Adapting Lesson Study towards a blended approach to support isolated teachers in teaching with technology

by

Jody Joubert

11028719

Submitted in partial fulfilment in accordance with the requirements for the degree of

MAGISTER EDUCATIONIS GENERAL

at the

UNIVERSITY OF PRETORIA

Supervisor: Prof Ronel Callaghan

Co-supervisor: Prof Gerrit Stols

October 2019

Declaration

I, Jody Joubert, declare that the dissertation/thesis, titled: **Adapting Lesson Study towards a blended approach to support isolated teachers in teaching with technology**, which I hereby submit for the degree MEd General at the University of Pretoria, is my own work and has not previously been submitted by myself for a degree at this, or any other, tertiary institution.

Jody Joubert

October 2019

Ethical Clearance Certificate

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Education

RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE	CLEARANCE NUMBER:	**UP 14/03/03 Callaghan 18-002**
DEGREE AND PROJECT	MEd	
	Adapting lesson study towards a blended approach to support isolated teachers in teaching with technology	
INVESTIGATOR	Mr Jody Joubert	
DEPARTMENT	Science, Mathematics and Technology Education	
APPROVAL TO COMMENCE STUDY	16 August 2018	
DATE OF CLEARANCE CERTIFICATE	09 September 2019	

CHAIRPERSON OF ETHICS COMMITTEE: Prof Liesel Ebersöhn

_____

CC
Ms Bronwynne Swarts
Prof Ronel Callaghan
Prof Gerrit Stols

This Ethics Clearance Certificate should be read in conjunction with the Integrated Declaration Form (D08) which specifies details regarding:
- Compliance with approved research protocol,
- No significant changes,
- Informed consent/assent,
- Adverse experience or undue risk,
- Registered title, and
- Data storage requirements.

Ethics Statement

![University of Pretoria logo - UNIVERSITEIT VAN PRETORIA, UNIVERSITY OF PRETORIA, YUNIBESITHI YA PRETORIA] Faculty of Education

Copyright declaration

I hereby certify that, where appropriate, I have obtained and attached hereto a written permission statement from the owner(s) of each third-party copyrighted matter to be included in my thesis, dissertation, or project report ("the work"), allowing distribution as specified below. I certify that the version of the work I submitted is the same as that which was approved by my examiners and that all the changes to the document, as requested by the examiners, have been effected. I hereby assign, transfer and make over to the University my rights of copyright in the work to the extent that it has not already been effected in terms of a contract I entered into at registration. I understand that all rights with regard to copyright in the work vest in the University who has the right to reproduce, distribute and/or publish the work in any manner it may deem fit.

Kopieregverklaring

Hiermee sertifiseer ek dat, waar toepaslik, die skriftelike toestemming verkry is van elke derdeparty wat die eienaar is van materiaal wat aan outeursreg onderhewig is en wat ingesluit is in my proefskrif, verhandeling of projekverslag ("die werk"), waardeur verspreiding op die wyse hieronder gemeld, ook toegelaat word. Ek sertifiseer dat die weergawe van die werk wat deur my ingedien is, dieselfde is as dié wat deur my eksaminatore goedgekeur is en dat alle veranderinge soos deur hulle versoek, aangebring is. Ek dra en maak hiermee my outeursregte in die werk aan die Universiteit oor insoverre dit nie reeds ingevolge 'n kontrak by registrasie deur my gedoen is nie. Ek begryp dat alle regte met betrekking tot outeursreg van die werk dus by die Universiteit berus en dat die Universiteit die reg voorbehou om na goeddunke die werk te reproduseer, versprei en/of publiseer.

....

SIGNATURE/HANDTEKENING   DATE/DATUM

Acknowledgements

Completing this dissertation, although not easy, has been a joyous journey. Along the way, I was supported by so many people. I appreciate the contributions made to this journey by the entire department. Those who offered advice, knowledge, expertise and enouncement and those who stuck around to listen to me mumble on about the tasks ahead.

I would like to thank my supervision team for their absolute dedication to me as a student and to the study. I strongly believe that you gave me academic freedom through expert guidance to complete this journey and do so smiling. Your support and compassion encouraged and sustained me in this journey.

My loving and supportive parents. You are the reason that I know how to persevere and work hard at everything I do. Thank you.

Above all, I thank the Great Almighty for the guidance and love without which this immense opportunity would have been fruitless.

I thank you.

Abstract

Lesson Study (LS) is a trusted format for teachers to work in communities of practice (COP). The process is a cyclic repetition of collaborative planning, teaching, observation of lessons, group reflections and lesson refinement. The problem arising from this practice is the isolation caused when teachers are not in the vicinity of those who can work with them in their subject field, phase and context. Teachers are also increasingly expected to incorporate the use of technology in their teaching, an addition that often poses a challenge. This study sought to determine the challenges that teachers face in their teaching practice with technology. The study investigated an adaptation of the LS process towards a blended approach that can support and address the challenges related to teaching with technology. The study further sought to determine the aspects that needed to be included in the LS process to assist isolated teachers in teaching with technology. The study delivers an adaptation of LS for a blended environment to support teachers in teaching with technology. This serves as a model for teachers who wish to work in COPs but are isolated from those who can partake in these processes.

Language Editor
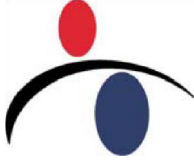
Member South African Translators' Institute

P.O. Box 3172
Lyttelton South
0176
https://www.language-services.biz
21 October 2019

TO WHOM IT MAY CONCERN

This is to confirm that the thesis titled "Adapting Lesson Study towards a blended approach to support isolated teachers in teaching with technology" by Jody Joubert has been proof read and edited by me for language usage.

I verify that it is ready for publication and / or public viewing in respect of language and style.

Please note that no view is expressed in respect of the subject specific technical contents of the document or changes made after the date of this letter.

Kind regards

Anna M de Wet

BA (Afrikaans, English, Classical Languages) (Cum Laude), University of Pretoria.
BA Hons ((Latin) (Cum Laude), University of Pretoria.
BA Hons (Psychology) University of Pretoria.

List of Abbreviations

CoP	Community(ies) of practice
ICT	Information Communication Technologies
LS	Lesson Study
PCK	Pedagogical Content Knowledge
TIP	Technology Integration Planning
TPACK	Technological Pedagogical and Content Knowledge

List of terms

Blended	A combination of face-to-face and online interaction
Isolated teachers	Teachers who are separated from their peers in terms of geographic location or field of expertise
Lesson Study	A cyclic collaborative process of planning teaching, observing reflecting on lessons and revising the lesson plan.
Technology	Any educational technology including but not limited to devices, internet, Virtual Reality, Augmented reality and mobile applications.
Technology integration	Using technology like computers, smartphones and tables in teaching and learning

Table of Contents

Table of Figures

Table of Tables

1. Chapter 1: Introduction and Orientation

1.1. Introduction

The educational realm has experienced an infusion of technology in recent years (Grant, 2019). Increasingly smarter, more accessible and innovative devices are making their ways into classrooms at a rate that could never before have been anticipated. In light of this, computer integrated education as a research field has seen growing interest in all levels of the education sector (Herselman, Botha, Mayindi, & Reid, 2018). Teachers can now also find and share resources that they have created for free consumption in classrooms all over the world (Hooks, 2015). This has led to the researcher's interest to understand how the sharing and collaboration of teachers could be supported through the use of trusted planning strategies like Lesson Study (LS). More especially so in the case where teachers are not close together. LS refers to a process where teachers work collaboratively to plan, teach and reflect on lessons to improve their collaborative teaching practice (Takahashi, 2014). The cyclic process of LS, typically consists of the phases plan, teach and reflect (Takahashi, 2014), with some also including the reteaching of lessons (Benedict, Park, Brownell, Lauterbach, & Kiely, 2013)

The research focusses on an investigation to find an adaptation of LS to a blended approach that supports isolated teachers in teaching with technology that will be shared.

Figure 1.1 shows the chapter overview of this chapter.
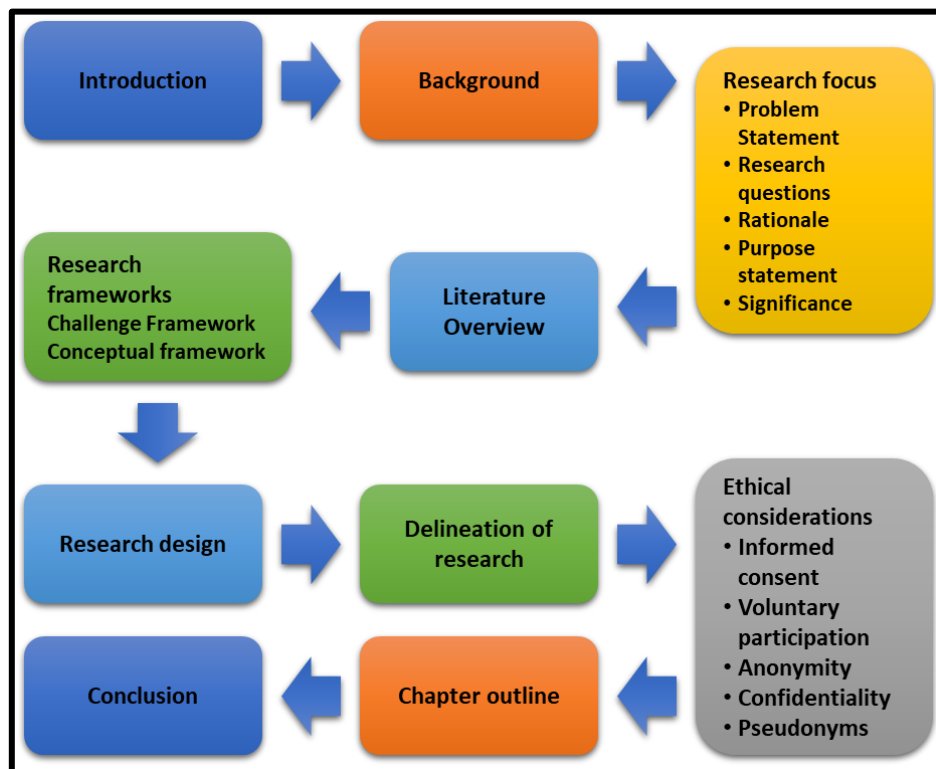
Figure 1. 1: Chapter 1 - Outline

1.2.   Background

In 2017, a course was presented to train teachers from all over South Africa as well as Botswana in the use of technology in teaching. The course was sponsored by a mobile technologies company ("the company").

The course, "e-Learning for the 21st Century Facilitator" was designed and presented by the University of Pretoria. The course content focussed on the use of the company's devices, using mobile technologies (especially mobile apps on tablets) in education and applying mobile learning strategies in education. The purpose of this course was to develop teachers' knowledge and skills in the use and integration of mobile technology in their teaching. The course was presented in a blended mode where participants would attend a three-day face-to-face session, followed by a two-month online session.

The attendees (52 in total) of the blended learning course all came from schools where the company had already deployed their technology or would do so after the course. The attendees were from schools in all nine provinces of South Africa as well as Botswana. The 52 attendees were mostly teachers. Those who were not teachers

(approximately 20%) were school administrators, strategic planners and school principals.

The blended learning course had teachers working together in a LS format to plan, present and perfect lessons that can be taught using the technology available to them. The teachers completed two LS cycles and made use of a proposed lesson planning structure.

1.3. Research focus

1.3.1. Problem statement

The problem that this study investigates is threefold. Teachers are required to use technology in teaching; the teachers also desire support on how to teach with technology, and professional development and other interventions pose a challenge to teachers.

Due to the spotlight being cast on the use of technology in classrooms as Herselman, Botha, Dlamini, Marais, and Mahwai (2019) states, there is a growing expectation for teachers to use technology as a part of their teaching practice. In South Africa, the literature makes it clear that policies like the Department of Basic Education's White paper on e-education (published in 2004) and the National Development Plan has increased this expectation (Herselman et al., 2019).

Teaching in general poses many challenges to teachers; however, teaching with technology creates challenges of its own. The most obvious is teaching with technology in resource constraint areas. Some authors (Elkaseh, Wong, & Fung, 2015; Herselman et al., 2019; Hossain, Salam, Shilpi, & Officer, 2016) highlight that teachers' anxiety and attitudes towards the use of technology in teaching pose a challenge to the expectations raised in Callaghan (2018) goes further to say that the rapid development of technology makes it difficult for educators to stay up to date with the technology and therefore, many may struggle with technology integration in their teaching.

In an attempt to address the challenges faced in terms of teaching with technology, teacher professional development is needed (Callaghan, 2018; Herselman et al., 2018; Ravhuhali, Kotare, Mutshaeni, Mokhele, & Maluleke, 2017). In South Africa, this need has been recognised, and many initiatives have been launched to address the need, mostly on a provincial level (Ravhuhali et al., 2017). Teacher professional

development, however, is expensive, takes time away from teachers doing their work and requires teachers to travel great distances to partake in programmes (Botha & Herselman, 2015; Elliott, 2017; Qasem & Viswanathappa, 2016; Xiaofeng, Qi, & Ling, 2015). These factors are exacerbated by teachers being isolated.

Isolated teachers can be defined as those who wish to partake in teacher professional development but cannot do so due to being unable to afford attending due to the cost related to the time to attend and distance to travel to teacher professional development. These teachers are further isolated from each other as subject specialists.

1.3.2. Research questions

How can Lesson Study be adapted to support isolated teachers for teaching with technology?

a. Which challenges do teachers experience when teaching with technology?
b. Which aspects should be incorporated into the Lesson Study process to support isolated teachers in teaching with technology?

1.3.3. Rationale

Addressing the research questions, as stated above, to attend to the problems stated in 1.3.1, can provide insight into teacher professional development (TPD) that can support isolated teachers in teaching with technology.

This research can, therefore, be beneficial to those who plan TPD interventions, in that they will be able to understand better the challenges that isolated teachers in South Africa face. Teachers could then benefit from TPD that supports them wherever they are, as the aspects that need to be included in the TPD will be understood. Along with the teachers' gains, the successful implementation of ICT in teaching and all who gain from it can benefit (Ahmad, Abubakar, & Dabo, 2013).

Addressing TPD in this manner, therefore, can diminish the challenges posed by earlier approaches to TPD such as cost, time and travel constraints. This can be done by accessing the benefits of the online or blended environment, as also indicated in other cases (Elliott, 2017; Xiaofeng et al., 2015).

In exploring this new realm of TPD, this research aims to inform practices of teacher development as well as LS practices.

1.3.4. Purpose statement

The primary purpose of this study was to develop an adaptation of the LS process that can support isolated teachers in teaching with technology, while acknowledging the challenges faced by teachers in the South African setting. This research aims to investigate the following:

1. The challenges that isolated teachers face in a LS environment when teaching with technology.
2. Aspects that need to be included in the LS process to create an approach that supports isolated teachers in teaching with technology.
3. An adaptation of the LS process to a blended approach that combines the knowledge obtained from the challenges and required aspects.

Ultimately, the outcomes mentioned above can inform a blended approach to LS that supports isolated teachers in teaching with technology.

1.4. Overview of Literature Review

The literature review contained in Chapter 2 of this dissertation was done using a systematic literature review process. This method is explained extensively in Section 2.2 of Chapter 2.

As part of the systematic literature review, Harzing's Publish or Perish (a graphic user interface for Google Scholar searches) was used to source and organise the items to be used in the literature review. This software is available from https://harzing.com/.

The literature review first looked at addressing the sub-research questions before moving on to address the literature that speaks to the main research question.

The review firstly focussed on the challenges that teachers face, and especially so when teaching with technology. The result was a broad range of challenges. Upon deeper investigation, the challenges were categorised, resulting in the Challenge Framework discussed in the next section.

Secondly, the review investigated which aspects need to be incorporated into the LS process when teaching with technology. The focus was placed on lesson planning. Researchers have engaged in research to determine the aspects that need to be incorporated when planning to teach, as well as planning to teach with technology. In the review, it was found that even though the processes are vastly different, both

contain valuable insight into the aspects needed to support teachers in planning for and teaching with technology. These included aspects like the backward design process and the Technological, Pedagogical and Content Knowledge (TPACK) framework.

The review furthermore explored the nuances within LS and the processes proposed by different researchers and practitioners. A five-step LS process was subsequently accepted for use in this research. This process follows the cyclic process of Plan, Teach, Observe, Reflect and Refine.

1.5. Research frameworks

In the literature review, two research frameworks were unearthed. The first is the Challenge Framework, a combination of various literature sources of the challenges that teachers face and their effect on teaching with technology. Secondly, the literature review delivered a Conceptual Framework that forms the basis of the understanding that certain aspects need to be present when teaching with technology in a blended LS environment.

1.5.1. Challenge Framework

The literature review explored the challenges faced by a teacher when teaching with technology. This delivered the Challenge Framework shown in Figure 1.2 below, as discussed in Section 2.3.
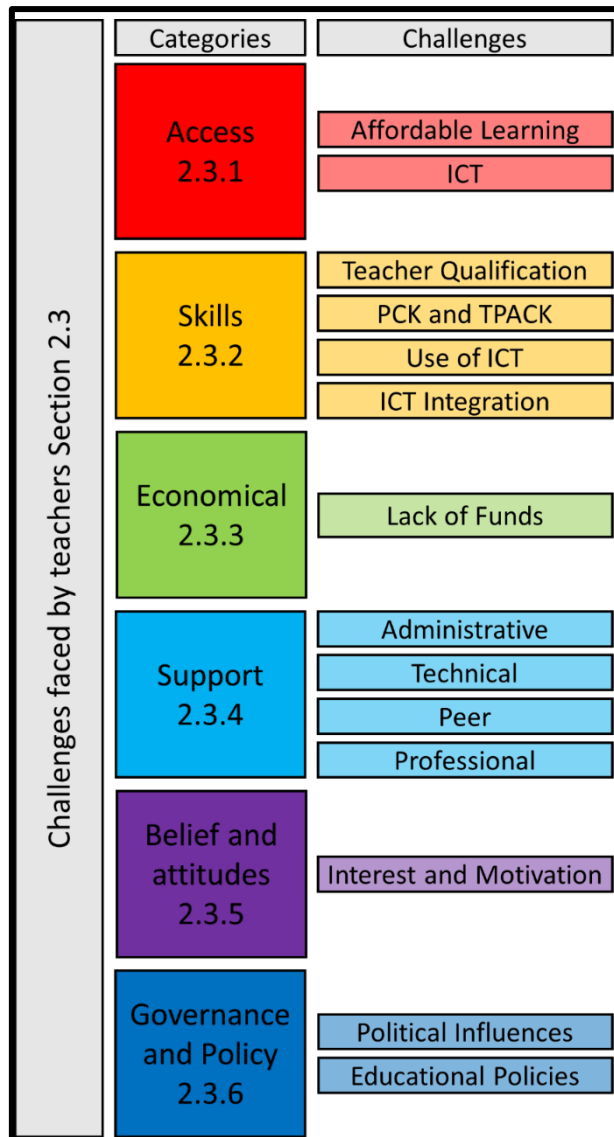
Figure 1. 2: Challenge Framework
Source: Researcher

This framework provided the necessary background needed to further explore the challenges faced by teachers in a LS setting when teaching with technology.

1.5.2. Conceptual Framework

In exploring the literature, the Technology Integration Planning (TIP) model was found to be an effortless connection to the LS process when focussing on aspects that need to be incorporated into the LS process when teaching with technology. Figure 1.3 below indicates the TIP model and the product of combining the TIP model and the LS process as they are laid out in Section 2.6 and 2.7. The TIP model is a planning process suggested by Roblyer and Doering (2014) that assists teachers in integrating their choice of technology based solutions in their teaching.
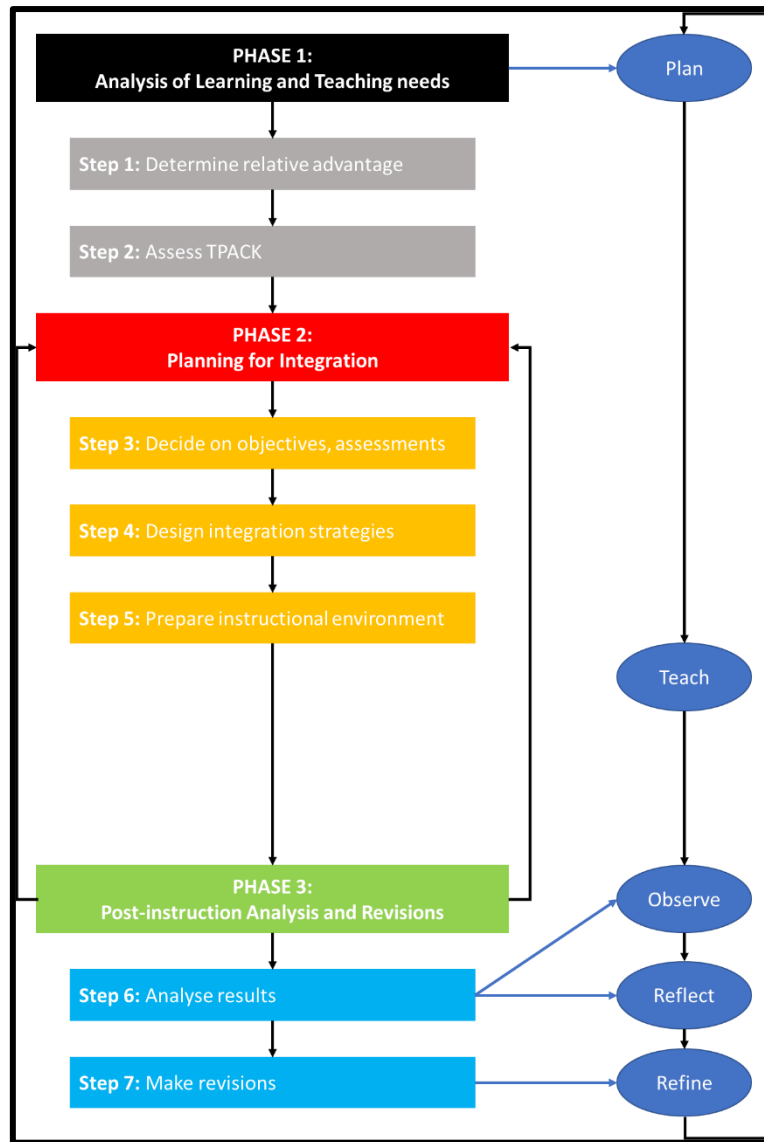
Figure 1. 3: Conceptual Framework
Source: Researcher

The combination of these two processes paved the way to investigate the aspects that need to be incorporated into the LS process to support isolated teachers in teaching with technology.

1.6.   Research design

The research design used for this study is described, as based on the Research Onion proposed by Saunders, Lewis, and Thornhill (2016). This model assists researchers in making design decisions from the more abstract philosophical choices to the more practical data collection and analysis decisions. Figure 1.4 summarises the decisions that were made for this study.
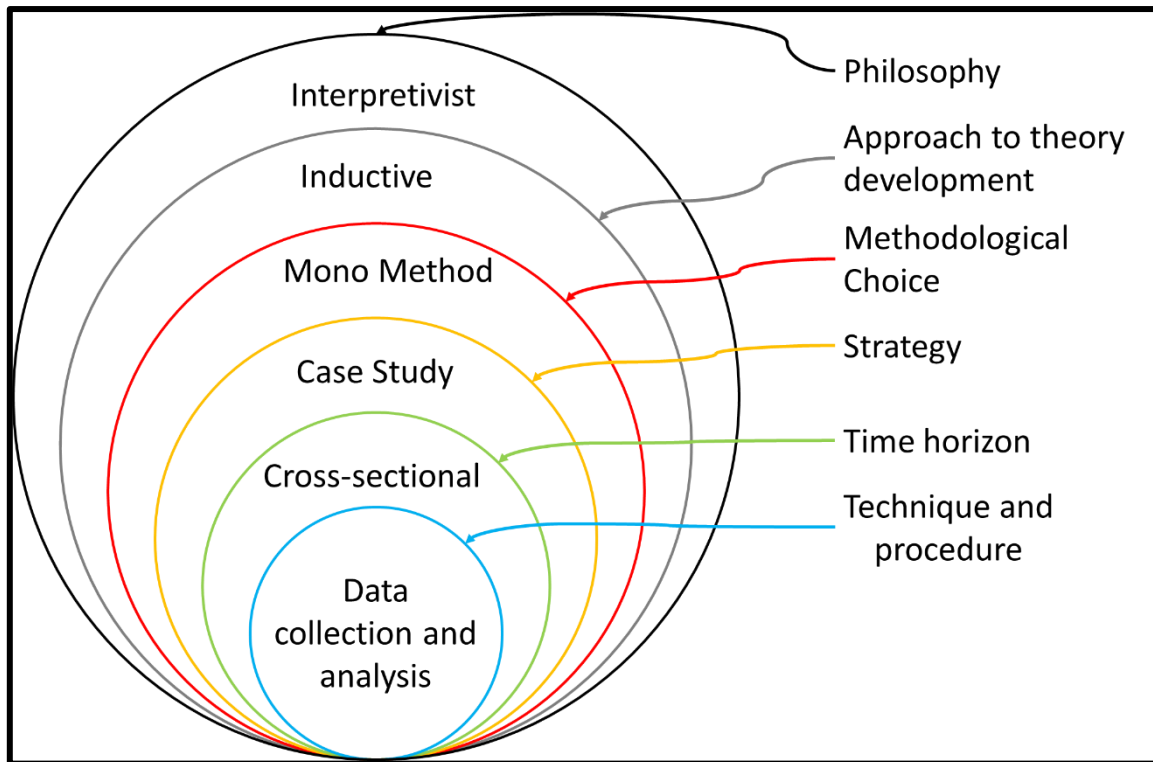
Figure 1. 4: Research Onion - Research Design

1.7. Delineation of research

Traditional applications of LS usually focus on mathematics and science (Takahashi, 2014). In this research, teachers from different subjects, including mathematics and science, were working together in LS.

