in school (under the age of 18). The literature review explained why this is such a pressing issue and addressed why the Department of Education needs to introduce cyberbullying into the LO curriculum before a learner can receive a junior certificate (Grade 9) and leave school, as explained in the literature review. Learners should be made aware of their rights regarding this issue and what can be done, as

being cyberbullied has a significant effect on learning mathematics. Cyberbullying is increasing as the world moves into a technological era, and drastic steps should be taken in South Africa to help prevent this problem.

The study concluded that cyberbullying affected learners' mathematics achievement in each system of Bronfenbrenner, although future research should pay more attention to the **microsystem,** which emerged strongly in the current study as a predictor of learners' mathematics achievement. Also, there needs to be more emphasis on the **macrosystem** since there are several laws and policies on cyberbullying as discussed in the literature review, including the cybercrimes act (Act 19 of 2020) which the government just implemented in 2020. Due to the drastic growth of cyberbullying, it should be incorporated into the LO curriculum so that learners can be made aware of the legal consequences thereof, the signs and symptoms to identify it and how to prevent it.

## 5.4 Main Findings

Finding 1 below addresses the first secondary research question which asked: *What is the association between self-reported cyberbullying and Grade 9 mathematics achievement as measured by TIMSS 2019?* and the second secondary research question which asked: *To what degree is cyberbullying associated with mathematics achievement of Grade 9 South African learners?* Findings 2 to 5 address the primary research question from the study, which was: *To what extent are various risk factors, such a parental involvement, school safety, gender and socio-economic factors (as identified by TIMSS) associated with cyberbullying and mathematics achievement?* as well as the last secondary research question which asked: *What are the risk factors associated with a higher reported frequency of reported cyberbullying, such as parental involvement and expectations, school safety and background variables, including demographic, gender and socio-economic factors?*

### 5.4.1 Finding 1: The Association of Being Cyberbullied with a Grade 9 Learners' Mathematics Achievement is Significant and Negative

Being cyberbullied has a significant negative association with Grade 9 learners' mathematics achievement. The results showed that if a learner reported being cyberbullied, their mathematics achievement would decrease by as much as a significant 27 points ($SE$ = 1.72; $t$ = -15.10) on the TIMSS 2019 international scale. This statistic means that learners that are

being cyberbullied would be more than half a year academically behind their peers in mathematics. Cyberbullying is not the main factor why a learner may experience difficulties in mathematics; however, it does have a significant negative effect on learners' mathematics achievement and should not be overlooked.

### 5.4.2 Finding 2: Confidence in Subject Ability and a Learner's Mathematics Achievement is Significant and Positive

Learners' confidence in learning mathematics has a significant positive correlation with learners' mathematics achievement, most likely because learners who have higher achievement in the subject would naturally be more confident. The results showed that if a learner feels confident learning mathematics, they have an average increase of 76 ($SE$ = 3.74; $t$ = 18.90) points on the international TIMSS 2019 benchmark. These results indicate that more focus should be placed on the teaching and learning of mathematics so that learners have higher achievement in mathematics and consequently feel more confident. This independent variable has the highest correlation with mathematics achievement. From the six risk factors which may influence learners' mathematics achievement, including a) gender, b) parental involvement and expectations, c) school location and SES, d) teacher's qualifications, e) technology use, and f) confidence in mathematics ability, confidence plays the main role in learners' mathematics achievement. It follows that it is important for a learner to feel confident learning mathematics but also that those who have higher maths achievement would be more confident.

### 5.4.3 Finding 3: Gender: Boys Report More Cyberbullying than Girls but Both Experience the Phenomena

Boys reported more cyberbullying than girls. Most researchers such as Kowalski et al. (2012), Bayraktar et al. (2015) in the Czech Republic, Holt et al. (2016) in Singapore and Wang et al. (2019) in China found that girls tend to be more at risk of cyberbullying than boys as stated in the literature review (see Section 2.4.1.1 to 2.4.1.3). However, Kasahara et al. (2019) in Belize, Akpunne et al. (2020) in Nigeria, Tustin et al. (2014) in South Africa, Motswi and Mashegoane (2019) in South Africa (see Section 2.4.1.1 to 2.4.1.3) and the present study found that boys tend to be slightly more at risk of cyberbullying than girls. The effect of gender differs between countries and cultures, which explains why there has not yet

been a definitive gender who are cyberbullied more. However, both boys and girls reported cyberbullying in the current studies and may be at risk for lower mathematics achievement.