Some LS cycles include a phase dedicated to reteaching what was planned and refined (Lucenario, Yangco, Punzalan, & Espinosa, 2016). The LS process chosen for this study did not include a reteach phase.

All participants were introduced to the technology before the blended learning course commenced. Although the participants were all at different levels of expertise in terms of their ability to use technology, they were not completely unfamiliar with the use of technology.

1.8. Ethical considerations

In this study, ethical consideration was made in terms of informed consent, voluntary participation, anonymity, confidentiality and pseudonyms. Throughout this study, the University of Pretoria's ethical guidelines were followed. These considerations, explained in detail in Section 3.13, are briefly presented below.

1.8.1. Informed consent

During the course, the consent process was explained to the participants as well as the various aspects that would be covered by the consent. Consent letters were given to the participants whereafter consent was granted by all of the participants (Morris, 2005).

1.8.2. Voluntary participation

Participants were reminded of the fact that research would be done on their contributions during the course, and that they were not obliged to continue their participation in the research but could withdraw at any stage (Hogan, 2008).

1.8.3. Anonymity and confidentiality

In the study, the group names and the names of participants who took part in the study were changed and replaced with pseudonyms (explained in 1.8.5). This assured that participants would remain anonymous for dissemination purposes (Ogden, 2008a). The data sources were thoroughly scrutinised to assure that participants' personal information, names and any other identifying information were removed. Seeing that no other personal information was needed for this study, the rest was omitted completely (Morris, 2005).

1.8.4. Pseudonyms

Pseudonyms add to the participants' anonymity and confidentiality in as far as they cannot be identified and remain private. All participants were given a pseudonym based on their group number. The group numbers were further changed into alphabetical characters. This allowed for the participants' confidentiality to remain in place while keeping the data in such a state that it could easily be traced back to its origin by the researcher (Ogden, 2008b).

1.9. Dissertation outline

This dissertation consists of seven chapters. Figure 1.5 below illustrates the outline of the chapters.
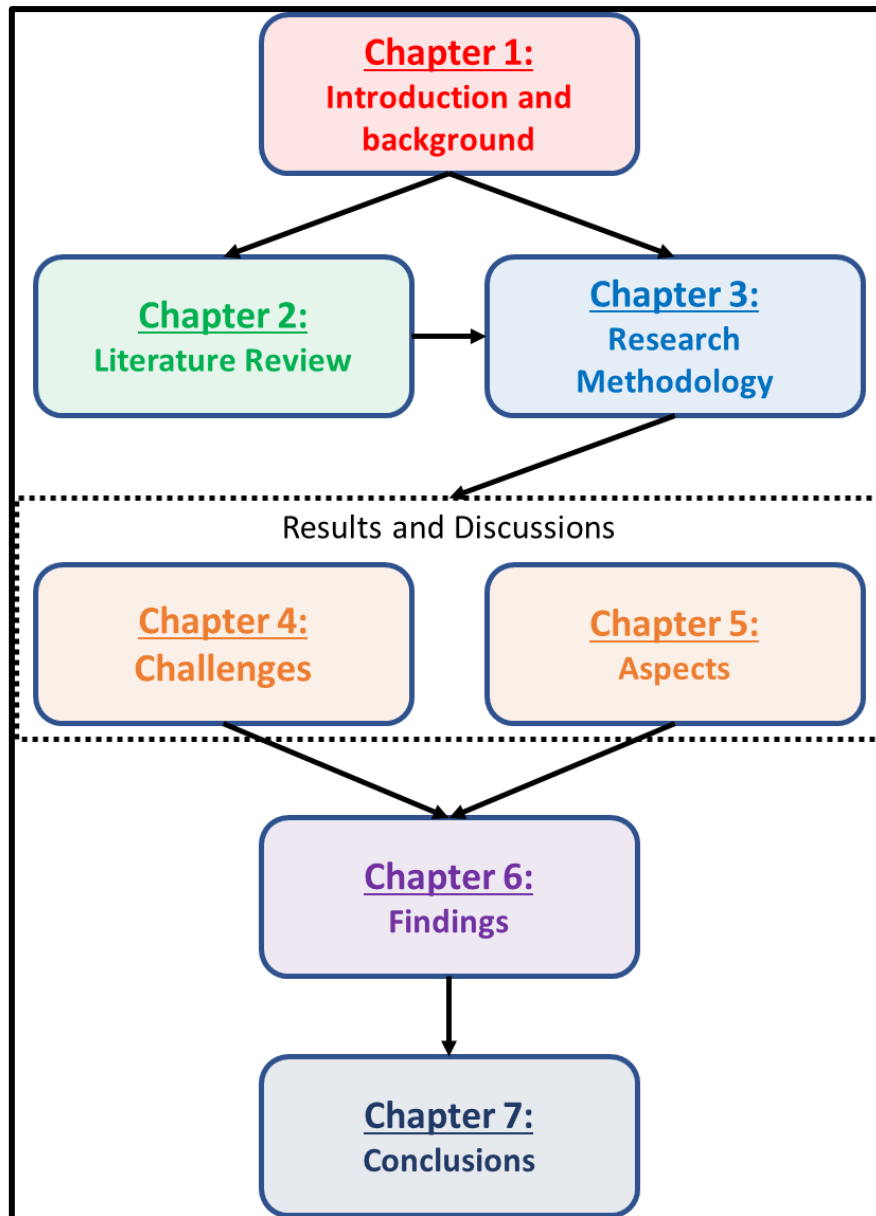
Figure 1. 5: Dissertation Outline

Chapter 1 aims to introduce the study and provide the background to the research that was done. The chapter sheds light on the reasoning for the chosen research to be done.

Chapter 2 contains the synthesis of the literature reviewed using the systematic literature process. The review shows essential information gathered from journal articles obtained using Harzing's Publish or Perish. The review is structured in terms of the sequential searches that were done based on the research questions.

Chapter 3 explains the methodological decisions that were made based on the Research Onion model. The chapter serves as a blueprint for the research that was completed for this study.

Chapters 4 and **5** deal with the results and findings of the two sub-research questions, respectively. These chapters follow the Challenge Framework and the Conceptual Framework as organisational bases for the results. In both chapters, the conclusion offers an amended framework for consideration in this context.

Chapter 6 integrates the findings made in Chapters 4 and 5 to address the main research question. In this chapter, the findings from Chapters 4 and 5 are synthesized on a higher level to gain the necessary insight to address the main research question. The chapter concludes with a framework that combined the amended frameworks from Chapter 4 and 5.

Chapter 7 contains the conclusive remarks made in terms of the research questions and conclusions. This chapter serves as the denouement to this dissertation, bringing together all the discussions made.

1.10. Conclusion

This chapter aimed to introduce the research conducted and provide a broad overview of the study. The chapter contains the essential research focus that informed the literature review, methodological decisions, data collection and analysis choices that was made to deliver this report. The next chapter will focus on the literature review that was conducted using a systematic literature review process. The chapter also outlines the two research frameworks that were derived from the literature review.

2. Chapter 2: Literature Review

2.1. Introduction

Now that the study had been introduced, the researcher can address the relevant literature that speaks to this study. In this chapter, the literature review will be delivered. The literature review was done though a systematic literature review approach. The review is broken up into three parts each focussing on a different research question.
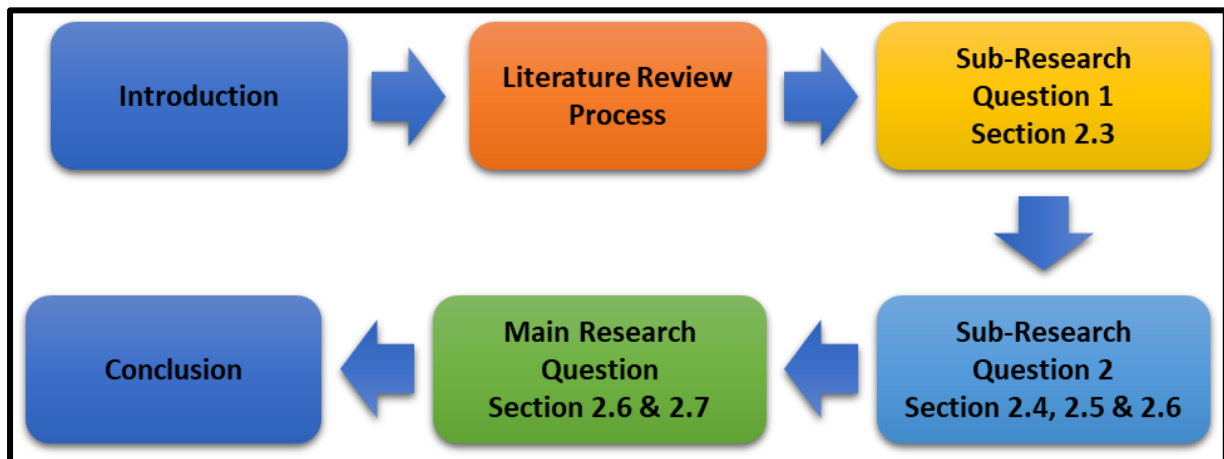
Figure 2. 1: Chapter 2 - Outline

2.2. Literature review process

The process followed to do this literature review contains elements of systematic and structured literature review. The aim was to avoid producing a passive summary of the literature collected.

Jesson, Matheson and Lacey (2011) propose a systematic literature review that consists of six phases as set out in the diagram below. Figure 2.2 illustrates the six phases that a systematic literature review could consist of, and how they lead to writing a literature review. Some key points, explained below, are also annotated in the figure.
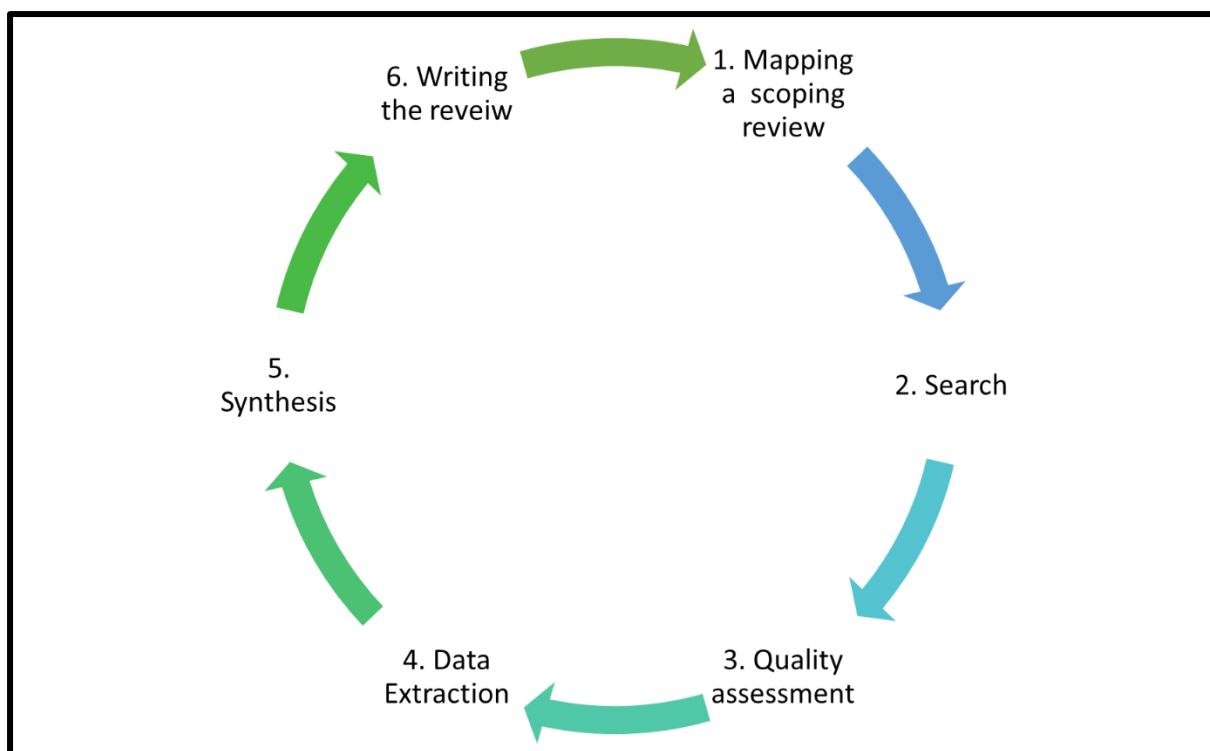
Figure 2. 2. Systematic literature review process
Source: Jesson et al. (2011)

The first phase that Jesson et al. (2011) proposes *Mapping a scoping review*, entails the researcher's planning of the systematic approach. Here, the researcher looks at what is known in the specific field and which gaps exist. This phase also expects the researcher to set out a protocol for the selection of content for the systematic literature review. Phase two, *Search*, requires the researcher to access electronic databases, search for and document relevant resources in terms of the study (Jesson et al., 2011). The third phase, *Quality assessment*, requires the researcher to read through the documents obtained and to decide whether or not the documents will be included in the literature review (Jesson et al., 2011). The researcher should be able to justify the choices based on the protocol set out in phase one. The fourth phase, *Data extraction*, requires the researcher to extract the data into an existing data sheet to summarise the data into a useful format (Jesson et al., 2011). Phase five, *Synthesis*, is where the researcher makes meaning of the data extracted during phase four. The data sheets are now combined into one single set of information to be used for the write-up (Phase 6) of the process.

Structured literature review refers to the organisation of literature in a way that is sensible to the reader. This structure can be derived from various sources such as the timeline of development (Woodwell, 2014), or the research question at hand (Serra, 2015).

This literature review will be structured according to the research questions proposed in Chapter One and the topics contained within them. Further, this review will answer the questions of what is known, who supports this knowledge, who contradicts this knowledge and what gap exists that can be filled by this research. To answer these questions, the data sheet referred to in paragraph 2.2.1 will be set up in such a way as to answer these questions.

The combination of these two literature review methods produced a literature review process (illustrated in Table 2.1) that the researcher used to formulate this literature review. Table 2.1 shows the five-phase process that the literature review followed. A discussion of each phase follows.

Table 2. 1: Combined literature review process

Phase 1:	Mapping a scoping review
Phase 2:	Harzing's search
Phase 3:	Assessment of relevance and quality
Phase 4:	Compiling of information
Phase 5:	Synthesis
Phase 6:	Write-up

Phase 1: Mapping a scoping review

The scoping review (Phase 1) for this study was determined using the Research questions set out in Chapter One. This was done by identifying the terms found in the research questions in various combinations to search electronic databases during Phase 2.

Terms from the research questions were identified to use for electronic database searches. Various combinations were formulated to search for full text journal articles available and accessible to the researcher in PDF format.

Figure 2.3 depicts how phase 2 and 3 will be conducted so that the data gathered can be used for the review. The figure also shows the software used during these phases.
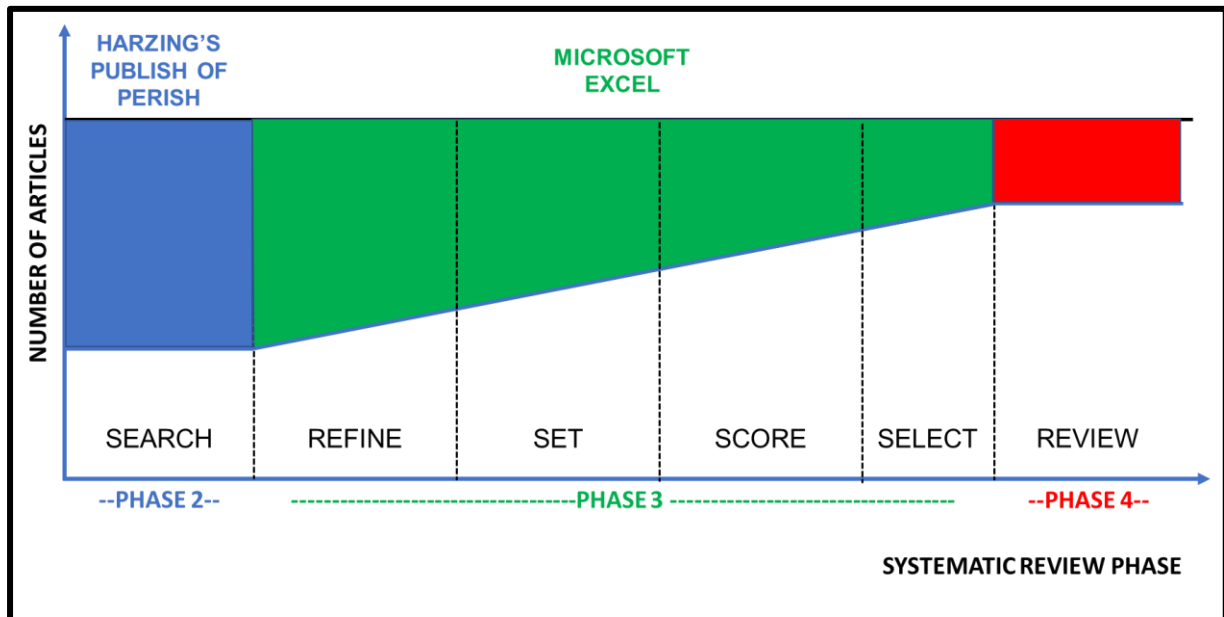
Figure 2. 3: Phase 2 and 3 of the Literature review
Source: Researcher

Phase 2: Harzing's Search

In the diagram above, phase 2, indicated in blue, is the initialisation of a computer aided part of this literature review. Here, a search is done through a computer programme known as Harzing's Publish or Perish (Harzing's). Harzing's searches the Google Scholar database for journal articles containing the search terms as set out during phase 1. The results are then captured by the programme and documented by the researcher using Microsoft Excel (Excel). Figure 2.3 shows how the data is captured in Excel. Note the annotations, outlined in red, made for record keeping of the search that has been done.
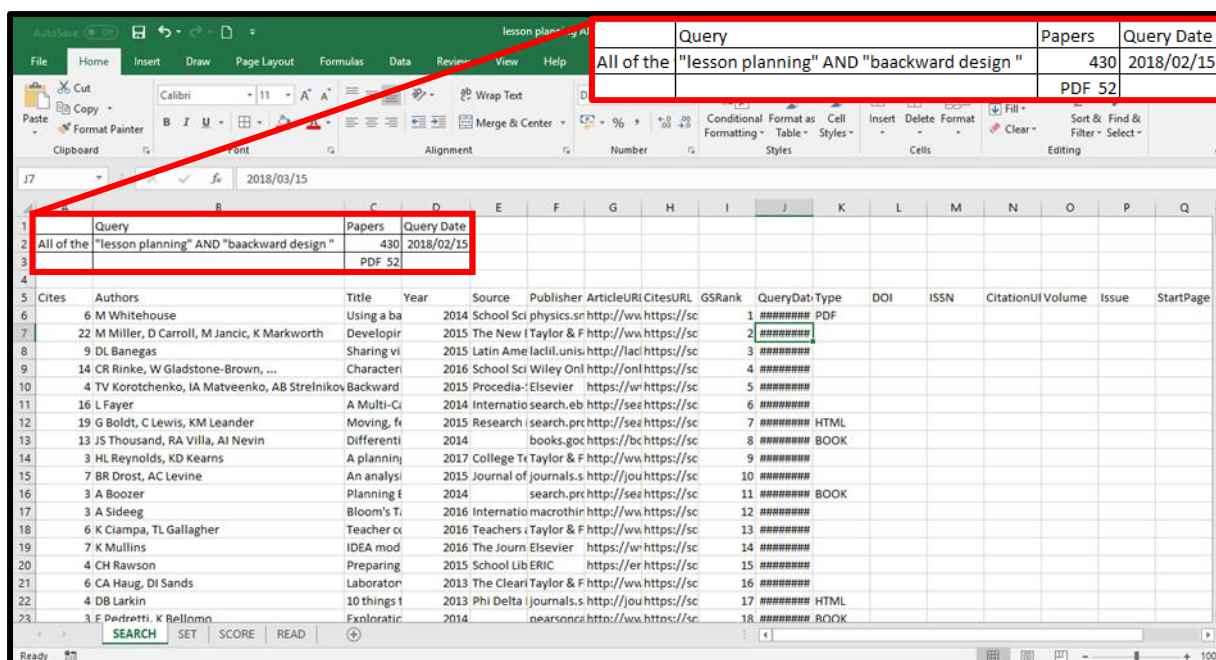
Figure 2. 4: Screenshot of Harzing's search results captured in Excel
Source: Researcher

Phase 3: Assessment of relevance and quality

Phase 3, indicated in green in Figure 2.3, consists of four steps. The table below outlines these steps with the task performed by the researcher during the steps and the annotations made in the Excel spreadsheet.

Table 2. 2: Steps followed for assessment of relevance and quality.

Step	Activity	Annotations in Spread Sheet
1. Refine	The resources found by the Harzing's search, are refined to the following attributes. a. PDF format b. English language c. No missing information	Contains all the search information including Search date Date range of the search Search Phrase Number of items retrieved
2. Set	The refined "set" of journal articles is allocated to a new spread sheet.	Indication is made of how many sources meet the requirements
3. Score	The titles contained in the search data are scored in terms of the presence of the search terms or the presence of other relevant terms identified during the examination of the titles.	Score columns are added to the set Scores are attributed Sources are ranked in terms of score
4. Select	The most relevant titles are chosen after briefly reading the most applicable articles. These documents are marked and indicated in the set.	Relevant documents are marked for inclusion in the literature review

The score (referred to in step 3 above) was developed after the set of articles was defined. The titles of the articles in the set were scrutinised for key terms that defined their content (for example 'technology'). Once a term was identified, all the texts were

17

gone through and a 1 (meaning the term is in the title) or a 0 (meaning the term is not in the title) was assigned to the text. Once all the terms that exist in the set of titles were scored, a total was determined as the sum of all the ones. Titles were then sorted by their score in descending order and the most relevant titles could be chosen.

In the literature review in Sections 2.3 to 2.6, the results from phase 2 and 3 are showed in tables. Table 2.3 is an example of how the resources found during the search were assessed, refined and selected for the review.

Phase 4: Compiling of information

The compiling of information was based on the questions below as part of the structured literature review. The information was indicated on a data sheets as it is shown in Figure 2.4.

1. What is known?
2. Who supports this knowledge?
3. Who contradicts this knowledge?

Author	What is known	SUPPORTED BY	COUNTERED BY	COMMENT
(Christmas 2014)	Teachers find it important to separate the "what" from the "how" of what they are teaching	(Desta, Chalchisa et al. 2013) By addressing PCK, teacher capacity can be improved.		PCK
(Desta, Chalchisa et al. 2013)	Teachers are expected to employ interactive teaching methods help students learn better			Interactive teaching methods
	Lack of knowledge and experience on the theoretical underpinnings, implementation inconsistencies, lack of uniformity in implementation, confusion and redundancy;			Lack of pedagogical knowledge
	Lack of budget to run the program at school level	(Hossain, Salam et al. 2016) lack of infrastructural development (Kamau 2014) funding of ICT implementation		Money
	Lack of interest, initiative and	(Kiragu, King'oina et al. 2013)		Will to teach and change into

Figure 2. 5: Example of a data sheet used for the literature review
Source: Researcher

Phase 5: Synthesis

The researcher internalised the information and wrote it up in the literature review. The researcher combined the data sheets from the sources selected, and then made meaning of the information by collating the sources.

Phase 6: Write up

To adhere to the aim of the literature review stated above, the review is not written as a summary of the literature. Rather, it is written as an internalised representation of the knowledge gathered during the review.

2.3. Challenges faced by teachers

The first research question stated in Section 1.3.2 reads as follows:

SQ1:

Which **challenges** do **teachers** experience when **teaching with technology**?

The question was used to determine search terms that could be used for the search in Harzing's search tool. Table 2.3 and Table 2.4 summarise the findings of the search and how the systematic process was used to derive certain sources to include in the literature review. The review of these sources follows the after the tables.

Table 2. 3: Harzing's search for Challenges and Teachers

Scope: Search Phrase	"Challenges" AND "Teachers"	
Search: Number of items found	998	
Refined set: Number of articles that are in PDF format and in English	142	
Score: Main recurring phrase	Challenges	116
	Teachers	55
	ICT	8
	Professional development	7
	Technology	5
	e-learning	3
	Mobile learning	3
	TPACK	1
Selection: Number of articles read for this section	24	
Write up: Number of articles cited in the write up	13	

Table 2. 4: Harzing's Challenges, Teaching and Technology integration

Scope: Search Phrase	"Challenges" AND "Teaching" AND "Technology Integration"	
Search: Number of items found	998	
Refined set: Number of articles that are in pdf format and in English	142	
Score: Main recurring phrase	ICT	37
	Teaching	33
	Technology integration	13
	TPACK	13
	Challenges	11
	Teaching and learning	11
Selection: Number of articles read for this section	23	
Write up: Number of articles cited in the write-up	10	

During the review of literature pertaining to the challenges faced by teachers, six overall categories were found. These categories of challenges are access, skills, economical, support, beliefs and attitudes and governance and policy. This corresponds to the approach followed by Mehdipour and Zerehkafi (2013), where they found categories of challenges that teachers face.