### 5.4.4 Finding 4: Being Economically and Socially Disadvantaged has a Significantly Negative Impact on Learners' Mathematics Achievement

Learners who are economically and socially disadvantaged may be the most at risk in SA for cyberbullying. The results showed that if a learner lives in a suburban area, their mathematics achievement was about 52 points higher (*SE* = 7.99; *t* = 6.77) on the TIMSS 2019 benchmark, whereas learners who live in small towns and villages' mathematics achievement was only 19 points higher when compared to deep rural areas (*SE* = 5.78; *t* = 3.32). Therefore, school location and SES per se might not be the main cause of cyberbullying, but rather other causative factors, including socioeconomic problems and poverty, as stated by Richardson and Fen Hiu's (2018) study in South, Central and West Africa.

The current results also found that more than a third (34%) of learners in more disadvantaged socioeconomic backgrounds were being cyberbullied, whereas only a quarter (26%) of learners in more affluent socioeconomic backgrounds were being cyberbullied. The results also found that mathematics achievement of learners in more affluent socioeconomic backgrounds would increase with an average of 50 (*SE* = 10.39*; t* = 5.22) points on the TIMSS 2019 benchmark. On the other hand, learners in neither more affluent nor disadvantaged socioeconomic backgrounds' scores would increase with an average of only 23 score points compared to disadvantaged learners (*SE* = 6.75*; t* = 3.76). These results can be due to having more resources at school in more affluent areas, including books, internet connections and physical apparatus. A possible explanation could be researched in subsequent studies as to why learners in more disadvantaged areas may be more at risk of cyberbullying.

### 5.4.5 Finding 5: Technology Use has a Complex Relationship with Cyberbullying

More than a third (35%) of learners who do not have an internet connection at home said they were cyberbullied, in contrast with 29% of learners who have an internet connection at home. It follows that cyberbullying may be more problematic when learners have access to

free Wi-Fi at school. Schools should block social media, use secure passwords and make sure that parental controls are installed. In addition, cyberbullying seems similar regardless if learners possess (31%) or do not possess (34%) a computer/tablet at home. Access to other devices (e.g. cell phones, as explained previously) probably contributes more to cyberbullying.

The question remains, why and how learners are being cyberbullied more if they do not possess an internet connection, nor a computer or tablet at home, since cyberbullying needs to happen using a technological device and some form of online connection.

## 5.5 Strengths and Limitations of the Study

The following section discusses the strengths and limitations of the current study and how the researcher handled the limitations.

### 5.5.1 Strengths of the Study

The data size and the quality of the data provided by the IEA is a major strength of secondary data analysis since the TIMSS 2019 survey was conducted in 64 countries, with 8,340 schools participating in the questionnaire. The validity and reliability of the survey are thus enhanced and used for more powerful statistical analysis (Gray, 2020). Another strength of the study is that it was marked under the quality assurance methods of the IEA taken to ensure that the data was accurately captured and made available for secondary analysis.

Secondary analysis minimises problems with data collection because the primary study's data will be re-analysed, and it will complement the primary research (Gray, 2020). Furthermore, the study will contribute to the TIMSS 2019 results, which is the primary research. Secondary analysis is also cost- and time effective, since the data was already collected by other researchers, which helps with up-to-date information and research (Gray, 2020; Crossman, 2019) and avoid spending time on methodological questions and issues such as research design, sample and instruments. The TIMSS 2019 data is publicly available, thus allowing researchers also to carry out replication studies on specific matters, which would also be beneficial to the original findings to enhance validity and reliability (Gray, 2020). The current researcher stayed detached from data collection, thus giving a new and

objective opinion on specific findings, which may have been difficult for the primary researcher(s) (Gray, 2020).

A strength of this study is that the primary research data was collected by highly qualified researchers who have contributed, worked and specialised on TIMSS from the first round of questionnaires. Thus, have many years of experience behind them on the research design, sample and instruments used, which enhanced the validity of the data (Gray, 2020). Using secondary data is also unobtrusive, which means protecting the participants' privacy and not being able to contact participants again in the case of sensitive and vulnerable information (Gray, 2020). Secondary analysis is also very beneficial for student researchers, myself included, since we need to complete dissertations to very demanding timescales, and secondary analysis reduces time pressure somewhat (Gray, 2020). MacInnes (2017) also states that secondary data is like Wikipedia. It helps a researcher gather enough information to decide whether it contains the type of information they are looking for or if your study's questions and objectives won't be met by that specific data set. MacInnes (2017) states that using secondary analysis is a good way of checking specific abstract and theoretical concepts in social science and whether they can be tested empirically or not.

### 5.5.2 Limitations of the Study

Firstly, the missing data weakened the model, and listwise deletion resulted in a considerably smaller sample. Some predictors did not have a relationship with the outcome variable, which weakened the regression model. While answering the learner questionnaire, learners might have been afraid or too ashamed to be honest about being bullied, thus not having accurate results. Learners could also have been tired while completing the questionnaire, thus not carefully reading the questions and possible response options before selecting one. O'Reilly-Shah (2017) states that some learners may also have experienced "survey fatigue", which refers to the phenomenon whereby participants become tired, bored, or disinterested during a survey and provide less thoughtful answers to queries–particularly in later parts of a survey–or prematurely terminate participation as a result.

Another limitation of the current study could be that the researcher used a secondary analysis approach and thus could only use questions from the TIMSS 2019 survey. The TIMSS 2019 survey consisted of four questionnaires per subject (mathematics and science) at the Grade 9 level. The researcher used three of them from the mathematics subject, namely, the learner,

teacher and school questionnaire. However, the researcher did not have control over the questionnaire structure or methodological aspects such as sampling. Further research is needed in areas where the survey could not provide answers.

The researcher could only use three items from the bullying scale which fitted with cyberbullying; these items were: a) sent me nasty or hurtful messages online (BSBG14H), b) posted embarrassing things about me online (BSBG14I), and c) shared embarrassing photos of me online (BSBG14J). However, cyberbullying can take many other forms, which could be viewed as a limitation of the current study since learners could only choose options from the questionnaire and not write their answers down.

Gray (2020) argues that data quality can also be a potential limitation since the current researcher was not part of the original research team. Gray (2020) recommends that only experienced researchers should utilise secondary datasets or, if possible, stay in contact with the primary researchers in the case of any questions. This limitation, however, did not hamper the current study, as the members of the IEA are always willing to answer questions about the TIMSS 2019 data. In addition, both the supervisor and the co-supervisor of the current study attended courses at the IEA TIMSS & PIRLS International Study Center in Hamburg, Germany, and have made lasting connections with the presenters of those courses who always respond to queries timeously. Lastly, learning and becoming familiar with new data sets can take time, which is why most large-scale assessments provide training for potential users. However, the current researcher did not receive this training and thus needed to spend more time becoming familiar with the TIMSS 2019 questionnaires, structure, data set and analysis (Gray, 2020). Although the current researcher did not receive training at the IEA Institute in Hamburg, Germany, both the supervisor and co-supervisor who attended the courses could assist the main researcher, the master's student, in this dissertation's data analysis.

### 5.6 Recommendations and Contributions of the Study

1. The current study showed that cyberbullying has a significant negative association with Grade 9 learners' mathematics achievement (see Finding 1 in Section 5.4.1). The results showed that if a learner reported being cyberbullied, their mathematics achievement would decrease by a significant 27 points ($SE$ = 1.72; $t$ = -15.10) on the TIMSS 2019 international scale. Thus, anti-bullying interventions may need to focus specifically on

cyberbullying since it plays an important role in learners' mathematics achievement (based on Finding 1). Anti-bullying interventions should also focus on how other stakeholders such as parents, schools, teachers and support groups can help victims of cyberbullying. However, there already are stakeholders and support groups presenting cyberbullying seminars, webinars and interventions for learners, parents and teachers to help with this phenomenon, including:

> Center for Problem Oriented Policing, Kid Against Bullying, KidsStopBullying.gov, National Crime Prevention Council, National Education Association Curriculum Resources for Bullying Prevention, National Bullying Prevention Center, School Mediation Associates, Stomp Out Bullying, StopBullying.gov, Melissa Meyer Foundation and Jodee Blanco (SADAG, n.d.b, para. 70),

they need to become more publicly known to help stop the drastic growth of cyberbullying.