The six themes identified in the literature are unpacked in the sections that follow. In these discussions, the challenges will be defined, explained, and possible solutions will be provided where possible.

2.3.1. Access

Access is defined as the availability of the amount and type of resources that are required by teachers and learners (Nkula & Krauss, 2014). Access challenges contained two sub-challenges, namely, access to affordable learning and access to information communication technology (ICT).

Access to affordable learning

Osang, Ngole and Tsuma (2013), in a study done in Nigeria, point out that there is a lack of access to affordable learning opportunities. They emphasise that affordable schooling cannot be provided in a sustainable manner (Osang et al., 2013). Access to a quality schooling environment is not available to many learners in developing countries. Mandoga, Matswetu and Mshishi (2013) state that the location of a school can be a determining factor to the access of schooling. Whether the school is in a rural or urban setting, in a developed or developing country can make the difference. In

response to the lack of access to affordable learning, many countries have opted for the implementation of measures such as e-learning (Saeed & Samani, 2014), m-learning (Osang et al., 2013) and distance education.

Access to ICT

Despite the innovation brought by solutions like e-learning, mobile learning and distance learning, some authors list insufficient access to ICT as a challenge that inhibits the integration of ICT into education (Afshari, Bakar, Luan, Samah, & Fooi, 2014; Hossain et al., 2016; Mandoga et al., 2013; Mehdipour & Zerehkafi, 2013; Nkula & Krauss, 2014). This includes resources like adequate technological infrastructure (Elkaseh et al., 2015), electricity (Mingaine, 2013a), ICT equipment like computers (Ahmad et al., 2013; Ang'ondi, 2013) and software (Ang'ondi, 2013). Changes in technology can also be an issue leading to outdated and low-quality technological devices, rendering them unavailable to use (Ang'ondi, 2013). These challenges can be attributed to the lack of awareness of the digital divide (Tondeur, Forkosh-Baruch, Prestridge, Albion, & Edirisinghe, 2016).

2.3.2. Skills

Skills refer to the knowledge (Cakir & Yildirim, 2013; Nkula & Krauss, 2014) and abilities (Nkula & Krauss, 2014) that teachers have at their disposal to use in their teaching.

Skills challenges in the literature consist of four unique challenges. Firstly, many studies identified a lack of trained teachers as a challenge in education (Christmas, 2014; Desta, Chalchisa, & Lemma, 2013; Hossain et al., 2016; Koh, Chai, & Tsai, 2014; Mandoga et al., 2013; Mingaine, 2013b; Osang et al., 2013). Secondly, teachers' skills to integrate pedagogical knowledge with content knowledge (Christmas, 2014; Desta et al., 2013), and more so in the integration of technology (Koh et al., 2014; Koh & Divaharan, 2013) seems challenging. This is mainly due to a challenge faced in not having the necessary skills to use ICT (Ahmad et al., 2013; Ang'ondi, 2013; Elkaseh et al., 2015). Further, the integration of technology in education poses a challenge to teachers (Ahmad et al., 2013; Elkaseh et al., 2015; Kamau, 2014; Koh et al., 2014; Koh & Divaharan, 2013).

Teacher qualification is seen as a significant challenge in the literature. Some authors (Mandoga et al., 2013; Osang et al., 2013) argue that many teachers are unqualified to teach. A shortage of qualified teachers can be seen as a prevalent issue in sub-Saharan Africa (De Clercq, 2013; Desta et al., 2013; Osang et al., 2013), which can be blamed on the lack of training opportunities that are available to teachers (Hossain et al., 2016).

Teachers who are unqualified to teach, are prevalent in all the subjects, but it is especially the case in teaching with ICT (Mandoga et al., 2013). This means that the teachers themselves are unable to use ICT (Mingaine, 2013b) and therefore struggle to implement its use in their teaching.

Although higher education institutions play a key role in training teachers with specialist skills to maintain themselves in the current classroom environment (Hammett & Phillips, 2014), some teachers are still under-qualified or not qualified at all (Mandoga et al., 2013). For this reason, effective in-service training programs could be put in place as a measure of intervention (Afshari et al., 2014). These training programmes should be aimed at improving teachers' professional knowledge (De Clercq, 2013), to assure effective teachers who can share in decision making and school management (Kiragu, King'oina, & Migosi, 2013).

PCK and TPACK

It has been identified that some teachers lack the pedagogical knowledge (PK) to implement teaching and learning theories, leading to a lack of clear implementation of instruction and learner confusion (Desta et al., 2013). Pedagogical Content Knowledge (PCK) is the combination of a teacher's pedagogical knowledge (PK) and content knowledge (CK). This combination means that a teacher should know what to teach (CK) and how to teach it (PK) (Christmas, 2014). Although teachers find it important to distinguish between CK and PK, they do not necessarily have the skills to do so (Christmas (2014). By enabling teachers to apply PCK, teachers' range of teaching can increase (Desta et al., 2013).

During the integration of ICT into teaching, PCK is combined with the technological aspect of teaching and is changed into Technological Pedagogical and Content Knowledge (TPACK). It is important to address, through teacher training and teacher professional development, the need for ICT integration training (Kamau, 2014) and for

training to adapt to include technological knowledge (TK) in lesson design (Koh et al., 2014; Koh & Divaharan, 2013). Only by doing this can the integration of Technological Knowledge (TK), Pedagogical Knowledge (PK) and content knowledge (CK) be integrated into education. Teachers' technological knowledge (TK) lack due to the fact that they are not aware of what ICT can bring to their teaching (Ahmad et al., 2013). This is explained in further detail in Section 2.4.1.

Use of ICT

Many authors have attributed this lack of awareness (Ahmad et al., 2013) to teachers' inability to use technology (Ahmad et al., 2013; Ang'ondi, 2013; Elkaseh et al., 2015), or do not use technology (Koh & Divaharan, 2013; Nkula & Krauss, 2014; Tondeur et al., 2016). It has been found that some teachers do not have the competence to use ICT and computers (Afshari et al., 2014; Ang'ondi, 2013; Cakir & Yildirim, 2013), while others are not computer literate (Ahmad et al., 2013). For others, not using technology is a result of a lack of confidence (Koh & Divaharan, 2013), willingness (Nkula & Krauss, 2014) and proficiency (Tondeur et al., 2016)

The skills of teachers to use ICT, both their personal and professional capacity (Ahmad et al., 2013), is integral to the integration of technology into teaching (Ang'ondi, 2013; Cakir & Yildirim, 2013). Training teachers to develop these skills will increase the chances of them using the technology in their classrooms (Ahmad et al., 2013; Elkaseh et al., 2015; Nkula & Krauss, 2014)

ICT integration

Teachers further lack the skill to integrate ICT into their teaching (Koh et al., 2014). Nkula and Krauss (2014) define ICT integration as teaching in an environment where ICT plays a key role in the learning processes. The challenge teachers face in integrating ICT into their teaching is threefold. Teachers find it difficult to integrate ICT (Koh et al., 2014), they do not fully use the technology at their disposal (Koh et al., 2014; Mandoga et al., 2013), and lack exposure to the technologies (Mingaine, 2013b). Although these reasons for lack of integration are interlinked, it is important to know that the lack of exposure to ICT during teacher training is a discernible challenge to the integration of ICT in education (Mingaine, 2013b).

To assist teachers in the integration of ICT in their classrooms, they need to be empowered to teach with ICT by being able to make informed decisions in terms of their use of ICT (Tondeur et al., 2016). To empower teachers, trainers need to model the use of ICT, allow teachers to work hands-on with the technology and use technology in their teaching practice (Koh et al., 2014).

A need for professional development has been identified as a challenge that teachers face (Kamau, 2014; Nkula & Krauss, 2014). Further, the implementation of professional development programmes has been found to focus on issues that are not directly related to the issues faced by teachers (Desta et al., 2013). Teacher professional development (TPD) contributes to the skills that teachers can present in their profession (Kamau, 2014). TPD is linked with the quality of work they produce (Desta et al., 2013) and is a way in which teachers can be brought up to date with the quality standards expected from them (Christmas, 2014; De Clercq, 2013; Desta et al., 2013). This means that without proper professional development intervention, focussing on the needs of teachers and addressing their real issues, teachers are unable to keep up with the demands of education. Tondeur et al. (2016) refer to this type of intervention as authentic professional development.

2.3.3. Economic challenges

Economic challenges include a financial shortage (Ang'ondi, 2013) for infrastructure development (Hossain et al., 2016), professional development of teachers (Desta et al., 2013) as well as the acquisition of teaching and learning materials like ICT to use in schooling (Kamau, 2014).

Lack of Funds

A shortage of infrastructural development hinders learners to be able to have access to quality education (Osang et al., 2013). Solutions to more affordable teaching by means of e-learning, mobile learning and distance education have been devised, but the acquisition of ICT like computers and mobile devices is expensive (Mandoga et al., 2013). With this also comes the challenge to fund the integration of ICT in everyday teaching (Kamau, 2014), by providing access to ICT infrastructure that is at an acceptable level (Afshari et al., 2014; Mingaine, 2013a). Once technologies are acquired, a further challenge is maintaining infrastructure (Mandoga et al., 2013), and supplying bandwidth to keep the devices on a dependable internet network (Mehdipour & Zerehkafi, 2013; Osang et al., 2013).

2.3.4. Support

Definition

Support refers to the proper guidance that teachers require in completing certain tasks (Ang'ondi, 2013). The literature categorises four types of support that teachers need namely, administrative support (Ang'ondi, 2013; Desta et al., 2013), technical support (Ang'ondi, 2013; Nkula & Krauss, 2014), professional support and peer support (Cakir & Yildirim, 2013). For this study, therefore, support would entail the assistance that teachers need in the four categories stated above.

Table 2.5 links these types of support with their meaning and the challenge that teachers face in terms of the support type.

Table 2. 5: Support challenges faced by teachers.

Type of support	Meaning	Challenge faced by teachers
Administrative support	Teachers are assisted by superiors such as school management, principals and heads of departments etc.	Teachers face the challenge of having to work long hours (Desta et al., 2013; Kiragu et al., 2013) without incentive for putting in the effort to teach at the best of their ability (Desta et al., 2013). Furthermore, there are issues with unsupportive school management (Afshari et al., 2014; Hossain et al., 2016) structures and principles (Ang'ondi, 2013; Mingaine, 2013a)
Technical support	Teachers are supported by an expert in the use of technologies.	Teachers require external support from experts to support them in the use of technology in their classrooms (Afshari et al., 2014; Osang et al., 2013). This assistance is needed due to the difference in devices (Mehdipour & Zerehkafi, 2013) and the teachers' inexperience (Ang'ondi, 2013; Nkula & Krauss, 2014).
Professional support	Professionals like education specialists assist the teachers to be better at their profession.	Hammett and Phillips (2014) state that specialists higher education institutions should assist in training teachers to integrate ICT into their teaching. To assure quality, teachers should have support in terms of materials like toolkits created by experts (Desta et al., 2013).
Peer support	Teachers support each other in matters where they have superior experience, knowledge or skills.	It has been found that there is a strain on ICT teachers to support other teachers in integrating technology (Cakir & Yildirim, 2013).

Teachers further need support from parents and the community to manage schools and to aid in joint decision making (Kiragu et al., 2013). This means that parents have to be empowered to support the teachers in managing a school (Kiragu et al., 2013).

Support in technology integration
Teachers who are obliged to work with technology face technical challenges pertaining to the devices they use for instruction (Mehdipour & Zerehkafi, 2013; Osang et al., 2013). These challenges include different device types in their classes, device limitations, file compatibility and learner safety and security (Mehdipour & Zerehkafi, 2013). Some older teachers require support to address their familiarity with ICT and the need to use in their classes (Koh et al., 2014).

Teachers should be supported administratively, technically, professionally, and by their peers to address the challenges they face (Nkula & Krauss, 2014). Further supporting teachers by showing them that the use of ICT can lead to the achievement of their instructional goals, will make teachers more willing to use ICT in their classes (Koh et al., 2014).

2.3.5. Beliefs and attitudes
Teachers' beliefs are important in the integration of technology into teaching (Ang'ondi, 2013). It entails the motivation (Ang'ondi, 2013), interests, initiative, commitment (Desta et al., 2013) willingness (Cakir & Yildirim, 2013; Nkula & Krauss, 2014) and conformance to the expectations of the occupation they are in (De Clercq, 2013).

Teacher interest and motivation
Teacher interest and motivation, in general, is a challenge that the literature reveals (Osang et al., 2013). Some teachers, especially those who have been teaching for a long time, lack the will to remain lifelong learners and become better teachers (Desta et al., 2013; Kiragu et al., 2013). Contrary, some teachers are challenged their over eagerness about education and expect results too quickly (Desta et al., 2013).

The integration of ICT is a challenge to teachers who do not believe that the use of ICT is beneficial to their teaching goals (Ahmad et al., 2013; Koh et al., 2014). Some teachers lack the interest to be the best teachers they can be (Hossain et al., 2016). A lack of parent and community support for teachers (Afshari et al., 2014) and learner attitudes, further hinder technology integration (Elkaseh et al., 2015).

Teachers should be motivated to change and conform to the expectations of the system (Ang'ondi, 2013). This motivation can be obtained through training and thereby cultivating a positive attitude amongst teachers (Ahmad et al., 2013) and bringing an understanding among teachers that ICT integration is beneficial to them (Ang'ondi, 2013).

2.3.6. Governance and policy

Many levels of governance apply to schools. This includes the political structures of a country (De Clercq, 2013; Kamau, 2014), school management structures (Kiragu et al., 2013), and school principles (Ang'ondi, 2013; Mingaine, 2013a).

Governance

Political influences can create great challenges in teaching. Influences like policies that create racially stratified educational systems as seen in countries like Kenya (Kamau, 2014) and South Africa (De Clercq, 2013) have challenged teachers and learners within the respective educational systems. Some teachers are challenged by their school heads' unsupportiveness (Ang'ondi, 2013) and that they are sometimes in the way of progress (Mingaine, 2013a).

Policy

Teachers are challenged by educational policies and curricula that expect them to make use of certain educational methods, such as interactive teaching (Desta et al., 2013), and teaching with ICT (Koh et al., 2014). There is a lack of curriculum development that integrates ICT and its use into teaching (Elkaseh et al., 2015). Curriculum and policy should also be transformed to enable learners to acquire the skills they need to perform in a technological world (Wilson & Boateng, 2014).

To address the challenges of governance and policy, educational change can be driven by the government (Wilson & Boateng, 2014). Tondeur et al. (2016) however warn that for government to be able to make decisions in terms of technology integration policy, stakeholders who share in a collective vision should be consulted before the policy's implementation is made compulsory.

2.3.7. Summary: Challenge Framework

From the review of the challenges that teachers face when teaching with technology, six main themes were identified. These themes include access, skills, economic, support, beliefs and attitudes and governance and policy. Figure 2.6 below, shows the Challenge Framework. This framework shows the six themes identified in the review

with their respective subthemes. The sections in which the themes were discussed, are also indicated in this figure.

Figure 2. 6: Summary of Challenges Faced by teachers
Source: Researcher

The Challenge Framework will serve as a reference point in the data collection and analysis phases of this study.

2.4. Planning for teaching

The second research question stated in Section 1.3.2 reads as follows:

> **SQ2:**
>
> Which aspects should be incorporated into the Lesson Study process to support isolated teachers in teaching with technology?

Although the question was used to determine search terms that the researcher could use during the Harzing's search, the results were not ideal. Experimenting with different search phrases (including *lesson planning*) it was found that many researchers have endeavoured to find aspects that should be incorporated into planning and teaching under this term. It is for this reason that this section will focus on lesson planning while Section 2.5 will focus on the review of literature related to LS.

Table 2.6 summarises the findings of the search for journal articles related to "lesson planning" and how the systematic process was used to derive certain sources to include in the literature review. The review of these sources follows the table.

Table 2. 6: Harzing's search for lesson planning

Scope: Search Phrase	"Lesson Planning"	
Search: Number of items found	999	
Refined set: Number of articles that are in PDF format and in English	134	
Score: Main recurring phrase	Professional development	12
	Lesson planning	11
	Lesson Study	10
	Professional learning	4
	Technology integration	3
	TPACK	1
Selection: Number of articles read for this section	34	
Write up: Number of articles cited in the write up	19	

Lesson planning is a fundamental part of the professional practice of teachers. Uhrmacher, Conrad and Moroye (2013) describe lesson planning as a meaningful experience for teachers that comes as an after-effect for learners.

2.4.1. Lesson planning process

The processes for lesson planning proposed in the literature differ greatly. The most elaborate of these processes is proposed by Fürstenberg and Kletzenbauer (2015) and consists of an eight-step lesson planning process.

Figure 2.7 compares the stages of lesson planning processes by Fürstenberg and Kletzenbauer (2015); Estes, McDuffie, and Tate (2014) and Krulatz (2014).
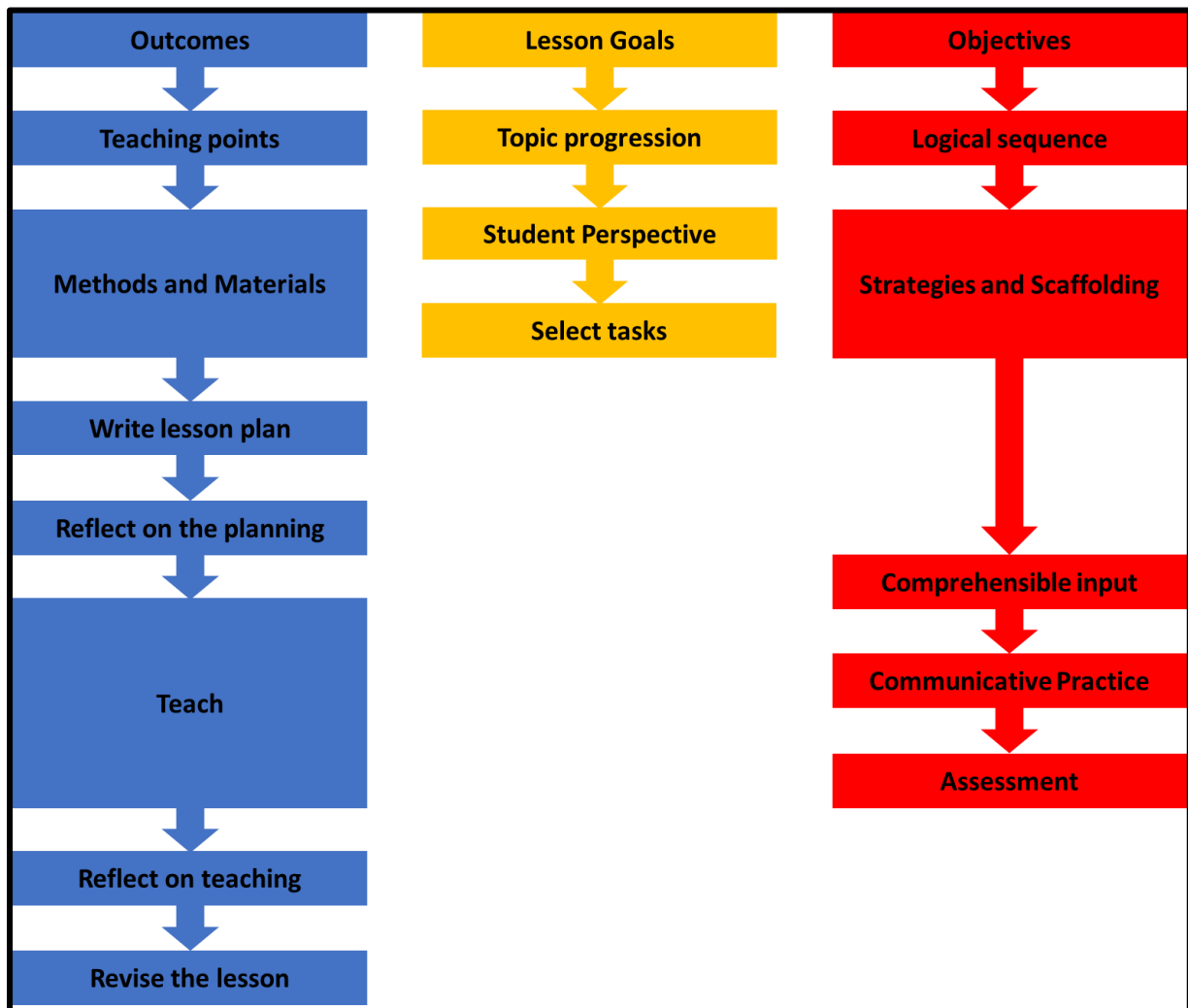
Figure 2. 7: Comparison of lesson planning processes
Sources: Fürstenberg and Kletzenbauer (2015), Estes et al. (2014) and Krulatz (2014)

The following is a discussion of the lesson planning processes. The steps have been derived from the above-illustrated processes.

Aims/Goals/outcomes/objectives

Many authors (Estes et al., 2014; Fürstenberg & Kletzenbauer, 2015; Krulatz, 2014) state that the planning of a lesson should start with the careful selection of lesson outcome goals (Estes et al., 2014), aims (Fürstenberg & Kletzenbauer, 2015) or objectives (Krulatz, 2014) that are explicitly specific (Krulatz, 2014).

Teaching points

The teacher now needs to consider the 'teaching points' for their lesson (Fürstenberg & Kletzenbauer, 2015). Teaching points are small, well-structured activities aimed at accomplishing the aims set for the lesson (Fürstenberg & Kletzenbauer, 2015). These teaching points should follow a logical sequence (Krulatz, 2014) to ensure the progression of the topic (Estes et al., 2014).

Methods and materials

Next, teachers should find teaching materials (Hammonds, Matherson, Wilson, & Wright, 2013; Hooks, 2015) which are up-to-date and relevant (Hooks, 2015). These resources can be collected and negotiated (Shúilleabháin, 2013) collaboratively between teachers using online bookmarking tools such as Pinterest (Hooks, 2015) or Diigo (Hammonds et al., 2013; Hooks, 2015; Xiaofeng et al., 2015). Tools like these can also be used to manage and share resources amongst teachers.

Teachers also need to consider the methods they will employ in their teaching. Teachers should consider learner-centred methods that support learners (Estes et al., 2014; Krulatz, 2014) to assure learner achievement (Estes et al., 2014; Jones, Stall, & Yarbrough, 2013), and should tailor their methods to the learners' abilities (Schraudner, 2014). Further, assessment should be built in continuously throughout the lesson (Krulatz, 2014).

The mobile learning course requested participants to make use of mobile learning strategies. Mobile learning strategies involve the use of mobile technologies like smartphones, tablets, laptops and other mobile electronic devices in education (Callaghan, 2018; Grant, 2019). Further, it involves the use of the internet and other e-resources (Sun, Liu, Luo, Wu, & Shi, 2017). Mobile learning strategies often involve the use of modular classroom activities (Sun et al., 2017) that include a variety of learning centred teaching strategies combined with handpicked technological materials to support teaching (Grant, 2019).

Write down the lesson plan (planning forms)

Out of the three processes in Figure 2.7, Fürstenberg and Kletzenbauer (2015) are the only ones to suggest that the next step is to write down a lesson plan. This means writing down the fundamental decisions that have been made. The teachers can capture their lesson plan in one of two ways (Naresh, 2013). The teacher can choose to follow a detailed, structured lesson plan, or capture their lesson plan as a brief informal running order or flow chart.

Lesson plans can be written up in detailed structures (Naresh, 2013) that emerge as different components of lesson planning that are combined within certain contexts (Seyyedrezae, 2014). A relatively simple structure, proposed by Naresh (2013) is illustrated in Table 2.7. Here, the teachers link the instructional task they want learners to complete with the possible responses that the learners may have to the tasks. Teachers also consider that they will adjust their teaching to the responses.

Table 2. 7: Planning format proposed by Naresh (2013)

Plan of approach/ teacher action	Tasks/ Anticipated response

Following such a structure can be time-consuming for teachers who are unfamiliar with the format at first (Estes et al., 2014; Xiaofeng et al., 2015). With time, however, teachers will see that some elements (like the lesson goals and methods) apply to wider parts of their teaching and that they can be repeated in the structure (Estes et al., 2014).

Reflect on the planning

Once a teacher has captured their lesson plan, they must reflect on the effectiveness of the plan. Using information from their experience, teachers can guide their decisions and make the necessary improvements (Jones et al., 2013) before commencing with the teaching of the lesson.

Teach

When applying the lesson plan in teaching, learners should be given clear instruction as to what is expected of them (Krulatz, 2014). The teacher should also encourage learner participation in the lesson (Estes et al., 2014; Krulatz, 2014) and use techniques like scaffolding to support learner's achievement on a high level (Jones et al., 2013; Krulatz, 2014).