2. The current study found that confidence plays a leading role in learners' mathematics achievement (see Finding 2 in Section 5.4.2). Teachers and parents should focus on learners' confidence in mathematics and help boost their self-confidence regarding mathematics achievement. The lack of confidence in mathematics is directly linked to how well learners achieve in mathematics; thus, it is recommended that the teaching and learning of mathematics at the Grade 9 level be strengthened. When learners have the opportunity to master mathematics, their confidence will also increase.
3. The results from the current study indicated that despite differences in cyberbullying between genders, boys might be more at risk of being cyberbullied (see Finding 3 in Section 5.4.3). It would be valuable to investigate the role of gender further regarding cyberbullying as there are opposing views in the literature about which gender is cyberbullied more (see Section 2.4.1.1 to 2.4.1.3 and Section 5.4.3). An entire in-depth study could be conducted solely on the association between gender, cyberbullying, and learners' mathematics achievement within a South African context.
4. Anti-bullying interventions may need to focus on high-risk individuals who do not feel confident learning mathematics and learners in economic and socially disadvantaged areas (based on Finding 4; see Section 5.4.4). It is recommended that every school in South Africa should also have rules and a policy against bullying and harassment, with all consequences stipulated in the policy, e.g. disciplining and, in severe cases, expulsion, especially so schools in socially and disadvantaged areas.

5. Cyberbullying occurred more when learners did not possess a home internet connection or a computer or tablet at home (based on Finding 5; see Section 5.4.5). Further research should be done on how these learners fall victim to cyberbullying. If cyberbullying does occur, it probably happens through easily accessible devices such as cell phones. Further questions that should be raised include:

- Do learners use their parents or friends' phones?
- How do the learners connect online (especially those in lower SES communities with fewer resources)?
- Why are these learners more at risk of cyberbullying than learners with a home internet connection and technological devices?

   Cyberbullying occurs more when learners do not have access to an internet connection at home. More research is required about how learners get access to devices and the internet for cyberbullying. If learners have access to free Wi-Fi at school, schools should block social media, use secure passwords and make sure parental controls are installed to limit the risks of cyberbullying. Further research should investigate when and how free Wi-Fi is being provided and managed in South African rural schools where cyberbullying occurs more.

6. Parental involvement and support should be investigated further. Previous literature has indicated the importance of parents regarding cyberbullying, but due to using secondary analysis, there was no significant association regarding parental involvement. Also, teachers answered questions regarding parents in TIMSS 2019, but it would be helpful if parents also answered a home questionnaire from their perspective as done in the TIMSS 2019 Grade 4/5 level. The results hinted that parents do play a role in learners' mathematics achievement, but further research is required to assess the role of parents. Free parental seminars and webinars should be held to make parents more aware of their role in learner cyber victimisation and for which warning signs, symptoms and emotions to heed. Schools should also ask and activate other stakeholders such as parents to help with managing and reducing bullying in schools.
7. Based on the research problem, The Department of Education should add the topic of cyberbullying into the LO curriculum of CAPS before learners can receive a junior certificate in Grade 9. Learners and other stakeholders such as parents and teachers should know the symptoms, effects and ramifications of cyberbullying on the victim and perpetrator. Every learner in South Africa should be made aware of their rights, the resources at their disposal, and action points regarding cyberbullying. Every South

African learner should know exactly what repercussions there are for cyberbully perpetrators.

8. Further research should be done from a holistic point of view on the impact of cyberbullying on learners' scholastic achievement. Although there has been a lot of research on a global and South African scale, other countries in Africa, e.g. Botswana, Nigeria, Namibia and Kenya, did not focus on the impact of cyberbullying on learners, their scholastic achievements or the schooling system. The current study shows that learners in economic and socially disadvantaged areas tend to report more cyberbullying than learners in more affluent social and economic areas. Most countries in Africa are developing nations; thus, it would be beneficial to know whether other African countries also experienced more cyberbullying than developed countries.