Reflect of the teaching

After teaching, teachers should reflect on the lesson they have presented. This reflection is an important part of a teacher's practice (Naresh, 2013) and should become a habit for teachers (Estes et al., 2014). During this reflection, teachers should think about the work their learners delivered as well as the learners' progress (Krulatz, 2014). Seyyedrezae (2014) states that lesson planning is dependent on feedback and that the information gained from reflection should be incorporated in future planning.

Revise the lesson plan

Reflection aims to find the needed improvements that need to be made to a lesson plan for it to be useful in future teaching (Souza, Lopes, & Pfannkuch, 2015). Teachers who adapt their lessons, use the information gathered during reflection to optimise their teaching (Schraudner, 2014; Seyyedrezae, 2014).

2.4.2. Planning to teach with technology

Sources that do not indicate specific lesson planning processes, outline two important considerations to be made during planning. These are Pedagogical Content Knowledge (PCK) and Technological Pedagogical and Content Knowledge (TPACK). These two aspects brought up in the review of literature related to challenges (Section 2.3.2), were are quite relevant as planning sees teachers implementing different teaching strategies (Estes et al., 2014; Fürstenberg & Kletzenbauer, 2015; Krulatz, 2014) and resources (that can include digital resources) (Fürstenberg & Kletzenbauer, 2015).

PCK
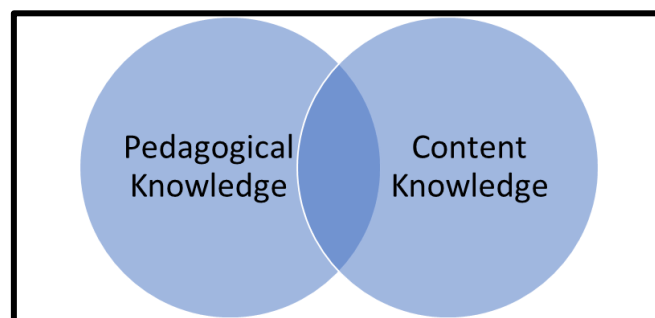
Figure 2. 8: Pedagogical Content Knowledge
Source: Ndongfack (2015), originally Gudmundsdottir and Shulman (1987)

PCK briefly mentioned in Section 2.3.2 has been identified as a crucial part of lesson planning. This model, depicted in Figure 2.8, combines the pedagogical knowledge (PK), or how to teach, and content knowledge (CK), or what to teach of a teacher together in the planning of lessons (Ndongfack, 2015). The intersection of these two

knowledge fields creates the opportunity for teachers to consciously link certain content with appropriate teaching methods.

Figure 2.9 shows the inclusion of technological knowledge into PCK, that resulted in the development of the TPACK model illustrated by Koehler and Mishra (2009).
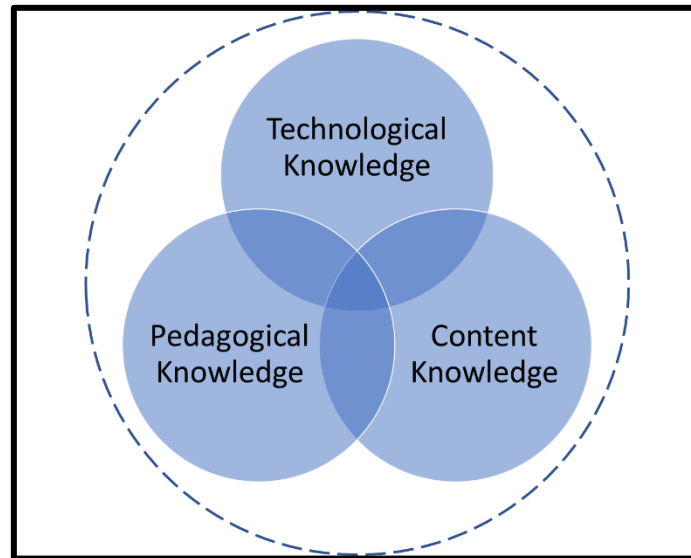
Figure 2. 9: Technological and Pedagogical Content Knowledge
Source: Koehler and Mishra (2009)

With the introduction of technology, however, three new areas need to be considered when planning to teach with technology. These are technological pedagogical knowledge (TPK), technological content knowledge (TCK) (Ndongfack, 2015) and Technological, Pedagogical and Content Knowledge (TPACK). TPACK is, therefore, the combination of what to teach, how to teach and which technology supports both the how and what of teaching.

Table 2.8 below illustrates the four intersections of the TPACK model with the considerations one needs to make in each of these intersections.

Table 2. 8: TPACK considerations

Intersection	Considerations
PCK	PCK plays an integral role in the capacity of teachers (Desta et al., 2013) to distinguish between the what and how of teaching (Christmas, 2014)
TPK	The considerations teachers make for TPK requires them to find a teaching strategy that aligns with the technological devices they have available (Cakir & Yildirim, 2013).
TCK	To consider TCK, teachers need to align the content they teach with the required technology that will support the teaching of that content. This is due to having an understanding of how the subject matter taught can be influenced by applying different technologies (Koehler, Mishra, & Cain, 2013).
TPACK	Cakir and Yildirim (2013) state that for teachers to be successful in the integration of technology in their teaching, they need to be able to combine their knowledge of technology, pedagogy, and content (TPACK). Using strategies that allow teachers to foster the use of technology in their teaching would allow teachers to solve real issues (Koh & Divaharan, 2013) and guide good teaching and learning (Hammett & Phillips, 2014)

The processes of lesson planning proposed above resembles the backward design process as they all start with determining an outcome and moving towards planning for teaching.

2.4.3. Backward Design

The backward design is an instructional design process that was introduced by Wiggins and McTighe (2005). The aim of the process is to give teachers the tools they need to purposefully analyse the tasks they create for their instructional practice (Wiggins & McTighe, 2005).
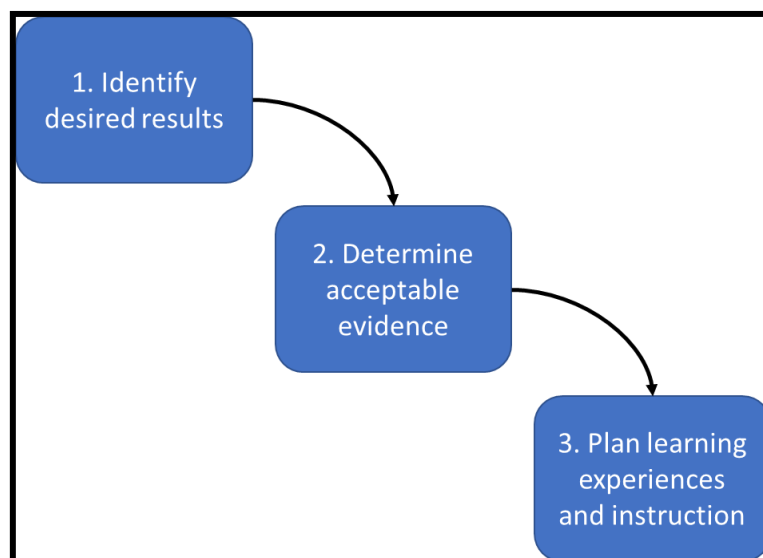
Figure 2. 10: Backward Design
Source: Wiggins and McTighe (2005)

Identify desired results

As with many other lesson planning processes (Estes et al., 2014; Fürstenberg & Kletzenbauer, 2015; Krulatz, 2014) the backward design process also starts with determining the outcomes that one wishes to reach through teaching. During this step, teachers must consider the goal that they want to reach with their teaching in terms of the context they find themselves in (Wiggins & McTighe, 2005).

Determine acceptable evidence

After carefully determining the outcome of the teaching, the teacher needs to consider how they will provide evidence of learning (Wiggins & McTighe, 2005). Wiggins and McTighe (2005) accentuate that this evidence consists of a range of formal and informal assessment that is done throughout the process of reaching the outcome. This reiterates that an assessment should be done throughout the teaching process (Krulatz, 2014).

Plan learning experiences and instruction

When the outcome has been determined and the teacher has put the appropriate assessment instruments in place, the teacher needs to design the teaching of the lesson (Wiggins & McTighe, 2005). This step fits in with the lesson planning processes, mentioned in Section 2.4.1, where methods, such as scaffolding, learner-centeredness, and materials are considered (Estes et al., 2014; Fürstenberg & Kletzenbauer, 2015; Krulatz, 2014).

Wiggins and McTighe (2005) advise that teachers should consider the following questions:

1. *What knowledge and skills do the learners need?*
2. *What activities will equip the learners with the required knowledge and skills?*
3. *What would have to be taught and how should it be taught in the light of the outcome?*
4. *What materials are needed for teaching?*

2.4.4. Teacher Collaboration

Throughout the literature, teacher collaboration (Hammonds et al., 2013; Hooks, 2015) and peer support (Cakir & Yildirim, 2013) play a big role in the successes that are required from teachers. Teacher communities of practice (CoPs) can be a source of such collaboration and support (Shúilleabháin, 2013). By creating these communities, teachers can collaboratively look at their professional and pedagogical practice

(Shúilleabháin, 2013) as teachers develop their skills and knowledge together (Xiaofeng et al., 2015).

Xiaofeng et al. (2015) define collaborative lesson planning as: *"Collaborative lesson planning refers to the joint efforts of teachers in planning for their lessons in scheduled meetings."* (Xiaofeng et al. (2015)

The use of this collaborative strategy supports the collaborative fabrication of knowledge (Hammonds et al., 2013; Hooks, 2015; Xiaofeng et al., 2015), peer instruction and support (Cakir & Yildirim, 2013; Jones et al., 2013; Xiaofeng et al., 2015) and reduces the isolation of teachers from each other (Xiaofeng et al., 2015).

Teacher communities of practice have features that make them beneficial to teachers. COPs encourage mutual engagements by all the teachers that give teachers a sense of inclusion (Jones et al., 2013; Shúilleabháin, 2013). Teachers are part of a collaborative endeavour where they can share their passion (Shúilleabháin, 2013), experience, knowledge and skills (Cakir & Yildirim, 2013). These communities bring together a collection of resources from different people from which selections can be made to be selected from (Hammonds et al., 2013; Hooks, 2015; Shúilleabháin, 2013). In these CoPs, different teaching and assessment strategies can be debated and put to the trial for teachers to include in their teaching (Xiaofeng et al., 2015). Teacher CoPs are ongoing and intensive processes of teacher development (Jones et al., 2013; Pella, 2015; Xiaofeng et al., 2015)

For teachers to work together in CoPs they all need to be available at the same time, in a central location. This, however, is difficult as teachers do not have a lot of shared meeting time (Xiaofeng et al., 2015) and are mostly unwilling to travel the distance between themselves (Wake, Foster, & Swan, 2013; Xiaofeng et al., 2015). Teachers are also heterogeneous in their goals, interests, subject areas (Xiaofeng et al., 2015) and cultures (Wake et al., 2013).

As a solution to some of these barriers, Xiaofeng et al. (2015) proposed the idea of an online community of practice. It is important to note that although online CoPs cannot completely replace the face-to-face interaction that teachers find beneficial, it has some benefits of its own. Table 2.9 below illustrates the benefits put forward by Xiaofeng et al. (2015) as well as other authors who support these benefits.

Benefit	Supporting authors
Allows individuals with the same interests and goals to collaborate.	(Jones et al., 2013)
Teachers can share resources online	(Hammonds et al., 2013; Hooks, 2015; Souza et al., 2015)
Teachers can develop working strategies	(Fürstenberg & Kletzenbauer, 2015; Krulatz, 2014)
Teachers can focus on learner achievement	(Jones et al., 2013; Schraudner, 2014)

Many authors (Kadroon & Inprasitha, 2013; Naresh, 2013; Shúilleabháin, 2013; Takahashi, 2014; Wake et al., 2013; Xiaofeng et al., 2015) propose Lesson Study (LS) as a form of Community of Practice and Collaborative lesson planning strategy. For this reason, LS was included as a Search phrase to use in Harzing's search tool. Section 2.5 unpacks the findings of the systematic process followed.

2.5. Lesson Study

Table 2.10 summarises the findings of the search and how the systematic process was used to derive certain sources to include in the literature review. The review of these sources follows after the table.

Table 2. 10: Harzing's Search for Lesson Study

Scope: Search Phrase	"Lesson Study"	
Search: Number of items found	999	
Refined set: Number of articles that are in PDF format and in English	104	
Score: Main recurring themes	Lesson study	31
	mathematics	23
	professional development	12
	Science	11
	Professional learning	7
	teacher education	4
Selection: Number of articles read for this section	27	
Write up: Number of articles cited in the write up	11	

Lesson Study (LS) has long been used as a form of professional development (Kadroon & Inprasitha, 2013; Susanto & Murwaningsih, 2015) and collaborative lesson planning strategy (Ndongfack, 2015). The idea originated amongst Japanese teachers as an informal, collaborative process of planning and perfecting their lesson plans

(Kadroon & Inprasitha, 2013). LS has since been formalised and is implemented in many contexts as a professional development tool for teachers and to improve learner performance (Alshwaikh & Adler, 2017).

Table 2.11 below shows the definitions of LS provided in the sourced material.

Table 2. 11: Definitions of Lesson Study

Chong, Abdullah, Chong, Widjaja and Shahrill (2017)	"Lesson Study is a form of teacher professional development that originated in Japan and has been cited as a key factor in the improvement of their Mathematics and Science education. Isoda defined Lesson Study as "an authentic activity for enabling teachers to conduct their classrooms. It includes discussions of subject matters, why they teach, how they teach and what students can learn." This accords to Lewis and colleague's call to engage in more research on "iterative cycles of improvement" in the field of Lesson Study research to avoid evaluating "an immature innovation without first doing all we can to improve it"
Stigler and Hiebert (2009)	"Another important benefit of the collaborative nature of Lesson Study is that it provides a benchmarking process for teachers to gauge their own skills. Collaboration includes continuing interactions about effective teaching methods plus observations of one another's classrooms."
Mee & Oyao (2013)	"The basic philosophy embedded in Lesson Study is the collaborative practice of teachers working together to plan, teach, observe, reflect and refine lessons."
Kadroon and Inprasitha (2013)	"Lesson Study refers to a major form of professional development and professional learning chosen by Japanese teachers, an approach to instructional development, and also provides a powerful mechanism for a system-wide improvement of education that has spread rapidly in North America and other countries."

Therefore, after considering the sources, the following definition of LS will be used for this study:

LS is a collaborative instructional development process (Kadroon & Inprasitha, 2013; Mee & Oyao, 2013; Stigler & Hiebert, 2009) that follows continual processes of improvement (Chong et al., 2017) and allows teachers to consider subject matter, the reasons for their teaching as well as the content and manner in which learners learn (Chong et al., 2017).

When looking at a LS process, it is evident that the process is easily changed for the context for which it has been designed. In some of the simplest cases LS is a three-step process of Plan, Do and See (Juhler & Håland, 2016; Kadroon & Inprasitha, 2013; Sudejamnong, Robsouk, Loipha, & Inprasitha, 2014; Takahashi, 2014). Some contexts call for a more long-drawn-out process to be followed. A study done by Chong et al. (2017) shows a more broken down version of the iterative process of LS. In this case, the elongation of the process is done to show how the researchers' level of support for the participants can decrease during the completion of successive LS cycles. Other authors (Lewis & Perry, 2017; Mee & Oyao, 2013; Zhou, Xu, & Martinovic, 2017) have adopted a less intense process. The processes of Mee and Oyao (2013) and Zhou et al. (2017) are five-step processes. Here LS consists of Planning, Teaching, Observing, Reflecting (critiquing in the case of Zhou et al. (2017)) and Refining (revising in the case of Zhou et al. (2017)). The process illustrated in Figure 2.11 below, the one used by Mee and Oyao (2013), is, therefore, a clear, all-inclusive, easy-to-follow process that can be used when doing LS. A discussion of the process follows.
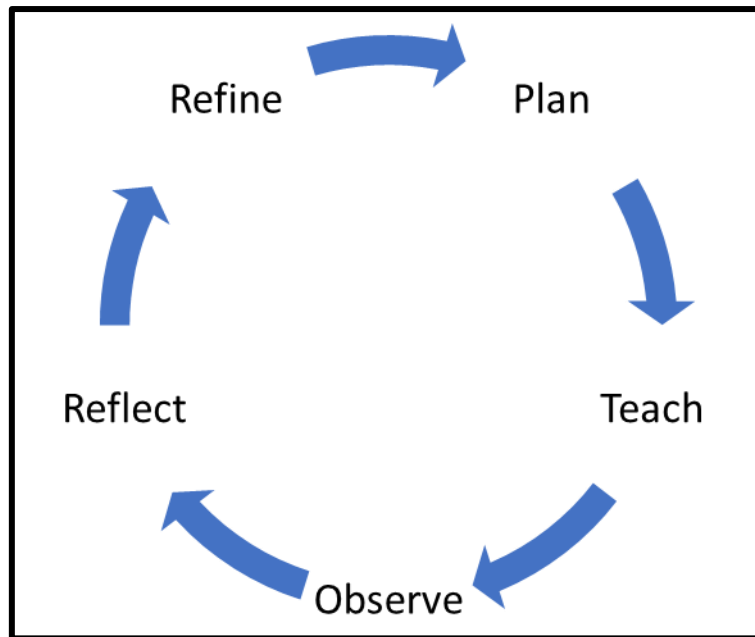
Figure 2. 11: The Lessons Study Process
Source: Researcher

2.5.1. Plan

Planning is done collaboratively by the teachers (Ndongfack, 2015; Xiaofeng et al., 2015). During planning, teachers typically meet in groups and discuss the plans for their upcoming lessons (Mee & Oyao, 2013). This creates the opportunity for collaborative discussion on what the teachers can do to improve the lesson before it is presented. Teachers scrutinise instructional materials to assure the quality and relevance of the material to the lesson being presented (Juhler & Håland, 2016). Planning can have a pre-set format, goal or strategy in mind (Mee & Oyao, 2013). In a study done by Chong et al. (2017) a predetermined strategy of group work was chosen before the planning commenced and all the teachers had to include group work in their lessons. Similarly, technology integration and mobile learning strategies can be a predetermined strategy (Zhou et al., 2017).

2.5.2. Teach

After carefully considering the planning (Fürstenberg & Kletzenbauer, 2015; Wiggins & McTighe, 2005), teachers then teach as set out in Section 2.4.1. In standard LS practice, this phase would see one teacher of the group teaching the lesson and the rest of the group would observe the lesson (Chong et al., 2017; Mee & Oyao, 2013). It is important that one also considers the comments made in terms of teaching in Section 2.4.1. This includes teacher input, and interaction between the teacher and learners in interactive class discussions (Estes et al., 2014; Krulatz, 2014).

41

2.5.3. Observe

Participants in LS, now observe each other's lessons. Some studies show that observation is done by teachers physically sitting in each other's classroom, viewing the lesson (Mee & Oyao, 2013). In the case of Teele, Maynard, and Marcoulides (2015) and Lewis and Perry (2017) teachers can also video record their lessons. This brings about the advantage that the observer can be anywhere and does not have to meet at the same place and time (Xiaofeng et al., 2015). These observations should focus on elements that need to be discussed during reflection.

2.5.4. Reflect

Good teacher practice is to reflect after teaching (Naresh, 2013). During LS, teachers have a detailed group discussion of the lesson (Hubbard, 2015; Wake et al., 2013). This collaborative reflection (Sudejamnong et al., 2014) and critical exchange of ideas (Ndongfack, 2015) occur in terms of classroom practice (Kadroon & Inprasitha, 2013; Sudejamnong et al., 2014; Wake et al., 2013), lesson content (Ndongfack, 2015) and learner interaction (Wake et al., 2013). Using written reflection reports or journals (Zhou et al., 2017), teachers can again take part in LS as part of an online community of practice (Xiaofeng et al., 2015).

2.5.5. Refine

Refining, or revising, is a process of improving the lesson (Chong et al., 2017). Reflection is an inevitable part of the refining process (Posthuma, 2012) as it serves as an instrument of improvement (Kadroon & Inprasitha, 2013). By questioning each other's practices, teachers can make the necessary refinements for future teaching (Mee & Oyao, 2013).

2.6. Technology integration planning model

This study has a strong focus on LS and technology integration into teaching. This can be seen in the main research question:

> **RQ:**
>
> How can **Lesson Study** be adapted to support isolated teachers for **teaching with technology**?

So far, the literature has indicated that LS is a form of practice that teachers can use to support each other. Some solutions, like that of Xiaofeng et al. (2015), have shown that LS could even be implemented in cases where teachers were isolated. In Section 2.6, more focus will be placed on the integration of technology in teaching.

Roblyer and Doering (2014) propose the Technology Integration Planning (TIP) model to integrate educational technology into teaching. This model is similar to other planning models like the ADDIE model (American Society for Training and Development, 1988), Dick and Carey model (Dick & Carey, 1978) and the Kemp model (Morrison, Ross, & Kemp, 2004).

Although there are not many of these models, as Lim, You, Kim and Hwang (2019) state, especially at postsecondary level, the choices become limited. Further, Instructional Designs models like these are notoriously systematic and of ten seem linear due to their step-by-step nature (Clayton & Abbass, 2019)

The TIP model was chosen for this study as it flows easily with the LS process. The TIP model, illustrated in Figure 2.12, shows the three phases with their seven steps to assure successful technology integration. A detailed discussion of the model, and how it integrates with elements already discussed in the literature, follows.
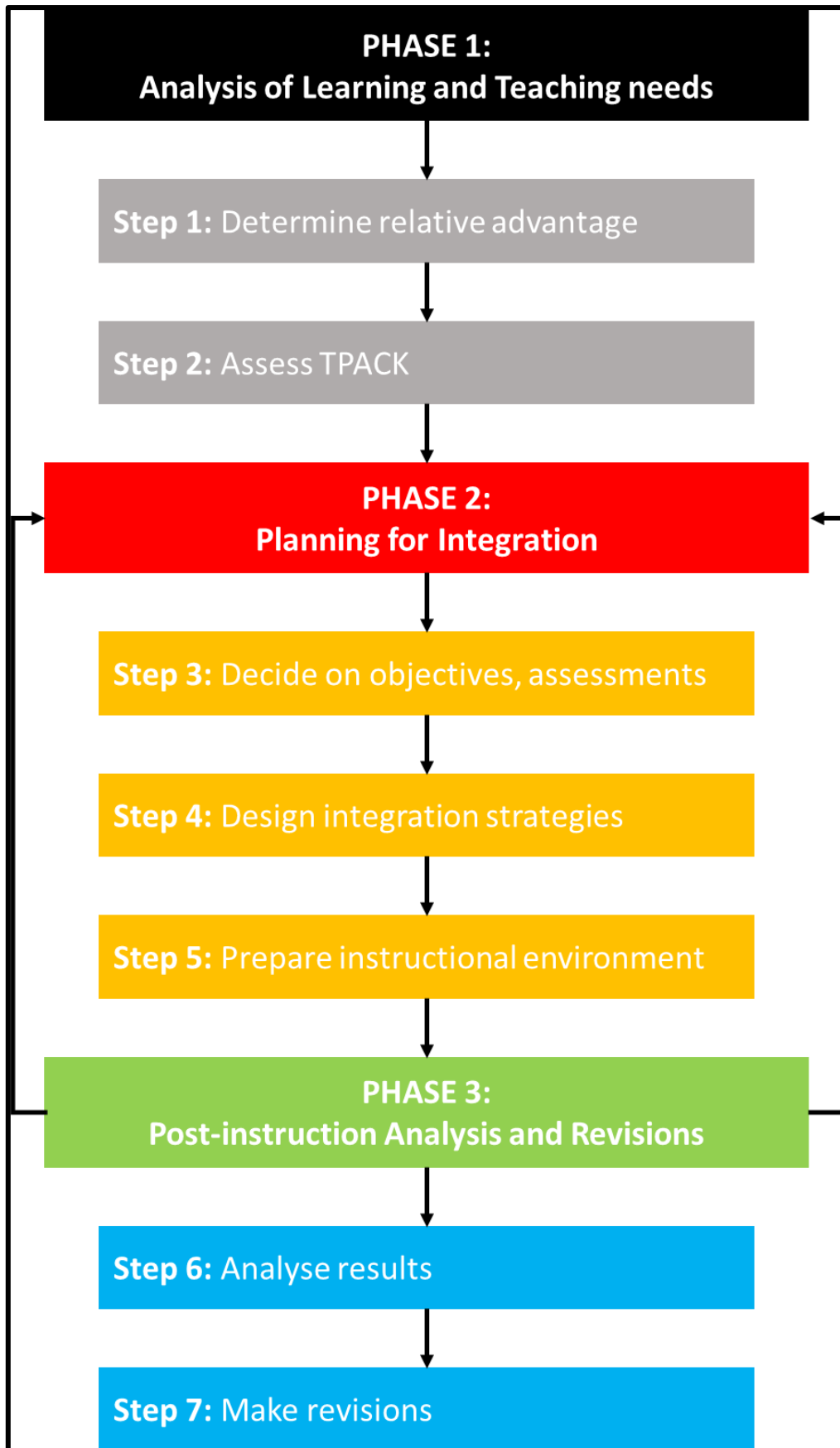
Figure 2. 12: Technology Integration Planning Model
Source: Roblyer and Doering (2014)

2.6.1. Phase 1: Analysis of learning and teaching needs

The first phase of the TIP model consists of two steps. The first requires teachers to consider the advantage that the inclusion of technology into teaching can have. Step two deals with the assessment of the TPACK as illustrated in Figure 2.13 below.
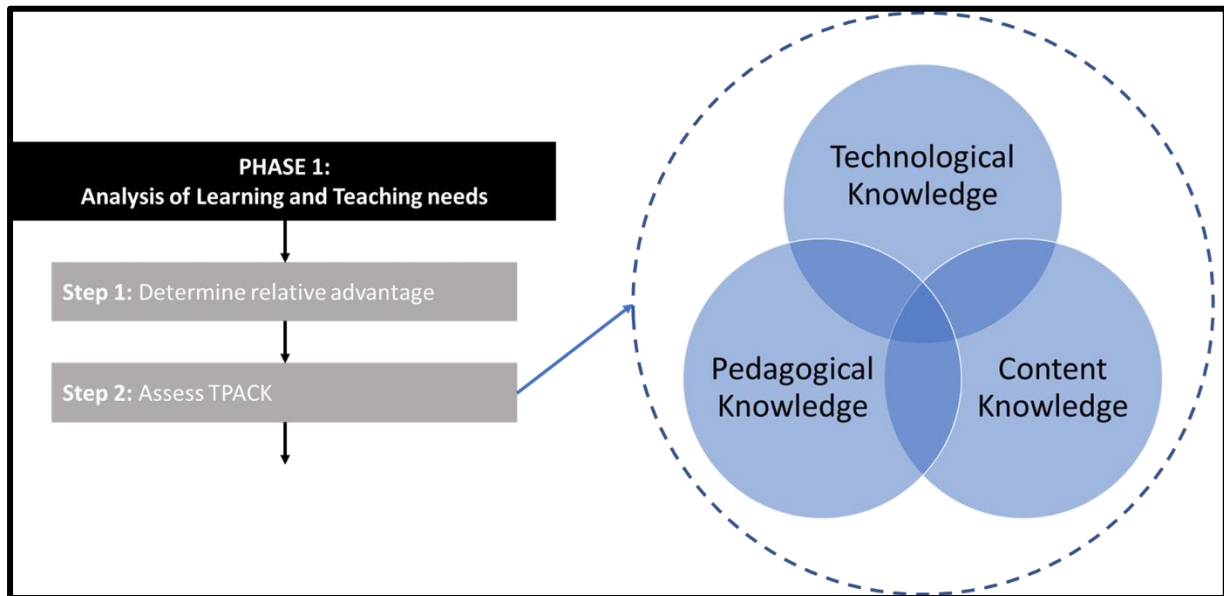
Figure 2. 13: TPACK in Analysis of Learning and Teaching needs
Source: Researcher

Step 1: Determine relative advantage

Technology integration is an important addition to conventional teaching practice (Sweeney-Burt, 2014). For teachers to be able to determine the advantage that the integration of technology in their teaching has, they need to understand the benefits that technology has. The table below illustrates Sweeny-Burt's (2014) four benefits that teachers need to understand with the pointers (Roblyer & Doering, 2014) to the relative advantages for teachers.