The current study contributed to understanding how cyberbullying links to the mathematics achievement of Grade 9 learners in South Africa. The current study addresses important and problematic issues from a holistic point of view using Bronfenbrenner's ecological framework. The results showed that learners in economic and socially disadvantaged areas tend to be more at risk of cyberbullying than learners in more affluent social and economic areas. As South Africa is a developing nation (World Population Review, 2021), these statistics are problematic since cyberbullying is a growing trend worldwide.

## 5.7 Synthesis and Conclusion

In conclusion, the findings of the current study revealed that cyberbullying does indeed have a significant association with learners' mathematics achievement. Most variables played a role in learners' mathematics achievement, including parental involvement and expectations, school location and SES, technology use and confidence, except for the following (as stated at the conclusion of Chapter 4), which were found to be non-significant:

1. Learner likes learning mathematics a little ($t = 0.99$).
2. Medium parental involvement for learner achievement ($t = 0.95$).
3. High parental involvement for learner achievement ($t = 1.52$).
4. Teacher majored in mathematics and mathematics education ($t = 1.31$).
5. Teacher's level of formal education completed ($t = 0.70$).
6. Learner possesses mobile phone ($t = -0.32$).

The main predictor for mathematics achievement was learners' confidence in learning mathematics. Looking at Bronfenbrenner's ecological model, mathematics achievement focuses mainly on the microsystem (individual) and whether the learner likes the subject. If the learner lacks confidence in mathematics and does not believe they can achieve the specific components in mathematics, they have lower mathematics achievement. Thus, it is important for a learner to enjoy mathematics and to feel confident in their ability to achieve well in the subject. Parental involvement and expectations play a role in learners' mathematics achievement, but further research should investigate cyberbullying from the parents' point of view and not only rely on teacher reports for the whole class. TIMSS 2019 did not provide a home questionnaire at the Grade 8/9 level; thus, it was impossible to conclude about the involvement of parents in their children's daily online activities.

The results showed that learners in economic and socially disadvantaged areas tend to be more at risk of cyberbullying than learners in more affluent social and economic areas. Similar research should be done in other developing African countries to investigate the differences between affluent and rural communities. Learners who do not have a home internet connection or possessed a computer/tablet at home were cyberbullied more than those who have access to an internet connection, as well as a computer/tablet at home. These statistics are problematic and need to be investigated further since it is important to know where learners access the internet and technological devices to fall victim to or perpetrate cyberbullying.

The research also addresses important issues from the macrosystem in Bronfenbrenner's ecological framework, such as the applicability of the laws and policies relating to cyberbullying to adolescents and the ramifications for perpetrators under the age of 18. An important recommendation is to include cyberbullying as a topic in the LO curriculum to address the warning signs, emotions, consequences, and ramifications of cyberbullying before a learner receives a junior certificate (Grade 9) and can leave school.

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## Annexures

## Annexure A: TIMSS items to be used in the study

## From the learner questionnaire:

| **Sex of Students (ITSEX)** | Girl | Boy |
|---|---|---|

| **Do You Possess Internet Connection at Home? (BSBG05D)** |
|---|
| Yes |
| No |

| **Do You Possess a Computer/Tablet at Home? (BSBG05A)** |
|---|
| Yes |
| No |

| **Do You Possess a Mobile Phone? (BSBG05E)** |
|---|
| Yes |
| No |

| **During this school year, how often have other students from your school done any of the following things to you (including through texting or the Internet)?** | At least once a week | Once or twice a month | A few times a year | Never |
|---|---|---|---|---|
| Sent me nasty or hurtful messages online **(BSBG14H)** | | | | |
| Posted embarrassing things about me online **(BSBG14I)** | | | | |
| Shared embarrassing photos of me online **(BSBG14J)** | | | | |

| **How much do you agree with the statement about learning mathematics:** Learner likes learning mathematics scale **(BSDGSLM)** | Agree a lot | Agree a little | Disagree a little |
|---|---|---|---|
| I enjoy learning mathematics **(BSBM16A)** | | | |
| I wish I did not have to study mathematics **(BSBM16B)** | | | |
| Mathematics is boring **(BSBM16C)** | | | |

| | | | |
|---|---|---|---|
| I learn many interesting things in mathematics **(BSBM16D)** | | | |
| I like mathematics **(BSBM16E)** | | | |
| I like any schoolwork that involves numbers **(BSBM16F)** | | | |
| I like to solve mathematics problems **(BSBM16G)** | | | |
| I look forward to mathematics class **(BSBM16H)** | | | |
| Mathematics is one of my favorite subjects **(BSBM16I)** | | | |

| **How much do you agree with the statement about learning mathematics: I am confident learning mathematics (BSDGSCM).** | Agree a lot | Agree a little | Disagree a little |
|---|---|---|---|
| I usually do well in mathematics **(BSBM19A)** | | | |
| Mathematics is not one of my strengths **(BSBM19B)** | | | |
| Mathematics is more difficult for me than for many of my classmates **(BSBM19C)** | | | |
| I learn things quickly in mathematics **(BSBM19D)** | | | |
| Mathematics makes me nervous **(BSBM19E)** | | | |
| I am good at working out difficult mathematics problems **(BSBM19F)** | | | |
| My teacher tells me I am good at mathematics **(BSBM19G)** | | | |
| Mathematics is harder for me than any other subject **(BSBM19H)** | | | |
| Mathematics makes me confused **(BSBM19I)** | | | |

| **Teacher easy to understand (BSBM17B)** |
|---|
| Agree a lot |
| Agree a little |
| Disagree a little |
| Disagree a lot |
| **Teacher explains Mathematics good (BSBM17D)** |
| Agree a lot |
| Agree a little |
| Disagree a little |
| Disagree a lot |

**From the teacher questionnaire:**

| **How would you characterise each of the following within your school?** | Very high | High | Medium | Low | Very low |
|---|---|---|---|---|---|
| Parental involvement for student achievement **(BTBG06E)** | | | | | |
| Parental expectations for student achievement **(BTBG06G)** | | | | | |

| **Teacher majored in mathematics and mathematics education (BTBG05A)** |
|---|
| Major in mathematics and mathematics education |
| Major in mathematics but not in mathematics education |
| Major in mathematics education but not in mathematics |
| All other majors |
| No formal education beyond upper secondary |
| **Teacher's level of formal education completed (BTBG04)** |
| Did not complete upper secondary education (Level 3) |
| Upper secondary education (level 3) |
| Post-secondary, non-tertiary education (level 4) |
| Short-cycle tertiary education (level 5) |
| Bachelor's or equivalent level (level 6) |
| Master's or equivalent level (level 7) |

**From the school questionnaire:**

| **Which best describes the immediate area in which your school is located? (BCBG05B)** |
|---|
| Urban- Densely populated |
| Suburban- On fringe or outskirts of urban area |
| Medium size city or large town |

| |
|---|
| Small town or village |
| Remote rural |

| **Which best describes the school's composition by socio-economic background? (BCDGSBC)** |
|---|
| More disadvantaged |
| Neither more affluent nor more disadvantaged |
| More affluent |