Sweeny-Burt	Roblyer and Doering	Consideration
Motivates teachers and learners alike.	There is a clear teaching and learning problem	Motivation
Technology enhances learning	Ascertain that the use of a technology-based solution will be beneficial	Advantage
	Effort and expense of time and work are outweighed by the benefits provided by the technology-based solution	
Supports content attainment and critical thinking,	The estimated impact of the technology-based solution based on benefits others have had in the past.	Impact
Improves traditional and technological literacy at the same time		

Motivation

When determining the relative advantage of a technology-based solution, teachers have to define a clear problem. This problem can include that the topic is challenging to learners due to it being abstract, boring and time-consuming (Roblyer & Doering, 2014). The use of technology in the lesson should then motivate the teacher and learners to overcome the problem faced (Sweeney-Burt, 2014).

Advantage

Using technology in a lesson should be beneficial to both the teacher and the learners. Firstly, technology should enhance the lesson. The effort and expense being exerted towards the execution of the solution, should then still be outweighed by the benefits of the solution for the solution to have a relative advantage.

Impact

Based on the impact of similar solutions by other teachers, a teacher can determine the impact of a solution in their context. Solutions that present a relative advantage should support learners' grasping of the content and their ability to think critically. Further, the solution should improve the traditional and technological literacy of learners.

Step 2: Assess TPACK

As discussed in Section 2.4.2, TPACK has seven aspects that need to be assessed. These are technological knowledge, pedagogical knowledge, content knowledge, technological pedagogical knowledge, technological content knowledge, pedagogical content knowledge and technological pedagogical content knowledge. The point of this assessment is not only for the teachers to focus on the various aspects, but how

they interact with each other. This brings about a logical integration of technology in terms of both Pedagogy and Content to solve problems through the use of technology (Koh & Divaharan, 2013). The use of TPACK within the TIP gives planning purpose, efficacy and meaning (Roblyer & Doering, 2014), and engages teachers in the integration process (Hammett & Phillips, 2014; Koh & Divaharan, 2013).

2.6.2. Phase 2: Planning for integration

Phase two of the TIP model has a strong correlation to the Backward Design, as proposed by Wiggins and McTighe (2005). The three steps in this phase link to the backward design process, as illustrated in Figure 2.14 below.
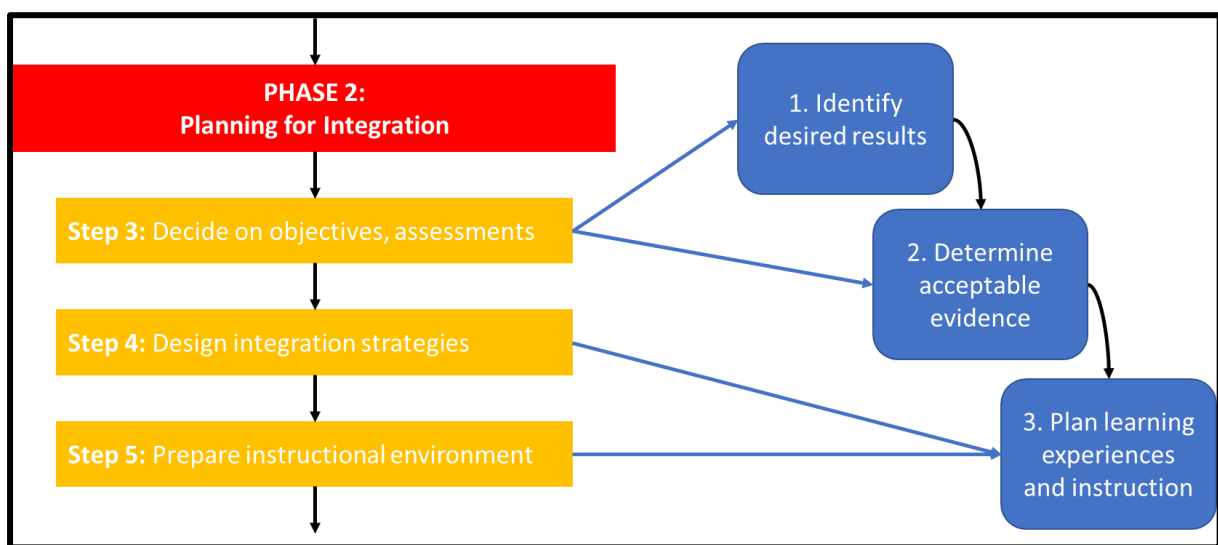
Figure 2. 14: Backward Design in Planning for Integration
Source: Researcher

Step 3: Decide on objectives, assessments

As shown in the diagram, this step entails the first two parts of the backward design process. Here, teachers need to identify the outcome of their lesson in terms of what they wish to achieve by the end of teaching a certain lesson or unit. They further need to think about the collected assessment evidence they will need to show that learning has been achieved through teaching (Wiggins & McTighe, 2005).

A lesson objective must be concise, clear and measurable. Mathumbu, Rauscher and Braun (2014) state that the use of taxonomies like that of Benjamin Bloom (Su, Osisek, & Starnes, 2004) is valuable in assuring that lesson outcomes are set in a way that makes them harmonious with the expectation of a lesson. The revised Bloom's taxonomy offers six levels, characterised by verbs on which an outcome can be based. These levels go from the least complex "remember" to the most complex "create" cognitive levels (Bloom & Anderson, 2014). Figure 2.15 illustrates this taxonomy.
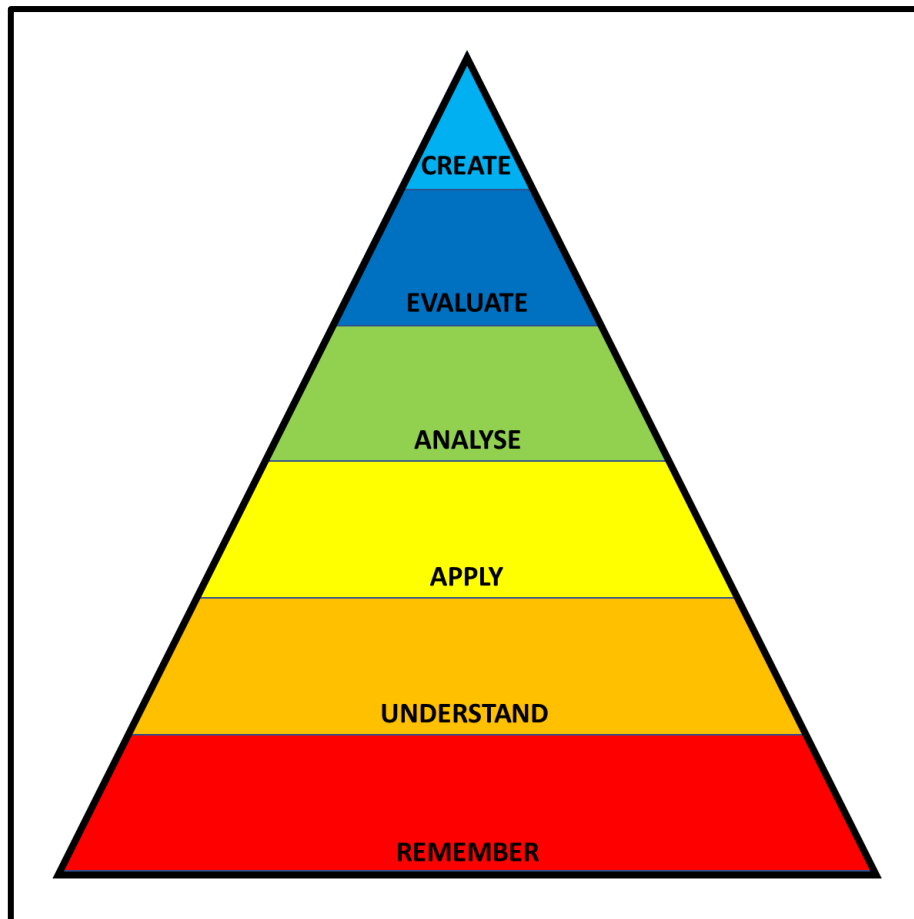
Figure 2. 15: Revised Bloom's Taxonomy
Source: Bloom and Anderson (2014)

Step 4: Design integration strategies

In this step, Roblyer and Doering (2014) suggest that teachers ask themselves what the best fitting strategies and activities would be to use in their teaching of the topic.

During this step Roblyer and Doering (2014) state that teachers need to make considerations for their choice of content approach, grouping approach, the progression of tasks and preparations that need to be made for learners to be able to use technology.

Step 5: Prepare the instructional environment

During this step, teachers need to make sure that the conditions within the classroom are ideal for the use of technology (Roblyer & Doering, 2014). Teachers will assure that the necessary technological devices are available and in the correct working order and with the necessary software (or other resources) installed.

2.6.3. Phase 3: Post-instruction Analysis and Revisions

After the integration of technology into the task that has been planned and the teaching has finished, the teachers review the success of the integration (Roblyer & Doering, 2014). Note that there is no consideration made in this model for the instruction itself.

Step 6: Analyse results

The first important consideration to make is whether the desired outcome as set out in step three has been achieved. The assessment (also set out in step 3) documentation and validation are used to gauge whether learning was achieved (Wiggins & McTighe, 2005). Teachers can also have informal discussions with learners to get their feedback and use it to reconsider their choices of instructional strategies (Roblyer & Doering, 2014).

According to Roblyer and Doering (2014) the following considerations must be made:

1. Outcome achievement
2. Learner opinions
3. Instructional strategy improvements
4. Environmental improvements
5. Integration success
6. Improvement of technological integration

Step 7: Make revisions

In this step, improvements are made based on the analysis that transpired in step 6 (Roblyer & Doering, 2014). In this step, the entire process is considered along with the post-instruction analysis to assure that all the relevant changes are affected to deliver a flawless integration plan.

2.7. Conceptual Framework

The Conceptual Framework is a combination of the TIP model and the LS process. These two frameworks are seemingly reliable in the academic field and have been relied on in many interventions. Carrying out this combination means that the first phases of the TIP model coincide with the first phase of the LS process. As mentioned in Section 2.6.3, the TIP does not make accommodation for the teaching phase of the LS process. With this combination in place, the consideration is made. The last three steps of the LS process, observe, reflect and refine are contained within the third phase of the TIP model. Here, observe, and reflect form part of the analysis of instruction and refine links directly with the revisions step. Figure 2.16 depicts the combination.
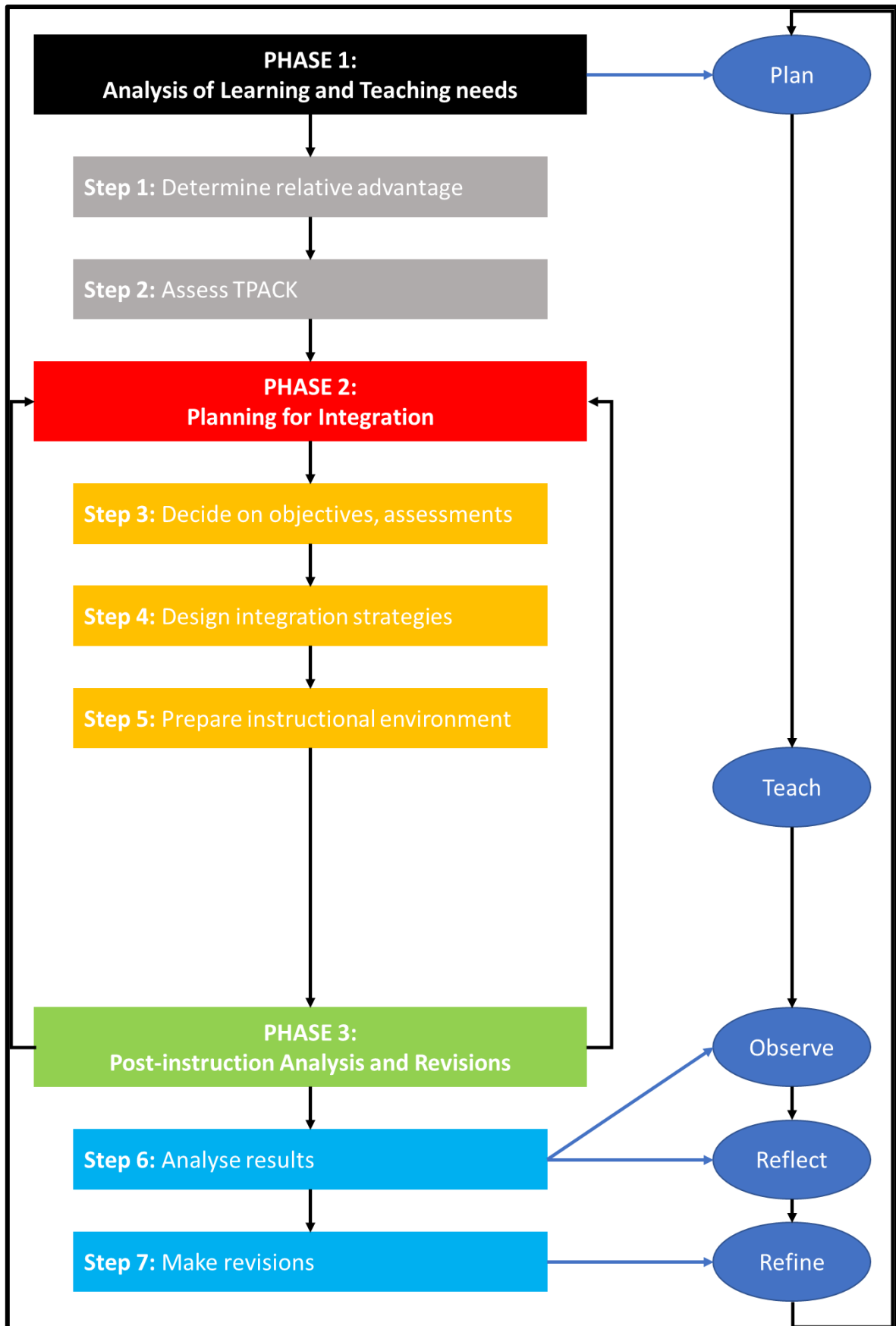
Figure 2. 16: Technology Integration Planning in Lesson Study
Source: Researcher

2.8. Conclusion

In this chapter, a systematic literature review was done to get insight into the relevant literature that speaks to the questions posed for this research. In this exploration, two frameworks were unearthed. The first outlined the challenge that teachers face in teaching and teaching with technology as the literature describes it. The second, the Conceptual Framework, is a combination of the LS process and the TIP model.

In the next chapter, the methodological underpinnings of the study will be shared. This will be done by using the research onion to sketch a blueprint for the research that transpired.

3. Chapter 3: Research Methodology

3.1. Introduction

In this chapter, the methodological design of the research is unpacked. The methodological choices are based on the two frameworks discussed in Section 2.3.7 and 2.7. The research design is explained in terms of the Research Onion and its subsections (Saunders et al., 2016). This chapter aims to show how the research was designed to answer the research questions. The main research question discussed in Section 1.3.2 is as follows.

> **RQ:**
>
> How can Lesson Study be adapted to support isolated teachers for teaching with technology?

Particular care was taken to assure that the methods chosen for analysis will lead to a high quality, true and trustworthy representation of the results that will be put forward. This chapter, therefore, serves as a blueprint for the research that was undertaken for this study to enable researchers of similar studies to repeat or modify the methods chosen and compare the results of their studies to the one at hand.
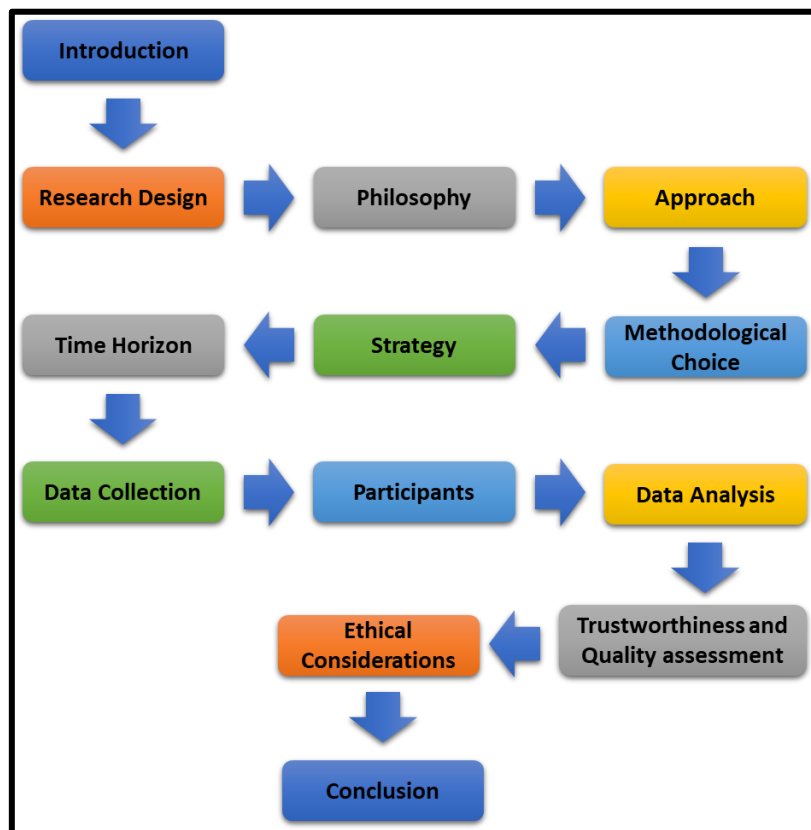
Figure 3. 1: Chapter 3 - Outline

3.2. Research design: Research Onion

The term *research design* is used by some authors (Nieuwenhuis, 2016c; Saunders et al., 2016; Xiao, 2010; Yin, 2014) as the stage in which researchers unpack their research and methodological strategies. Yin (2014) states that during this step the researcher needs to make considerations pertaining to the general approach, role of theory, quality and design or strategy (Saunders et al., 2016). Combining these ideas, and elaborating on them, one can use the Research Onion to unpack the research design.

Saunders et al. (2016) propose the Research Onion to support researchers in unpacking their decisions for the research design. These decisions range from the more abstract philosophical to the more practical considerations of data collection and analysis. Figure 3.2 illustrates how the Research Onion was applied in this study.
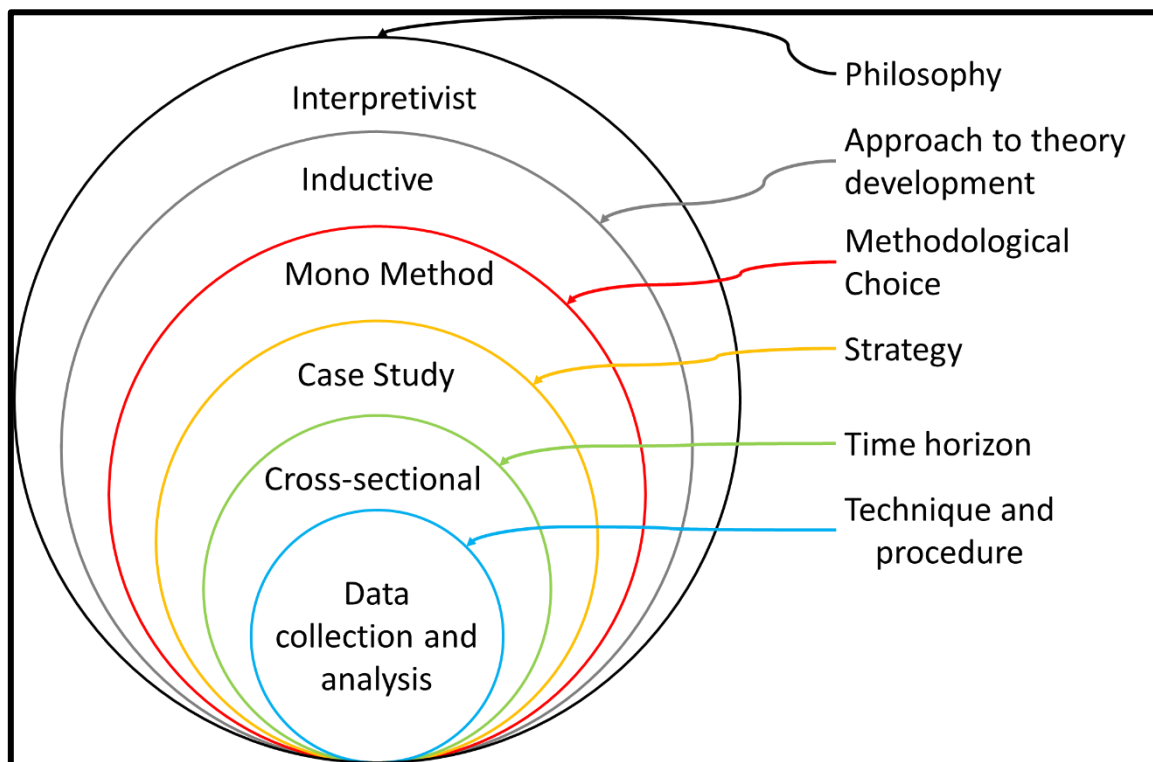
Figure 3. 2: Research Onion
Adapted from Saunders et al. (2016)

The sections that follow elaborate on the choices made and their implications to the study.

3.3. Philosophy: Interpretivist

In this section, the most abstract considerations required by Saunders et al. (2016) will be addressed. This includes the interpretivist philosophy and exploratory epistemology that apply to this study.

3.3.1. Interpretivism

The philosophy in this study was interpretive. We create meaning and are therefore different from physical phenomena (Saunders et al., 2016). Within the interpretive philosophy, reality is socially constructed for the researcher to show an understanding of contextual nature. In this study, practice and theory were interlinked (Willis, 2007).

The researcher was a facilitator in the blended learning course and was, therefore, subjectively involved in the study. The researcher, however, later looked at the events that transpired in terms of the research.

The interpretivist philosophy holds the ontological stance that there is no single reality. This is because reality is socially constructed (Mathison, 2005a) by groups of people with multiple perspectives (Nieuwenhuis, 2016b). Therefore, multiple realities can develop due to different meanings and interpretations of events (Mathison, 2005a). Conducting research under this ontological stance means that researchers need to subject themselves to the fact that their interpretation might be different than the interpretation of others. This is due to the fact that emotions become involved during the interaction with participants and the data (Mathison, 2005a).