**Annexure B: Life Orientation curriculum annual teaching plan Grade 7-9 (Department of Basic Education, 2011)**

| TOPIC | TERM 1 | GRADE 7 |
|---|---|---|
| **WEEKS 1 – 2** | | **Recommended resources** |
| **Development of the self in society** | 2 hours | Textbook, life skills books and posters |
| • Concept: self-image<br>- Identify and reflect on positive personal qualities: relationship with self, family, friends<br>- Personal interests, abilities and potential<br>- Strategies to enhance self-image through positive actions: respect for self<br>- Strategies to enhance others' self-image through positive actions: respect for others and respect for diversity | | |
| **Physical Education** | 2 hours | Textbook, resources on fitness |
| • Participation in a fitness programme<br>• Safety issues relating to fitness activities | | |
| **WEEKS 3 – 5** | | |
| **Development of the self in society** | 3 hours | Textbook, life skills books |
| • Changes in boys and girls: puberty and gender constructs<br>- Physical and emotional changes<br>- Understanding the changes and how these impact on relationships<br>- Respect for own and others' body changes and emotions<br>- Appreciation and acceptance of the self and others | | |
| **Physical Education** | 3 hours | Textbook, resources on fitness |
| • Participation in a fitness programme<br>• Participation and movement performance in a fitness programme | | |
| **WEEKS 6 – 8** | | |
| **Development of the self in society** | 3 hours | Textbook, life skills books, youth magazines |
| • Peer pressure: effects of peer pressure<br>- How peer pressure may influence an individual: use of substances, crime, unhealthy sexual behaviour, bullying and rebellious behaviour<br>- Appropriate responses to pressure: assertiveness and coping skills<br>- Negotiation skills: ability to disagree in constructive ways<br>- Where to find help | | |
| **Physical Education** | 3 hours | Textbook, resources on fitness |
| • Participation in fitness a programme | | |
| **WEEKS 9 – 10** | | |
| **World of work** | 2 hours | Textbook, resources on careers and study skills |
| • Importance of reading and studying: reading for enjoyment and reading with understanding<br>• Skills to develop memory: ability to recall | | |
| **Physical Education** | 2 hours | Textbook, resources on fitness |
| • Participation in a fitness programme<br>• Participation and movement performance in a fitness programme | | |

| | |
|---|---|
| **Formal assessment:**<br>1. Written task<br>2. Physical Education Task (PET) | It is compulsory to cover the given topics in the term indicated. The sequence of the topics within the term is however, not fixed. |

| TOPIC | TERM 2 | GRADE 7 |
|---|---|---|
| **WEEKS 1 – 2** | | **Recommended resources** |
| **Constitutional rights and responsibilities** | 2 hours | Textbook, newspaper articles, Bill of Rights, South African Constitution |
| • Human rights as stipulated in the South African Constitution:<br>- Application of human rights<br>- Application of responsibilities in relation to human rights<br>• Fair play in a variety of athletic and sport activities: role of values, trust and respect for difference | | |
| **Physical Education** | 2 hours | Textbook, resources on indigenous and invasion games |
| • Plays community or indigenous games that include the concept of invasion<br>• Safety issues relating to participation in invasion games | | |
| **WEEKS 3 – 5** | | |
| **Constitutional rights and responsibilities** | 3 hours | Textbook, resources on child safety and protection |
| • Dealing with abuse in different contexts: between adults and children and between peers<br>- Identify threatening and risky situations<br>- Effects of abuse on personal and social health and relationships<br>- Importance of communication to promote healthy and non-violent relationships<br>- How to protect oneself from threatening and risky situations<br>- Places of protection and safety for victims of abuse: where to find help | | |
| **Physical Education** | 3 hours | Textbook, resources on indigenous and invasion games |
| • Plays community or indigenous games that include the concept of invasion<br>• Participation and movement performance in community or indigenous games that include the concept of invasion | | |
| **WEEKS 6 – 8** | | |
| **World of work** | 3 hours | Textbook, resources on careers and career guidance and counselling |
| • Career fields:<br>- Qualities relating to each field: interests and abilities<br>- School subjects related to each career field<br>- Work environment and activities in each career field<br>- Opportunities within each career field<br>- Challenges within each career field<br>- Level of schooling – requirements for each career field<br>- Duration of study for each career field<br>- Services and sources for career fields and study information | | |
| **Physical Education** | 3 hours | Textbook, resources on indigenous and invasion games |
| • Plays community or indigenous games that include the concept of invasion<br>• Participation and movement performance in community or indigenous games that include the concept of invasion | | |
| **WEEKS 9 – 10** | | |
| **EXAMINATIONS** | | |

| | |
|---|---|
| **Formal assessment:**<br>1. Mid-year examination<br>2. PET | It is compulsory to cover the given topics in the term indicated. The sequence of the topics within the term is however, not fixed. |

| TOPIC | TERM 3 | GRADE 7 |
|---|---|---|
| **WEEKS 1 – 4** | | **Recommended resources** |
| **Health, social and environmental responsibility** | 4 hours | Textbook, life skills books and health magazines |
| • Substance abuse:<br>- Types/ forms of substance abuse<br>- Symptoms of substance abuse<br>- Personal factors that contribute to substance abuse: intrapersonal and interpersonal<br>- Protective factors that reduce the likelihood of substance abuse<br>- Prevention measures: early detection | | |
| **Physical Education** | 4 hours | Textbook, resources on physical and movement activities |
| • Performs a sequence of physical activities including rotation, balance, elevation and rhythmic movements<br>• Safety issues relating to movement activities | | |
| **WEEKS 5 – 7** | | |
| **Health, social and environmental responsibility** | 3 hours | Textbook, newspaper articles; environmental health books |
| • Concept: environmental health<br>- Local environmental health problems<br>- Community and individual projects and strategies to prevent and deal with environmental health problems<br>- Problem-solving skills: an action plan to address an environmental health problem and formulate environmentally sound choices and actions | | |
| **Physical Education** | 3 hours | Textbook, resources on physical and movement activities |
| • Performs a sequence of physical activities including rotation, balance, elevation and rhythmic movements<br>• Participation and movement performance of sequence of physical activities including rotation, balance, elevation and rhythmic movements | | |
| **WEEKS 8 – 10** | | |
| **World of work** | 3 hours | Textbook, newspaper articles; resources on careers |
| • Simulation of career-related activities: name of career, who is the employer<br>- Dress code for the career<br>- Tools or working equipment for the career<br>- Activities related to work environment<br>- Place or institution of employment<br>- Personality characteristics<br>- School subjects and level of schooling: requirements for this career<br>- Where to study and duration of study<br>- Related careers<br>• Value and importance of work in fulfilling personal needs and potential | | |
| **Physical Education** | 3 hours | Textbook, resources on physical and movement activities |
| • Performs a sequence of physical activities including rotation, balance, elevation and rhythmic movements<br>• Participation and movement performance of sequence of physical activities including rotation, balance, elevation and rhythmic movements | | |

| | |
|---|---|
| **Formal assessment:**<br>1. Project<br>2. PET | It is compulsory to cover the given topics in the term indicated. The sequence of the topics within the term is however, not fixed. |

| TOPIC | TERM 4 | GRADE 7 |
|---|---|---|
| **WEEKS 1 – 2** | | **Recommended resources** |
| **Development of the self in society** | 2 hours | Textbook, nutrition and health magazines and brochures |
| • Concepts: personal diet and nutrition<br>- Factors that influence choice of personal diet: ecological, social, economic, cultural and political<br>- Ways to improve nutritional value of own personal diet: a plan for healthy eating habits | | |
| **Physical Education** | 2 hours | Textbook, resources on recreational activities |
| • Participation in an outdoor recreational programme<br>• Safety issues relating to outdoor recreational activities | | |
| **WEEKS 3 – 5** | | |
| **Health, social and environmental responsibility** | 3 hours | Textbook, health books, magazines and brochures |
| • Common diseases: tuberculosis, diabetes, epilepsy, obesity, anorexia, HIV and AIDS<br>- Causes of diseases: social, economic and environmental factors including use of alcohol and tobacco, poor eating habits and physical inactivity<br>- Treatment options, care and support<br>- Resources on health information and health services<br>- Strategies for living with tuberculosis, diabetes, epilepsy, HIV and AIDS | | |
| **Physical Education** | 3 hours | Textbook, resources on recreational activities |
| • Participation in an outdoor recreational programme<br>• Participation and movement performance in an outdoor recreational programme | | |
| **WEEK 6 – 7** | | |
| **Constitutional rights and responsibilities** | 2 hours | Textbook, resources on religions |
| • Role of oral traditions and scriptures in major religions in South Africa: Judaism, Christianity, Islam, Hinduism, Buddhism and African | | |
| **Physical Education** | 2 hours | Textbook, resources on recreational activities |
| • Participation in an outdoor recreational programme<br>• Participation and movement performance in an outdoor recreational programme | | |
| **WEEK 8 – 10** | | |
| **EXAMINATIONS** | | |

| | |
|---|---|
| **Formal assessment:**<br>1. End-of-year examination<br>2. PET | It is compulsory to cover the given topics in the term indicated. The sequence of the topics within the term is however, not fixed. |