The role of the researcher in this study under the interpretivist philosophy was to be an interpreter of the participants' reality (Creswell, 2007; Nieuwenhuis, 2016b) and to understand people's conceptions of reality (Nieuwenhuis, 2016b). The researcher aimed to deliver an interpretation in which he explained and revealed the socially constructed reality to truly show the participants' experiences (Nieuwenhuis, 2016b).

To deliver such a true representation, Nieuwenhuis (2016b) suggests that the researcher should follow an emic approach. This requires the researcher to be an "insider" in the participants' perspectives of the events that transpire during the research (Nieuwenhuis, 2016b). This helps the researcher to achieve the goal of

interpretivist research by delivering their interpretation of the participants' experiences rather than abstract generalisations (Fetterman, 2005).

3.3.2. Exploratory Epistemology

As part of the interpretivist philosophy explained in Section 3.3.1, an exploratory epistemological stance requires the researcher to understand that interpretations have to be made. Nieuwenhuis (2016b) puts it plainly that epistemology refers to the way that people are able to know. Hence, only by interpreting meaning into the events that take place around us, can we gain an understanding of the reality in which we live.

The relationship between the researcher and the participants was such that the researcher could be submerged (Nieuwenhuis, 2016b) as an insider in the research to deliver the most authentic results (Creswell, 2007). This is due to the opportunity that the researcher created to have an unhindered look at the events on ground level with the perspectives and an emic attachment to the situation.

The purpose of the methodological choice is to explore the possible theoretical underpinnings created by the events and activities followed during the conducting of this research.

3.4. Approach to theory development: Inductive

Three options are available as an approach to theory development namely deduction (theory to data), induction (data to theory) and abduction (moving back and forth between data and theory) (Saunders et al., 2016). The research within this study will follow an inductive approach.

Results were taken from the analysis of data gathered in this research and used to amend theory or create new theory (Saunders et al., 2016). The researcher was working from his capacity to ultimately influence theory (Creswell, 2007). Nieuwenhuis (2016b) links induction to the emic approach that researchers should follow under the interpretivist philosophical stance. Using a pre-developed framework, like the challenge framework presented in Chapter 2, however, means that the approach is etic and not emic. Although the generation of it is done through an emic approach, analysing data in this regard is an etic action. In this research, the analysis is simultaneously emic and etic.

Using this approach, the researcher aimed to pursue understanding and knowledge and to form links between the theory expounded in the literature and real-life observations made in the study (Fox, 2008).

3.5. Methodological choice: Qualitative

For the proposed study, a single method (mono-method) was followed (Saunders et al., 2016). The interpretivist philosophy and inductive approach to the development of theory lend itself to qualitative research designs (Saunders et al., 2016). Creswell (2007) sees the interpretive philosophy and qualitative research as "interwoven" counterparts. This is because this approach is founded in interpretation, a natural representation of the world (Creswell, 2007). Qualitative designs are a subjective, non-experimental way of research that allows the researcher to be subjective (Nieuwenhuis, 2016c).

The researcher interacted with the participants to understand their perceptions, feelings and attitudes. This allowed the researcher to understand the participants' reality and therefore have a better understanding of the participants' views. Melia (2010) state that due to the use of observation and the influence of perceptions, the data gathered by qualitative enquiries is not easily transferable into numeric values. Although it may seem disadvantageous, the reality is that data collected can be used for interpretation rather than inference. Nieuwenhuis (2016c) justifies qualitative approaches as a methodological choice in saying that they are not less scientific than their quantitative counterparts.

3.6. Strategy: Case Study

The strategy that was used in this study was case study research. Case studies allow researchers to do research within contexts that have clear boundaries (Nieuwenhuis, 2016c). The blended learning course was a complex system with clear boundaries. Perusing the literature, case study research can be done in many forms, with many variations.

Yin (2014) states that a researcher can choose to follow the process of case study research, as depicted in Figure 3.3 In this chapter, the focus will be on the first stages of the process namely Plan, Design and Prepare.
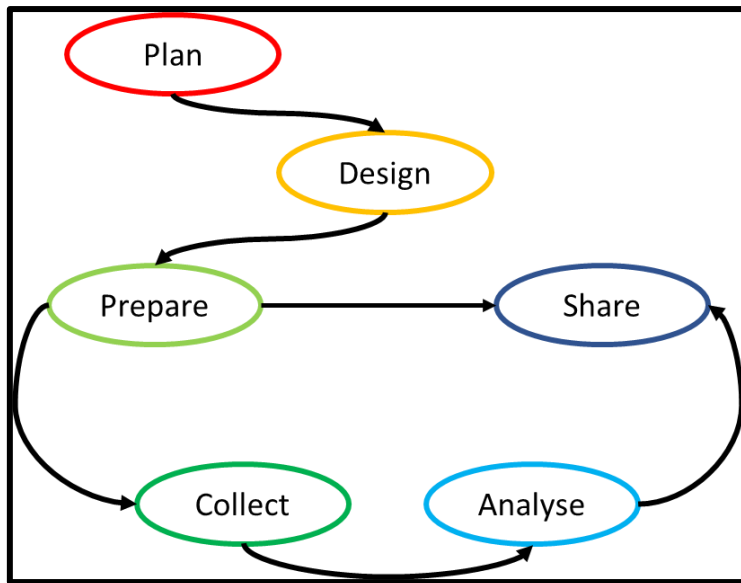
Figure 3. 3: Process of Case Study Research
Source: Yin (2014)

Scholz and Tietje (2011) state that a case study can be defined by the design, motivation, data and epistemological status it adopts. Figure 3.4 below was derived from the discussions of Scholz and Tietje (2011) and Simons (2012) (indicated with *).
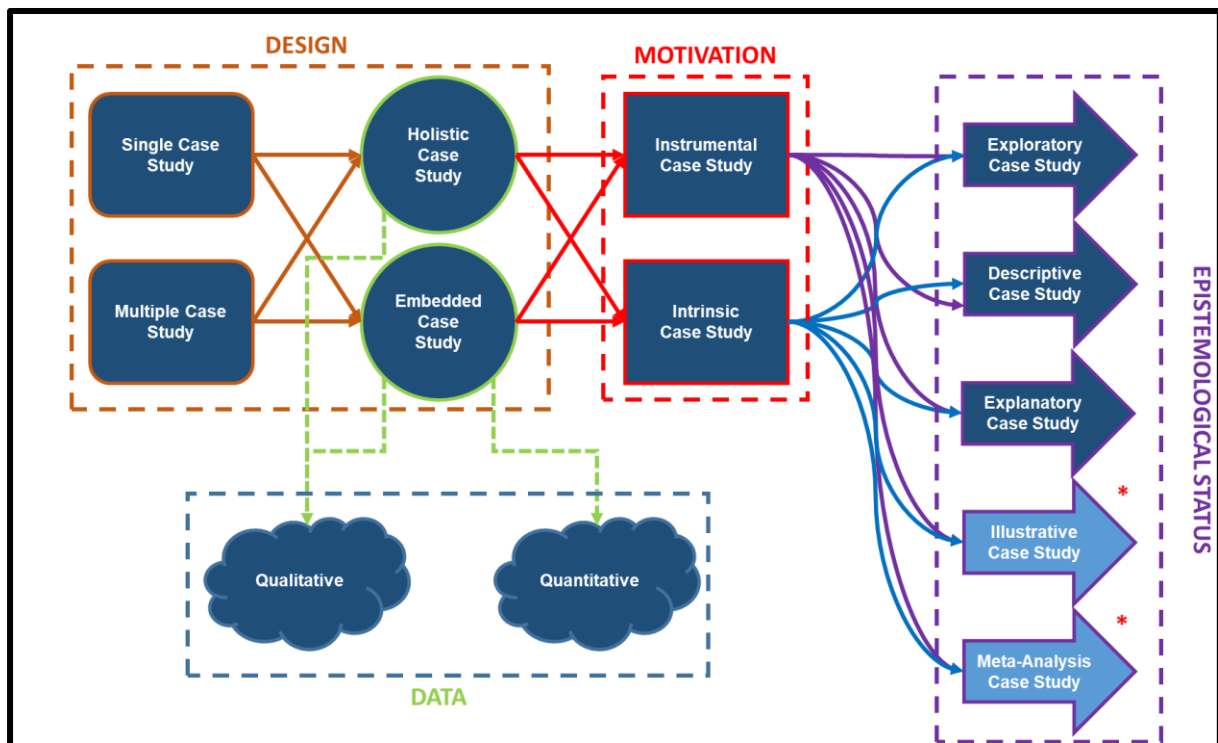
Figure 3. 4: Defining a Case Study
Source: The Researcher

Here, one can see the considerations researchers should make when doing case study research. These decisions include decisions around design, motivation, data and epistemological stance. In the following sections, the considerations made for this study will be discussed. The discussion that follows shows the implementation of the decisions made.

3.6.1. Design: Single Holistic Case Study

Single case studies, like any other qualitative research designs, use the same scientific data gathering strategies (Morgan & Morgan, 2009). The data collected in single case study designs is, however, different from that in group designs (Morgan & Morgan, 2009). Single case studies, according to Morgan and Morgan (2009), lend themselves as an effective alternative to large groups studies.

The rationale for choosing the case study, according to Yin (2014) can be because the researcher feels they are dealing with a case that is critical, unusual, common, revelatory or longitudinal. The rationale for this case study was based on the fact that the case was unusual, due to the fact that the occurrence of the blended learning course itself was unique (Xiao, 2010; Yin, 2014). The participants, their connection to the course that was presented, and the nature of the course programme were unusual.

The implications for choosing to do a single case study under the rationale that the case is unusual, means that the true meaning of the research needs to go beyond the participants (Yin, 2014). According to Xiao (2010), the advantageous aspect of this design is that a clear focus on the unit of analysis is formed.

Doing a holistic case study, the researcher aims to capture the entirety of a phenomenon (MacQuarrie, 2010). The case study that was performed is holistic as many factors contributed to the specific phenomenon (Yin, 2014). Further, the case study was holistic because the study explored the greater nature of the course that was presented for the company (Yin, 2014).

As Yin (2014) states, the researcher should assure that the study is not contained within an abstract level due to the fact that it has been examined so holistically that no boundaries were identified. Further, the implication is that the researcher should maintain focus on the envisaged outcome, despite the flexible nature of this type of research. This is to ensure that the research does not deviate from its path due to the holistic nature of the case study design. Further, the combination of this design with

that of the single-case study design will bring a focussed element to the study as the unit of analysis is clearly demarcated (Xiao, 2010). In this case, the groups in which the delegates worked as part of the course will be the unit of analysis.

3.6.2. Motivation: Instrumental Case Study

Instrumental case studies aim to deliver a thick description of the case at hand, and the case being studied enables the understanding and exploration of knowledge that is separated from the case, (Grandy, 2010). In other words, the focus is not on understanding the case, but on understanding the theories that are linked to the case (Scholz & Tietje, 2011) and the research question was chosen on other grounds than the interest in the case itself (Simons, 2012). This choice is not based on the case being studied, but rather on the purpose of the study as a whole (Grandy, 2010). Grandy (2010) states that with instrumental case studies the focus of the study is likely to be known before the study is designed and conducted.

This implies that the choice of the research questions, although inspired by the case were not done for the interest in the case itself, but to develop theory from the case. The researcher can, therefore, focus on the scientific objective that is identified and to find more information on this objective (Scholz & Tietje, 2011).

3.6.3. Epistemological stance: Exploratory Case Study

The case study strategy followed in this study was an explorative case study. It should be noted that this fits in with the exploratory epistemology described in Section 3.3.3. Research, according to Lazar, Feng, and Hochheiser (2010), is undertaken because the researcher already has a vague understanding of the problem and the context in which the problem exists. The exploratory case study, therefore, seeks to explore the answers that the researcher does not yet have in terms of the phenomenon of the case's context (Streb, 2010).

The researcher, by implication, needs to take care when conducting an exploratory case study not to let their intuition control the research process, and to maintain a trustworthy study (Streb, 2010). The researcher developed research strategies that suited the unique nature of the case (Streb, 2010; Yin, 2014).

3.6.4. The Case

The case within this study is a blended learning course that was presented by the University for 52 teachers from Southern Africa. The course, e-Learning for 21st Century Facilitators, was the focus and foundation of this study. (See Figure 3.5).
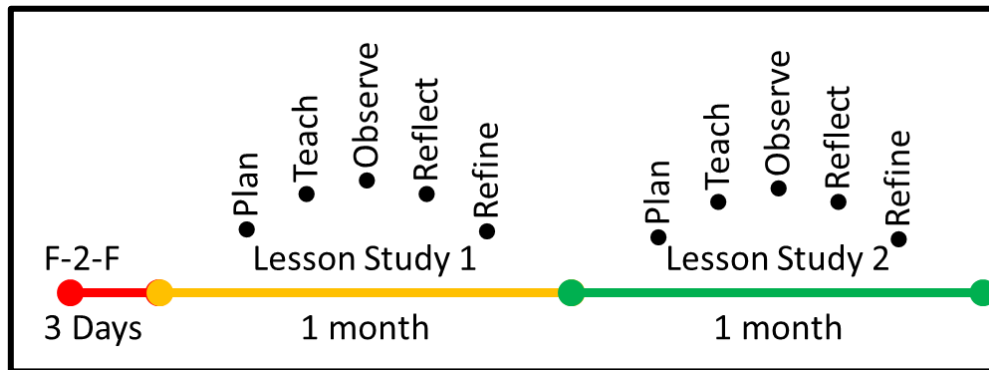
Figure 3. 5: Timeline of events
Source: The Researcher

In 2017, the University was commissioned by a company that provides mobile learning technologies to schools to present a course on the use of mobile technology in education. The blended learning course was presented in face-to-face sessions over three days whereafter it continued in an online format.

The course had three sets of facilitators as well as the delegates. Firstly, the 52 delegates were chosen by the company to partake in the training. The delegates came from schools where the company had by then or would after the course implement their technology.

The technology implemented by the company was done in the form of a specialised classroom. At some schools, the classroom consisted of an existing classroom in the school that was converted to house the equipment provided by the company. In other cases, the company would place a "mobile classroom" at the schools. This classroom is a converted shipping container that is made into a classroom to house the equipment. The equipment that the company provided were different sets of devices and software from the company as well as any other infrastructure seen necessary by the company.

Secondly, the three sets of facilitators worked in a relay over the training period. The training started with a three-day face-to-face training session. Here, on the first day, a delegation of trainers from the company used the day to teach the delegates how their

devices worked. This team also shared some best practice examples of how the company's software can be implemented in the classroom.

The second and third days of the face-to-face session was used by a lecturer from the University, who had prepared the course and presented it to the participants in a gamification setup.

After the face-to-face training, the delegates continued the course online. They were supported by three online facilitators (including the lecturer and the researcher). The online facilitators guided participants through the course assignments that had to be completed and supported the participants in the preparation of their assignments.

The participants who attended the course worked through the activities of the course whereafter they started engaging in an online Lesson Study (LS) structure for the rest of the course.

3.7. Time horizon: Cross-sectional

This study focused on a brief period from June to September of 2017, when the blended learning course took place. According to Saunders et al. (2016), this means that the time horizon for the study is cross-sectional. The motivation for this choice is further substantiated by the fact that there are time constraints to the study such as the limited amount of time given to students to complete studies at academic institutions, and the fact that the information might become irrelevant over time (Saunders et al., 2016).

3.8. Data Collection: Techniques and Procedures

Yin (2014) parallels the collection of data to the collection of evidence. Strategies used in sourcing such evidence for qualitative research are using documents and textual data, interviews, observations and focus groups (Nieuwenhuis, 2016c). Willig (2014) states that these data collection strategies allow the researcher to make knowledgeable decisions about the participants' experiences and perceptions.

During both the face-to-face and online sessions of the course presented to the participants, five data sets were collected in the form of discussion forums, lesson plans, surveys, observation schedules and reflections. Table 3.1 below shows the data sets that are available from the course as well as the instrument that was used to obtain the data.

Table 3. 1: Instruments for Collection

Data set	Instrument for collection
Discussions	Blackboard Learn: Discussion forum
Lesson Plans	Lesson planning form
Reflections	Lesson planning form Blackboard Learn: Discussion forum
Final survey	Blackboard Learn: Questionnaire
Observation schedule	Observations made in terms of lesson planning forms

As seen in the above tables, the study makes use of multiple sources of data. Yin (2014) sees this as a fundamental principle of data collection in case study research. Further, it is visible that the Blackboard Learning management system was used to obtain the majority of the data. This means that this data was obtained in electronic format. The lesson plans referred to, were a mix of hard copy and electronic documents. The observation schedules were filled in by hand, therefore it was hard copy documentation. Yin's (2014) principles of data collection were followed in this study in assuring that multiple sources of data were used, that the data was all collected onto a single database, that a chain of evidence was maintained throughout, and that care was taken when working with electronic sources of data.

Yin (2014) delineates six types of data that are useful in case study research. Table 3.2 below indicates how the data sources collected for this study relate to the six data sources that Yin (2014) deems important in case study research.

Table 3. 2: Yin's six data sources within the study's data sets

	Discussions	Lesson Plans	Lesson reflections	Final survey	Observation schedule
Documentation	X	X	X		X
Archival records					
Interviews				X	
Direct observations					X
Participant observation			X		
Physical artefacts		X			

The data collection techniques and procedures, including data collection, analysis and sampling was governed by the Challenge Framework (Section 2.3.7) and Conceptual Framework (Section 2.7) chosen for this research. Table 3.3 below, indicates the different data sources that were used in terms of the frameworks.

Table 3. 3: Data sources used for frameworks

Data Source	Challenge Framework	Conceptual Framework
Group discussions	X	X
Open Discussions	X	
Lesson plans		X
Lesson reflections	X	
Observation schedule		X
Final survey	X	X

The discussion that follows will explain the details of each of the data sources. This will be done through examples and illustrations of the collected data.

In Section 3.10 the discussion on the link between the data sources and the two frameworks will continue.

3.8.1. Discussions: Documentation

The discussions that took place between the participants were done over the Blackboard Learning management system. This allowed for the discussions to be downloaded and stored in document format for analysis by the researcher, as shown in Figure 3.6.
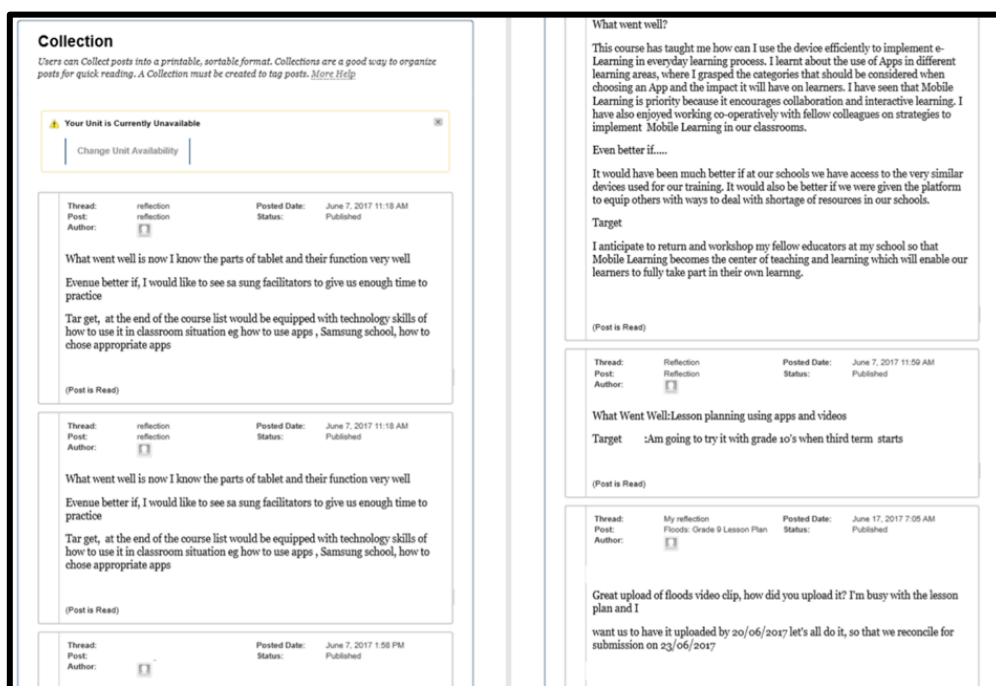
Figure 3. 6: Example of Blackboard Learn Discussion
Source: Blackboard Learn

In total, there were 20 discussion boards on Blackboard Learn. Thirteen of these were Group discussion boards where only members of the smaller subject groups were able to communicate with each other. Open Discussions (7 in total) were available for all delegates of the blended learning course to participate in. Table 3.4 below summarises these discussion boards with their name and planned purpose.

Table 3. 4: Discussion boards and their purposes

Group Discussion Boards	
Group name	Purpose
Group 1-13	These discussion boards were made available for group members to reflect, collaborate and support each other and for the online facilitators to support group members and facilitate discussion.
Open Discussion Boards	
Day 1 and 2 Reflections	These discussion boards were made available to participants to structure their reflections and to make the reflections available to the entire group to elicit discussion
Day 3 Reflections	
Online phase reflection	
Company Mobile Learning	These were more general topical discussions. The various discussion was used to structure discussions based on discussions and to elicit a sense of community.
First Online Assignment Discussions	
General Discussions	
Sharing apps, resources and Ideas	

3.8.2. Final survey: Interviews

Once the blended learning course was completed, a questionnaire was made available to delegates on the Learning Management System (LMS). Yin (2014) refers to questionnaires as a data collection tool grouped within the category of interviews. The survey consisted of 17 questions, of which 11 were identified to inform this study. Table 3.5 shows the questions that were identified for this study. The full list of questions is available in Appendix B.

Table 3. 5: Final survey questions

	Question
1	Which technology interventions are in your school? The company's software? Other interventions?
2	How did you access the LMS? Which devices did you use (Computer, laptop, tablet, smartphone)? Where did you access it - at work, in an internet cafe, with free Wi-Fi, at home with your own data?
3	How did you experience the online collaboration during the post-course section of the Company course?
4	How often did you access the LMS to collaborate with your group members?
5	What did you do when accessing the LMS? (Reading other's posts only, reading and replying, posting comments, submit material, download material etc.)
6	How did you experience the online facilitation process?
7	How did you experience the process of lesson planning - first plan a lesson with others, then teach the lesson, then refine and submit a final lesson plan?
8	Which challenges did you experience during the online lesson planning process?
9	How did you experience the use of the lesson planning form for the planning and refinement of the lessons?
10	Which challenges did you experience during the teaching of the lessons planned?
15	How did the course impact on your teaching practice?

The survey was administered on a voluntary basis and participants could complete it anonymously. This was done to ensure that participant would feel ensured that the answers they provided could not be traced back to them. Of the 52 participants. 33 completed this survey. None of the questions were compulsory. Table 3.6 below summarises how many participants answered each of the questions.

Table 3. 6: Answers to the Final survey

Question	Answers		Question	Answers
1	31		10	28
2	32		11	28
3	30		12	28
4	30		13	28
5	29		14	28
6	29		15	27
7	29		16	27
8	29		17	28
9	28			

In this table, it is clear that most of the items were answered by a majority of the participants. The shaded items are the items that were not included in this study. In total 89 items were left unanswered.

3.8.3. Lesson plans: Documentation and physical artefacts

During the course, the delegates had their first interaction with the prescribed lesson planning form. During this introduction, the delegates worked with a physical form. This form was collected and stored by the researcher. Figure 3.7 shows an empty lesson planning form. The numbers (1-9) annotated here, refer to the discussion that follows. This lesson planning form was given to participants is available in Appendix C.

Figure 3. 7: Lesson planning form – annotated

Two planning strategies were intentionally built into this form. Firstly, the backward design process is facilitated by the lesson planning form. The form assisted participants to work in the order of outcome, assessment and teaching. This is depicted by the numbers 1-3 annotated on the planning form above. Placing these items next to each other was meant to assist participants in aligning their choices for each desired outcome.

Secondly, the Technological Pedagogical and Content Knowledge (TPACK) framework was facilitated in the form as shown by the numbers 5, 7, and 9. Participants used a symbol to indicate the teaching strategy (pedagogical knowledge) they chose to use for a specific activity in block five. The symbols were a way to save space on the lesson planning form as well as to allow a method that participants could use to provide their teaching strategy without having to write too much. Participants did, however, explain their chosen symbols in the lesson planning documents they

submitted. They then went on to provide the specific content for the activity (content knowledge) in block 6. In block 8 and 9, participants described the technology chosen (technological knowledge) for the activity. The technology was divided into general technology used (block 8) and specific technology from the company (block 9).

Some of the symbols, referred to above are presented in Appendix D. It should be noted that although these symbols were given as examples, participants were free to make their own symbols that depicted strategies from their own arsenal. In this regard, participants were asked to make use of mobile learning strategies. It was advised that the participants assured that their strategies were learner-centred, modular and included the use of the mobile technologies available to them in their classrooms.

Figure 3.8 is a photograph that was taken of a completed hard copy of the lesson plan. This photograph was taken at the face-to-face session of the blended learning course after delegates had the opportunity to look at and comment on the other groups' lesson plans.
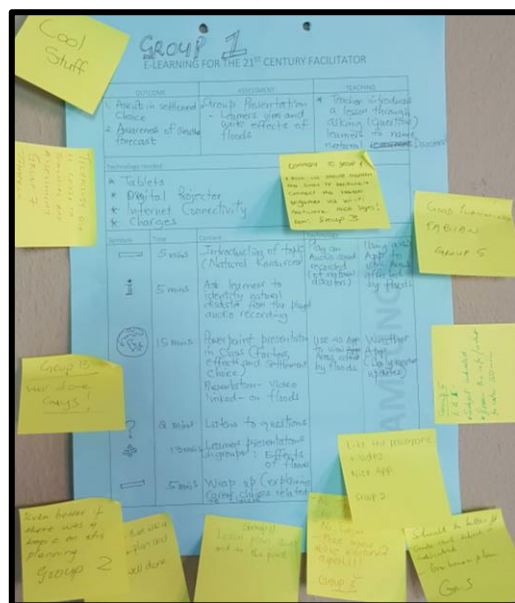
Figure 3. 8: Example of a physical lesson planning form
Source: Group A

In their groups, the delegates put together a further four lesson plans. A lesson planning form had to be submitted for each of the three assignments of the blended learning course. This meant that two lesson plans were requested for each of the LS cycles. A total of four lesson plans, therefore, had to be submitted by each group (1 hard copy 3 electronic copies). Participants shared these documents over a file exchange on the Blackboard learning management system during their collaborative

planning sessions. The use of the LMS meant that the researcher could download and store the lesson plans for analysis.

Figure 3.9 is an example of an electronic lesson plan submitted by one of the groups. Note that the participants adapted the lesson planning form as they saw fit, but mostly kept to the prescribed format.

Figure 3. 9: Example of electronic format lesson plan
Source: Group A

For the study, the focus was placed on the refined lesson plans submitted at the end of each of the LS cycles. In the first cycle, ten refined lesson plans were submitted. In the second cycle, eight refined lesson plans were submitted. Three groups, however, indicated that they were satisfied with the initial lesson plans they submitted. This meant that the second cycle had a total of 11 refined lesson plans.

The lesson plans were used to inform the Conceptual Framework in terms of aspects that need to be included in the LS process to support isolated teachers in teaching with technology. Table 3.10 clarifies the elements of the Conceptual Framework that were informed by the lesson plans.

3.8.4. Reflections: Documentation and participant observation

The refined lesson plans from both LS cycles were expected to include a reflection on the lesson and the events that transpired, as well as the LS process they followed. The participants also reflected using the discussion board discussed above. This means that their reflection was part of their own observations as a group on how the

lesson they planned together took place. These discussions and the documents that related to them have been downloaded and saved from the learning management system for analysis.

To assist the participants in structuring their reflections, the blended learning course proposed three questions for participants to use. These questions are "What went well", "Even better if" and "Target". These questions are based on work by Kolb (1984) where he suggested using reflection questions as a source of learning in experiential learning. These reflection questions are posed in a way that enables the participants to reflect on their teaching in a positive way (Kolb, 1984).

The question: "What went well" was used to have participants look at the positive aspects of the events that transpired first. This was used to have them realise that they had accomplished something and were successful no matter the outcome.

The second question: "Even better if?" was used as a way for participants to positively look at the challenges they experienced during the LS process in the lesson. Using this method, participants considered the solution rather than the problem. An example of this would be instead of saying the learners were all ill-behaved, rather phrasing it as "It would be even better if the learners were well-behaved".

Lastly, "Target?" was meant to have participants think about things they would endeavour to do going forward in the blended learning course and their general practice.

Table 3.8 depicts an example of such a reflection.

Table 3.7: Participant reflection

What went well:
• The company software is an amazing app that I am looking forward to using.
• I loved seeing the different cool applications, especially the Life Science 4D app.
• Kahoot was fun and interesting. Looking forward to using it.
• Understood the device.
• Collaboration with other educators was great.
• Loved hearing about the different advantages to mobile learning.
Even Better If:
• We had more time to work on the apps.
• Explored company software some more.
• Had more discussions on how we are planning on using mobile learning in the classroom amongst educators.
Target:
• To explore relevant applications for the classroom every day.
• To improve my knowledge and skills on mobile learning.
• To collaborate with other educators and improve education all over Africa.

Source: Participant B2 – Day 1 and 2 reflection

Participants used these reflections in two ways, namely personal and group reflections. In most cases, personal reflections were a way for participants to share the events that transpired in their environment in a structured manner. Further, groups used this structure to give a collaborative idea of the events that transpired for the group as a whole.

The reflections were further shared in two platforms. Firstly, as indicated in Table 3.5, discussion boards were made available for participants to engage in focussed reflection on different parts of the blended learning course. Secondly, participants were asked to include a group reflection in each of the two refined lesson plans submitted. This meant that although the primary data sources for reflection questions are the discussion boards and lesson plans, the reflection questions became a stand-alone focussed data source.

3.8.5. Observation schedules: Direct observations and documentation

As with the reflections, the observation schedule is based on the completed lesson plans. Here, the lesson plans are also the primary data source with the observation schedules becoming a separate data source on their completion. The observation was not completed with the researcher observing participants. The observation schedule

was rather used as a structured way to observe "predefined" aspects of the lesson plans, that were focussed and consistent (McKechnie, 2008).

Figure 3. 10: Observation schedule - Annotated

In the observation schedule, depicted in Figure 3.10, three items were observed. This included the backward design process, the TPACK framework and mobile learning strategies.

Firstly, the backward design process was observed. This was done by evaluating the outcome (1.1) in terms of the level of Bloom's taxonomy on which the outcome was written. Moving on, the assessment strategy was evaluated (1.2), whereafter the teaching strategy chosen was also evaluated (1.3). To conclude the observation of the backward design process, the alignment (on Blooms' taxonomy) of the outcome assessment and teaching was assessed (1.4). Typically, the researcher noted that the backward design was aligned (all three parts align); partially aligned, (two parts align) and not aligned.

The second observation question was: "Could they choose technology that supports pedagogy and content". The observation schedule allowed the researcher to note a binary answer (yes or no) and to comment on the choice. The typical case in which the researcher would indicate "yes", would be if the technology choice made had an

apparent relevance to the content and teaching strategy chosen. The researcher would, for example, choose "no" if the participants indicated that they would use an interactive anatomy application to teach weather pattern in Geography.

The third observation asked the question: "Were they able to apply mobile learning strategies?" Again, a binary choice (yes or no) was provided. The researcher examined the activities set out in the lesson plan to assure that they were short, modular activities (looking at block 6 in Figure 3.6). Further, the researcher ensured that the teaching strategies were learner-centred and varied before assuring that participants made use of mobile technology in their activities.

3.9. Participants

Now that the data sources have been clarified, it is important to consider the participants. In this section, the population and sample chosen for this study will be explained.

3.9.1. Population

Lepkowski (2008) defines population in quantitative research as a finite group of individuals that poses the same attributions, and therefore the same inferences could be made about them. The target group for this study is all teachers who are involved in teaching with technology. In the case of this study, it is not possible to demarcate the target population. This is because it would be difficult to identify all the individuals who meet the criteria of teachers who use technology in their teaching.

For this reason, this research will have to make use of a population of inference. Lepkowski (2008) elaborates to state that a population of inference is a subsection of the target population that the researcher can reach due to the constraints in the operation of the research. This might be for example, that the researcher can only reach some teachers who use technology in their teaching due to the fact that they cannot include participants who are far away from them. In this study, there might have been teachers close enough to the researcher to include, but they did not take part in the blended learning course.

3.9.2. Sample

The intervention that was brought forward by the company created the opportunity for the researcher to gain access to a group of individuals who have already been introduced to the world of teaching with technology. Figure 3.11 illustrates how the sample was framed (Shapiro, 2008) to obtain the individuals who would ultimately participate in this study.
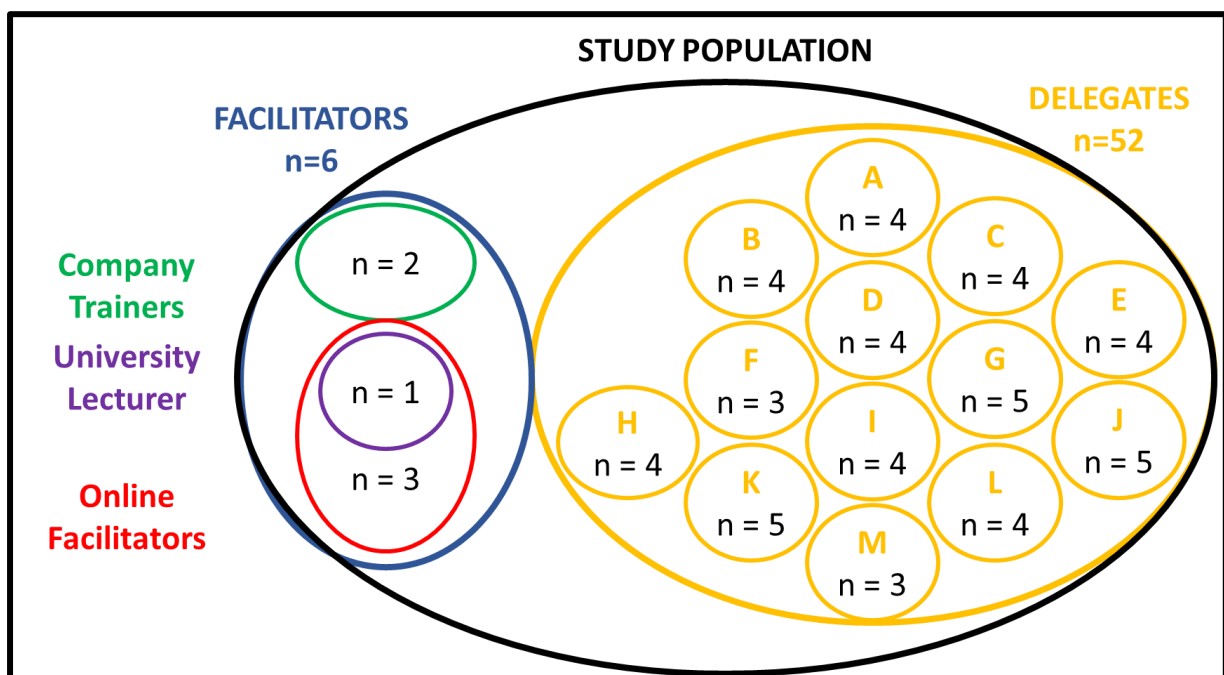
Figure 3. 11: Study Population
Source: The researcher

The participants in this study are the 52 teachers and staff from South Africa and Botswana that attended the E-Learning for the 21st Century Facilitator course as well as the online facilitators. As per the definition stated earlier, all of these teachers could be deemed as isolated teachers.

The course was presented in a blended format and comprised of a three-day face-to-face session and a 2-month online session. Facilitation of the course was based in online LS groups. Two LS cycles were completed. During the LS cycles, the participants took part in the activities in groups of four (13 groups in total).

3.9.3. Convenience Sample

Sampling can be done with either probability or nonprobability sampling methods (Corbetta, 2003). Nonprobability sampling refers to a sample that is chosen without the probability being determinable or known (Vehovar, Toepoel, & Steinmetz, 2016).

One method under nonprobability sampling is convenience sampling. Figure 3.12 below illustrates the hierarchical relationship between these methods.
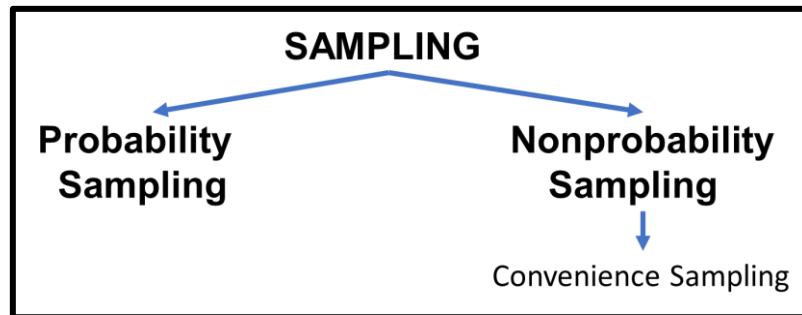
Figure 3. 12: Hierarchical relationship between sampling methods
Source: The Researcher

Convenience sampling (or accidental sampling (Vogt, 2005)) refers to a sample that is obtained due to how easy it is for the researcher to reach the participants (Salkind, 2010). The participants in this study were easy to access because they were already attendees to the course that was presented for the company. This in turn, gave the researcher access to a group that was already linked to the attributes that were required for the study.

According to Phua (2004), the advantage of this method lies in the fact that the participants are sourced inexpensively, both in terms of monetary and time value. Although this means that one cannot generalise from the results found from this sample, it is not the intention of this study to deliver results that can be generalised. The main disadvantage of this method, according to Vogt (2005), is that by using this sampling method, the researcher only has a vague idea of what the possible population of the study might be. Phua (2004) extend this argument in saying that it is, especially in conditions where the population is more difficult to define, appropriate to employ convenience sampling methods.

3.9.4. Data saturation

Theoretical saturation refers to the amount of data that needs to be considered before no new theoretical findings can be made (Nieuwenhuis, 2016c). It further refers to the fact that considering any additional added data does not deliver any added information to what has already been found (Hennink & Kaiser, 2008).

Data saturation is difficult to define according to Nieuwenhuis (2016c), because there are no clear guidelines as to how much data should be collected in a specific research design. Once again, this research will make use of all of the data that was obtained in

the data collection process to make sure that even if the data is not "saturated", there is no unconsidered data.

The results and findings from the Challenge Framework will be discussed in Chapter 4.

3.10. Data Analysis: Techniques and Procedures

The Challenge Framework discussed in Section 2.3.7 and the Conceptual Framework discussed in Section 2.7 was used to guide the analysis of the data. The discussion that follows shows how the frameworks informed the data analysis decisions.

3.10.1. Data analysis – Challenge Framework

Two data sources were consulted to determine the challenges that teachers experienced when teaching with technology. This included the discussion boards and the final survey.

Discussion boards: Any statements made by participants related to challenges were isolated to be coded in both of these sources. In Table 3.8 below, it can be seen that the Challenge Framework (explained in Section 2.3.7) was converted to codes that could be used for analysis. Further challenges that did not conform to this framework were marked with the code "C" (for Challenge) for further consideration.

Table 3. 8: Coding challenges for analysis

Challenge	Code	Subtheme	Code
Access	CA	Affordable learning	CA1
		Access to ICT	CA2
Skills	CS	Teacher Qualification	CS1
		PCK and TPACK	CS2
		Use of ICT	CS3
		ICT Integration	CS4
Economical	CE	Lack of Funds	CE1
Support	CU	Administrative	CU1
		Technical	CU2
		Peer	CU3
		Professional	CU4
Beliefs and attitudes	CB	Interests and motivations	CB1
Governance and policy	CG	Political Influences	CG1
		Educational Policies	CG2

All the discussion board entries that contained a challenge were noted down in a Microsoft Excel spreadsheet. Figure 3.13 below indicates an example of such a spreadsheet. Note that the thread number and participant account are noted.

Participant account refers to the participants' recollection of an event on the platform. Thereafter the challenge code is noted followed by an excerpt of the text that led to the code being allocated.

Thread Number	Posted By	Code	Quoted text
1	B1	CU2	manage[d] to get get to the group finally, through your guidanc
1	B1	CU4	manage[d] to get get to the group finally, through your guidanc
1	B1	C	then I had an emergency to tend to
1	B1	CU4	support and help each other
1	B1	C	I am still at DBE setting Setswana examination
6	B2	CA3	We do not have We do not have available wi
6	B2	CA2	Even better if I had Wifi connection
6	B2	CA2	If I had a SmartBoard
6	B2	CA2	If I had
12	B2	CA2	We do not have a smart board or wifi at school
13	B1	CU4	Did anyone download the video created by [S2] on how to upl
17	B1	CS3	Challenge was to save it on my computer
17	B1	CS3	I am unable to scroll
45	B1	CE1	I am teaching learners who cannot afford to pay for excursion
45	B1	CA2	Only a few percent have smartphones

Figure 3. 13: Discussion boards coded
Source: Group Discussion – Group B

Note in this figure that the participant names have been changed to pseudonyms. Further, the name of the company has been removed from the data. The excerpts from the participant statements are done verbatim including their typographical, grammatical and language errors.

Final survey: The second data source that was used to inform this framework was the Final survey. The two questions that were used (8 and 10) in this regard are listed in Table 3.9 below.

Table 3. 9: Final survey questions that inform Challenge Framework

	Question
8	Which challenges did you experience during the online lesson planning process?
10	Which challenges did you experience during the teaching of the lessons planned?

The answers to these questions were first read through to note any possible emerging themes, to analyse the responses. The themes were then colour coded before the researcher made a comprehensive summary on a different piece of paper.

Figure 3.14 below, depicts the analysis that was done on one of these questions. Note the annotations that were made with distinct colour highlighters to isolate the various themes found in the responses.
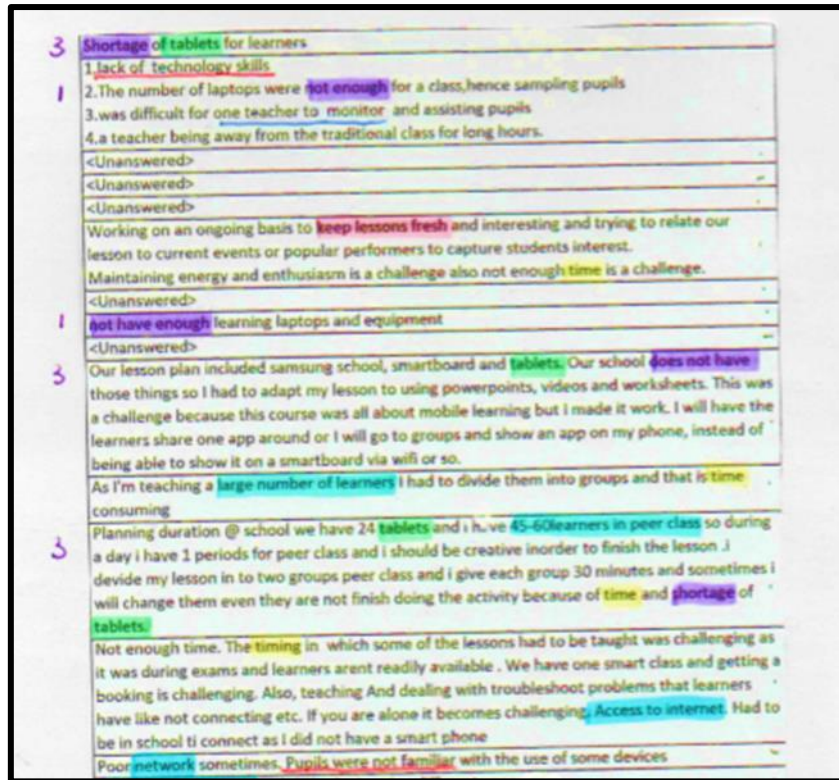
Figure 3. 14: Annotations on responses to Final survey
Source: Final survey – Question 10

Figure 3.15 below depicts a summary of the responses to the question illustrated above.
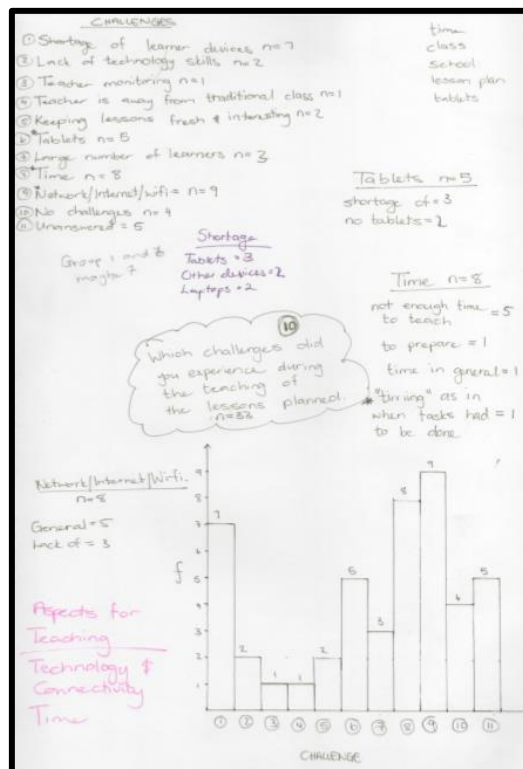
Figure 3. 15: Summary of responses to Final survey
Source: Final survey – Question 10

3.10.2. Data analysis - Conceptual Framework

Four data sources informed the Conceptual Framework set out in Section 2.7. Table 3.10 shows how the different data sources informed the parts of the Conceptual Framework.

Table 3. 10: Data links with the Conceptual Framework

Conceptual Framework		Data			
TIP	Lesson Study	Discussion boards	Final survey	Lesson plans	Observation schedules
Phase 1					
Step 1		X	X	X	
Step 2					X
Phase 2	Plan				
Step 3					X
Step 4					X
Step 5					X
	Teach		X		
Phase 3	Observe				
Step 6		X			
	Reflect			X	
Step 7	Refine		X		

As with the previous framework, the analysis methods used to analyse the participants' accounts on the discussion boards and in the final survey were similar. These are explained in detail in Section 3.10.1. For the remaining data sources, the data was analysed as discussed below.

The lesson plans were used to inform the technology that teachers chose to use in their teaching. The different technologies were listed and counted to determine the different technologies that teachers chose to incorporate in their teaching. Figure 3.16 depicts a screenshot of an MS Excel spreadsheet. Here, it can be seen that there were various technologies used. The groups that indicated the use of every technology were allocated with the value 1. This made it possible to add up the technologies using MS Excel functions. Note that the groups in red did not supply a lesson plan.

	A	B	C	D	E	F	G	H	I	J	K	L	M
Tablets	1	1		1		1	1			1		1	1
Apps	1	1		1			1		1	1		1	
Company LMS	1	1					1			1		1	1
Smart Board	1	1		1								1	1
Data Projector	1			1			1		1	1			
Videos	1	1				1				1		1	
Laptops		1		1					1	1		1	
Powerpoint	1	1				1							1
images		1				1						1	
wifi						1			1	1			
smart tv						1			1	1			
websites						1						1	
schoology (LMS)						1							1
Sound Clips	1												
Web Browser	1												
smart phones				1									
desktop computers				1									
Voice recorder										1			
digital notepad										1			
camera												1	
digital notes												1	
	9	8	0	7	0	8	4	0	5	10	0	10	5

Figure 3. 16: Analysis of lesson plans
Source: Lesson plans – all groups

The observation schedules of the second and fourth set of lesson plans were used to inform the Conceptual Framework as they were the refined sets of lesson plans. MS Excel was used to capture, categorise and compile the researcher's notes on the observation schedule.

Figure 3.17 shows a scanned image of one of the completed observation schedules. Note that the annotations are concise and specific to the investigation, as suggested by McKechnie (2008).

Figure 3. 17: Completed observation schedule
Source: Observation schedule – Task 2 – Group C

Figure 3.18 below shows an example of one of these spreadsheets. Once again, it can be noticed here that the groups are anonymous due to the use of pseudonyms.

	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	LEVEL 6
A2	1	3	1			1
B2	2	1				2
C2	1	2				
D2			1		2	
F2	2	1				
G2	1	2			1	
H2	1	1	1			
I2		1	1		2	
J2		1			5	
L2	2					
M2	1	1	1			
CYCLE 2	11	13	5	0	10	3

Figure 3. 18: Analysis of observations
Source: Observation 1.1 – Cycle 2

The results and findings in terms of this framework will be discussed in Chapter 5.

3.11. Trustworthiness and quality assurance

In this section, the criteria for high-quality analysis credibility, transferability, dependability and confirmability will be discussed as they pertain to the study

3.11.1. Criteria for high-quality analysis

To ensure a high quality data analysis, Yin (2014) advises that one should assure four things. Table 3.13 shows the measures that were put in place to ensure a high-quality analysis of the data

Table 3. 11: Criteria for High-quality analysis and measures taken to ensure them

Criteria for high quality analysis	Measures that were put in place to assure the criteria were met
Show that all the Data is attended to	The researcher considered all the data that was available after the completion of the blended learning course. All of the data sources identified as applicable to this study were used. In terms of the Challenge Framework, the group discussions were not all used as data saturation was reached after completing the analysis of 4 groups.
Address all possible rival interpretations	To address rival interpretations, the researcher consulted the other two online facilitators in cases where participant accounts could have more than one meaning. This did not happen often.
Address the most significant aspect of the case study	Because the case was so extensive, the researcher focussed only on the strategy used to support teachers in teaching with technology, the challenges the teachers faced and the aspects that had to be incorporated to support isolated teachers in teaching with technology.
Use prior expert knowledge during the analysis process	The researcher made an effort to assure a good foundational knowledge of theoretical aspects before attempting to make judgements in their regard.

Mathison (2005b) stipulates the criteria for trustworthiness as credibility, transferability, dependability and confirmability. These elements help to answer these questions:

1. Are data able to be traced back to a primary source?

As depicted in the data sources before, the researcher created a reference system to refer back to data. This is especially the case in terms of the discussion boards. Here, the researcher used the name of the discussion board, thread number and participant code (pseudonym) to capture the data to MS Excel. This assured that the researcher could easily refer back to data.

2. Are data verifiable?

To assure that data could be verified the researcher only made use of verbatim copies of the statements made in participant accounts in all the data sources. This assured that the data, data links to participants and the connection of codes stayed relevant throughout the data analysis process.

3. Are the conclusions reached logical, sensible and plausible?

The researcher made conclusions based on literature and verifiable evidence. All possible alternatives were considered and interrogated to assure that conclusions remained as logical, sensible and plausible as possible.

3.11.2. Credibility

McGinn (2010) states four determinations that need to be answered to determine the credibility of a study. These questions have been converted to goals for this research to ascertain the credibility thereof. These goals and the steps that were taken to achieve them follow.

Firstly, the researcher needs to determine whether the interpretations made are relevant to the participants' experiences. In this regard, the researcher was privileged to have worked closely with the participants for two months as an online facilitator of the blended learning course. This assured that the researcher had insight into the participants' context and could make informed findings.

Due to the wide boundaries of the case, the second determination, making findings that were applicable in other contexts with other people is uncomplicated. The fact that the sample was so heterogeneous and from so many contexts means that this study can be adaptable to many other contexts.

Comparing the research with similar research, the findings are relatable, and many similar findings are made. The South African context has however informed the perspective of the host of international literature that was obtained for this research.

The researcher looked at the case from an outsider's perspective to avoid bias.

3.11.3. Transferability

The aim of the researcher should be to make their research transferable to similar contexts and similar participants. Jensen (2008c) says that this can be done when the researcher divulges all the information of their study through thorough descriptions. These should include descriptions of the research context, the participants who took part in the study and the research design that was followed to reach the conclusions of the study (Jensen, 2008c).

Dick (2014) emphasises the need for diversity to promote rigour in the study, this diversity, according to Dick (2014), should not be bound to the participants only but should be extended to diversity in the data collected, the researchers' perspectives and analysis methods used.

Jensen's (2008c) consideration states two aspects that need to be in place to enhance the transferability of the research. The first of these is that the participant should be closely linked to the context of the study by assuring that they are relevant members of the community attached to the study. The second is that the researcher should provide a complete and unambiguous explanation of the context that is associated with the study. This will illuminate the contextual boundaries of the study to promote transferability.

According to Dick (2014), these elements and considerations on their own or as a collective strategy should enhance the quality of the research that is conducted.

3.11.4. Dependability

Jensen (2008b) refines the underlying constraint of dependability as the structure that is put in place to allow researchers to repeat or replicate the current study to achieve the same results. To achieve this, the researcher should provide full disclosure of the research design (Jensen, 2008b). It is possible during the execution of a research design that some aspects may change (Jensen, 2008b; Nieuwenhuis, 2016a) this could be changes in the context of the study (Jensen, 2008b) or changes in the research design (Nieuwenhuis, 2016a). A dependable study, according to Nieuwenhuis (2016a), is one where the researcher meticulously kept track of the changes that were affected and disclose them to those who read the report.

3.11.5. Confirmability

Nieuwenhuis (2016a) states that for a study to be confirmable, the researcher needs to remain neutral to their own biases, motivations and interests when determining the findings of the study. Jensen (2008a) clarifies that research that leads a reader to understand the findings made from the participants' viewpoint is confirmable. Further, the research should aim to understand the meanings that participants give to their experiences. This means that the information obtained from the participants should also be used in the context it was delivered in and not misconstrued by the researcher to support the researcher's own expectations of the research outcome (Nieuwenhuis, 2016a).

This does not deny the fact that every person who interprets the data will not have their own representation of the events and meanings that were delivered by the researcher (Jensen, 2008a), and adheres to the interpretivist philosophy of a multiplicity of interpretations.

3.12. Ethical considerations

Parsons (2018) notes the Belmont principles of ethical research, such as respect, beneficence and justice. In essence, this means that the researcher should respect the anonymity of the participants, assure that participation in the research has greater benefits than harm to the participant, and that the selection of participants should be done fairly and that those who participate should also benefit from the research (Parsons, 2018).

This study took place in an existing project that had already received ethical clearance with the ethics committee of the University of Pretoria. Permission was also obtained from the company to collect data from the blended learning course and use it for research purposes. The researcher has completed the ethics application to attain a unique ethics certificate for this study. In this study, ethical consideration was made in terms of Informed consent, Voluntary participation, Anonymity, Confidentiality and Pseudonyms. The University of Pretoria's ethical guidelines were followed throughout the study.

3.12.1. Informed consent

Informed consent is when a participant gives their formal (Parsons, 2018) knowledgeable permission for the researcher to ask them questions or investigate their environment in any way (Fitzpatrick, 2005). The researcher should ensure three things during the acquisition of informed consent (Brooks, te Riele, & Maguire, 2014). The first is that the participant has adequate knowledge of what their participation will entail (Brooks et al., 2014; Fitzpatrick, 2005). This means that during the course of the consent process, informed consent should be explained to the participants as well as the distinct aspects that they will be covered by the consent. Secondly, the participants should understand that their participation in the research is voluntary (discussed in 3.4.2) (Brooks et al., 2014). Thirdly, the researcher should ensure that the participants are competent to choose freely whether or not they want to participate (Brooks et al., 2014).

The participants in this study were asked to give their consent after reading a consent letter. At the blended learning course's face-to-face session, the fact that research would be conducted on the course was discussed first and letters were provided to participants. The letter explained to the participants that with their consent the assignments and other sources of data that they provided during the course would be used to inform research. An opportunity was given in the course to ask questions in terms of the research that would be conducted, and the facilitators provided any clarity that the participants required. The participants consented to the study by completing a consent form. Consent was granted by all 52 participants.

3.12.2. Voluntary participation

Voluntary participation, required as a part of informed consent (Brooks et al., 2014), refers to the participant having the power to decide whether or not to participate in the study (Hogan, 2008). Participants were reminded of the fact that research would be done on their contributions during the course. Participants were reminded that they could refuse participation or terminate their participation at any time.

3.12.3. Anonymity and confidentiality

Maree (2016) sees anonymity as an essential consideration to ethical research as the research should protect the identities of the study participants. Anonymity refers to the fact that the research is conducted in such a way the participants and their responses cannot be identified by a reader of the research report (Ogden, 2008a). Although

Kennedy (2008) says that the researcher should ideally not be able to identify participants, the most important aspect is to keep the participants anonymous in the report. In essence, the participants need to remain private so that the participant feels free to remain completely truthful in their participation in the study (Kennedy, 2008).

Kaiser (2012) emphasises the fact that assuring confidentiality is an ongoing process for researchers. Confidentiality refers to the fact that the participants' privacy is taken into consideration when their responses and information is being used (Kushner, 2005). There are, according to Kaiser (2012), three stages during which the researcher should consider the confidentiality of their participants. Firstly, during the planning of the study, the researcher should think about how their participants' information will remain confidential (Kaiser, 2012). Kaiser (2012) states that, as has been done in this study, research projects should be presented to committees that will assure the anonymity of participants before the research is conducted. Secondly, during the conduct of the research, the researcher must ensure that the information given by participants is held in such a manner as not to reveal it to any person (Kaiser, 2012). This means that in cases like this study, participants would have to give their information to the researcher to make sure that they have completed all the needed tasks. It is then the responsibility of the researcher to assure that no information is revealed. Thirdly, when sorting, analysing and reporting the data, the researcher should take care not to link the participants to the data that they offered (Kaiser, 2012). In this study, the participants provided data in groups. This will make it impossible for participants to recognise themselves, or others in the research report (Kaiser, 2012).

3.12.4. Pseudonyms

Pseudonyms are used to disguise the true names of participants, organisations they are affiliated with and their place of residence (Ogden, 2008b). This adds to the participants' anonymity and confidentiality by the fact that they cannot be identified and remain private. Pseudonyms can be assigned by the participants (if they wish to do so), or in a random order of numerical or alphabetical characters, or by the researcher (Ogden, 2008b). In this study, pseudonyms were assigned to the participants based on the group they participated in (alphabetical order) and the order in which they contributed to group discussions. Therefore, a participant in this study will be identified as Participant A3, meaning they were in a group randomly chosen to be A, and contributed to the discussion third.

3.13. Conclusion

In this chapter, the blueprint for this study has been unpacked. The research design, assisted by the research onion, was unpacked from the interpretivist philosophy, through the case study approach and ended with the specification of data collection and analysis strategies. Further, the ethical considerations made for this study were also discussed.

In the chapter that follows, the first sub-research question will be addressed. It will lead to an exploration of the challenges that teachers face when teaching with technology in a LS environment.

4. Chapter 4: Challenges

4.1. Introduction

This chapter will focus on the themes that emerged from analysing the data related to the challenges that teachers experienced in preparing to teach with technology through Lesson Study. The results and discussions will be focussed around the first sub-research question posed for the research as indicated below.

SQ1:

Which challenges do teachers experience when teaching with technology?

The results and a discussion of the findings will be organised in terms of the Challenge Framework discussed in Chapter 2. Results in terms of the challenge themes as shown in the framework (shown in Figure 4.1) will be discussed as "existing" challenges. Further challenges that emerged from the data will be discussed.
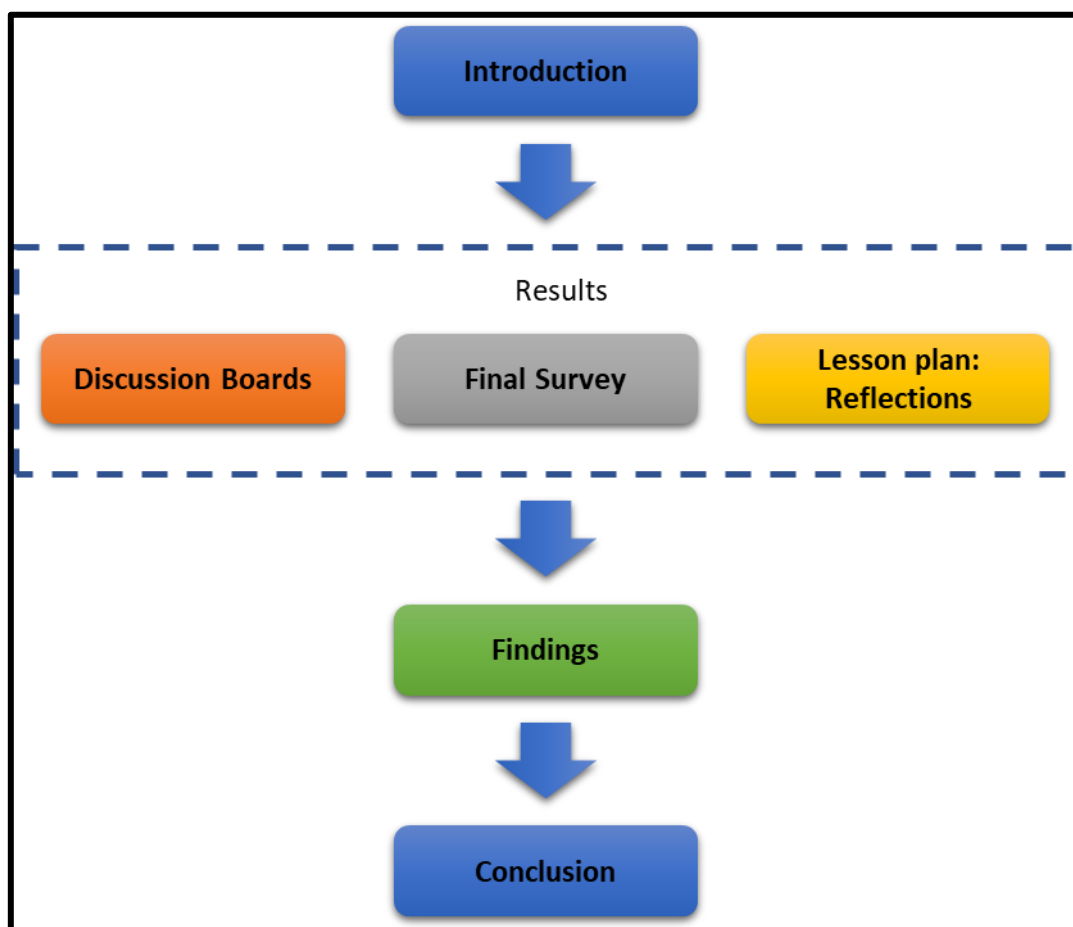
Figure 4. 1: Chapter 4 - Outline

4.1.1. Data Sources

Three data sets were considered to determine the challenges that participants experienced. These are the discussion boards (both group discussions and open discussions), the post-course survey and the lesson reflections.

Four groups' (B, C, D and H) accounts in the discussion forums were used for this research question. Refer to Section 3.9.2 for the explanation on this choice. This included the statements made by the participants in these groups. The statements were scrutinised for accounts that mentioned challenges based on the outline (shown in Figure 4.1) as well as other challenges that emerged.

The Final survey, which consisted of 17 questions, contained two questions related to the challenges that the participants experienced during the blended learning course. These questions are further discussed in Section 4.3.

Lesson reflections were done by the groups at the end of each of the two Lesson Study (LS) cycles. In this reflection, the groups had to formulate their accounts under three headings, namely "What went well", "Even better if…" and "Target". The researcher scrutinised 14 lesson plan reflections, six being from the first cycle and eight from the second cycle. Although focus was placed on the "Even better if…" section of the lesson reflections, challenges that emerged from other parts of the reflection were also noted.

4.1.2. Challenge Framework

Figure 4.2 (a copy of Figure 2.6) illustrates the challenges brought forward by the literature along with the sections where the challenges were discussed in Chapter 2. Using the figure, codes were generated. The data sets were analysed to find statements related to the challenges originating from the literature (existing challenges) as well as new challenges that might have been unearthed in the process (emerging challenges).

Figure 4. 2: Existing challenges

4.1.3. Summary of Codes

The following Table (4.1) shows the codes that were derived from Figure 4.1. Table 4.2, that follows, indicates the additional codes that emerged from the data. The discussion of the results found in the sources mentioned above will be organised in terms of these codes.

Table 4. 1: Summary of Codes: Existing Challenges

Challenge	Code	Subtheme	Code
Access	CA	Affordable learning	CA1
		Access to ICT	CA2
Skills	CS	Teacher Qualification	CS1
		PCK and TPACK	CS2
		Use of ICT	CS3
		ICT Integration	CS4
Economical	CE	Lack of Funds	CE1
Support	CU	Administrative	CU1
		Technical	CU2
		Peer	CU3
		Professional	CU4
Beliefs and attitudes	CB	Interests and motivations	CB1
Governance and policy	CG	Political Influences	CG1
		Educational Policies	CG2

Every data set will be discussed based on these and emerging challenges.

4.2. Results from discussion boards

The first data set, the discussion boards, consisted of seven open discussion boards and 13 group discussion boards. Table 3.4 summarises the purposes of each of the discussion boards. The group discussion allowed participants to communicate with their group members, share images, videos and files and discuss anything they considered important. These discussions were only visible to the members of the groups and the three online facilitators. The open discussion boards were open for all participants. Here, they could discuss matters related to the theme of the discussion boards.

The accounts from the discussion boards were combed through for any statements or accounts related to the challenges mentioned in Table 4.1 above. Further, other challenges were marked to assist the researcher in determining any possible emerging challenges. The accounts that mentioned challenges were then coded and the results were recorded in a MS Excel spreadsheet.

The following section provides a summary of each challenge and their sub-themes including the number of accounts that rendered the related codes. The first example is Table 4.4 that depicts the challenge of access along with the two sub-themes and the results for every code. Following the table is a discussion of the results found under the challenge of access.

4.2.1. Existing challenges: Discussion Boards

4.2.1.1. Challenges of access

Table 4. 2 Summary of access challenges: Codes and Results

Challenge	Code	Subtheme	Code
Access	CA (1)	Affordable learning	CA1 (0)
		Access to ICT	CA2 (27)

It can be seen from the table above that no accounts mentioned a challenge of lack of access to affordable learning (CA1).

The illustration below is a synopsis of the recurring themes that emerged from the participants' accounts relating to the challenge of access to ICT (CA2) in the discussion boards.
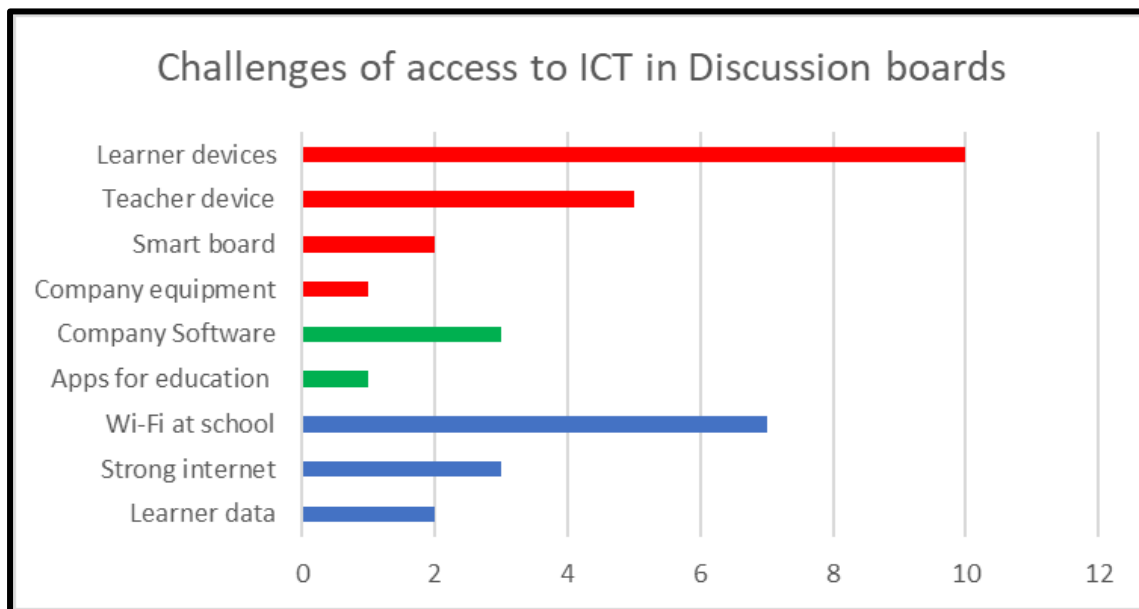
Figure 4. 3: Challenges of Access to ICT in Discussion Boards

It can be seen from the graph, that within this sub-theme, three challenges of access to ICT emerged from the participants' accounts. These are access to devices, access to software and access to the internet.

In terms of devices, the participants voiced the need for learners (10) and teachers (5) to have access to devices. Further, the participants stated the need for access to smartboards (2) and the company's equipment (1).

The software needs that were voiced in the discussion boards, was the need to access the company's software package (3) and more apps (1) that have been identified for education use.

In terms of internet access, participant accounts voiced a need for access to Wi-Fi (7). Those who had access to the internet (through Wi-Fi or other means) stated that they needed access to "strong internet" (high-speed internet) (3) for their classes to run smoothly. Two participants stated that the learners needed access to mobile data so that they could work at school and home.

One participant (D4) stated in general that they felt challenged by the need for access to more resources (CA).

4.2.1.2.   Challenges of skills

Table 4.3 shows a summary of the skills challenges and the four sub-themes found in the literature. The numbers, indicated in brackets next to the codes, show the results for every code. Following the table is a discussion of the results found under skills challenges.

Table 4. 3: Summary of skills challenges: Codes and Results

Challenge	Code	Subtheme	Code
Skills	CS (1)	Teacher Qualification	CS1 (0)
		PCK and TPACK	CS2 (0)
		Use of ICT	CS3 (23)
		ICT Integration	CS4 (2)

In terms of the first two subthemes identified in the literature, CS1 and CS2, there were no accounts by the participants mentioning these challenges.

One general skills challenge that a participant (D4) noted, was the skills challenge in creating a learning environment in the classroom.

One participant (B1) mentioned that they struggled with figuring out how to scroll through a document and also save the document to their computer. Another participant (C1) stated that they struggled to use a certain app. Further, a participant (C3) also stated that they were uncomfortable with the use of ICT in general.

Twenty-three participant accounts mentioned a challenge related to the skills to use ICT (CS3). While coding the data, it was noticed that many of the challenges related to the use of ICT were connected to the use of the learning management system. Therefore, the accounts were then divided into two categories. Typical use of ICT (4) and the skills in using the Learning Management System (LMS) (19). Challenges related to the LMS was the first challenge to emerge from the data. Unlike the other

challenges that will be mentioned in Section 4.2.2, this challenge emerged with a direct link to an existing challenge.

Table 4. 4: Summary of LMS Challenges:
Codes and Results

Challenge	Code
Utilising the LMS	CC (19)

As shown in Figure 4.3 below, the LMS posed four problems to the participants, namely, navigation, uploading, logging in and approach.
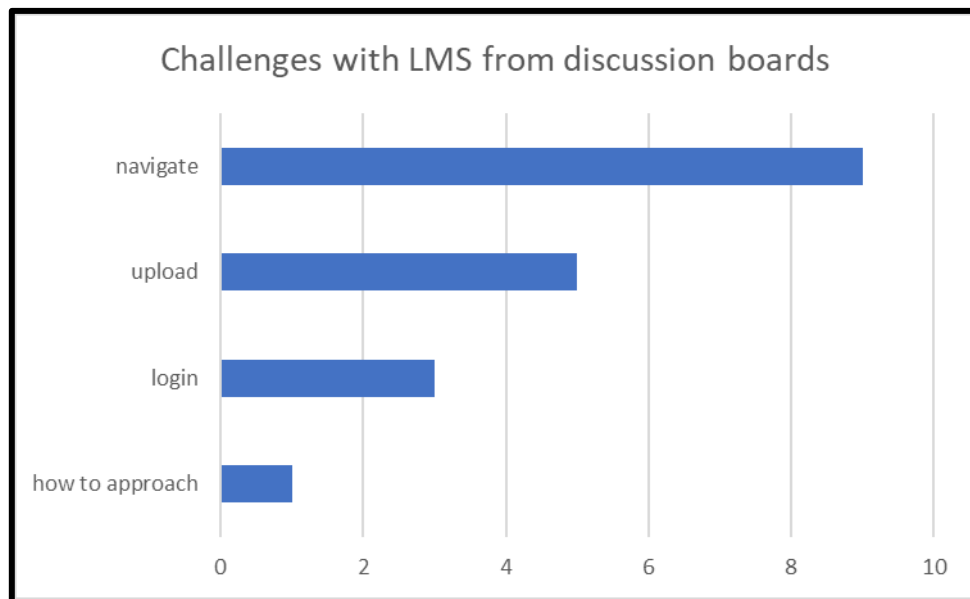
Figure 4. 4: Four LMS challenges

The first challenge that the LMS posed to the participants was that of not knowing how to navigate the LMS (9). Of the nine accounts that pointed to this challenge, five stated that participants struggled to find specific things on the LMS. This included finding the assignment briefs or the places where tasks had to be submitted. Two participant accounts noted that they struggled to find each other's lesson plans on the LMS. One participant voiced that they struggled to locate the space created for their group collaboration to take place. Another participant's account showed that they were unsure of the steps they needed to follow when working with the LMS. Participants further struggled to upload (5) their assignments, documents and photos to the LMS. Four participants noted in their accounts in the discussion boards that they struggled to log into the LMS. It should be noted that this challenge had to be overcome for their accounts to reflect on the discussion boards, but it is nevertheless a challenge to note. One participant stated that they did not understand how to approach the online working

environment created through the LMS. They stated that they did "not have the know-how of how [to] share [their] experience" (E3).

In terms of the challenge of integrating ICT into teaching (CS4), two participants (C2 and D3) noted they had a challenge. Both their accounts mentioned that they were challenged by the fact that they had to use apps in their lesson of which D3 specified that the use of a variety of apps was a challenge.

4.2.1.3.   Economic challenges

We now turn to the economic challenges that were present in the data. A summary of the challenges and the single sub-theme is shown in Table 4.5 along with the number of accounts related to the codes

Table 4. 5: Summary of economic challenges: Codes and Results

Challenge	Code	Subtheme	Code
Economical	CE	Lack of Funds	CE1 (2)

Throughout the discussion boards, only two participants (B1 and B2) mentioned that they experienced economic challenges. Their accounts stated that they were challenged by the fact that they were "teaching learners who cannot afford to pay for excursions" (B1) due to the learners' economic challenges.

4.2.1.4.   Support Challenges

The support challenges and the four sub-themes brought forward by the literature are summarised with the results in Table 4.6.

Table 4. 6: Summary of support challenges: Codes and Results

Challenge	Code	Subtheme	Code
Support	CU (1)	Administrative	CU1 (0)
		Technical	CU2 (7)
		Peer	CU3 (1)
		Professional	CU4 (0)

It is worth noting that two support challenges, namely Administrative support and Professional Support, were not brought up in participant accounts.

Technical support challenges (CU2) that were present in participant accounts rendered three unique challenges. The participants firstly noted a support necessity for the use of the LMS (4). This relates to the skill challenges (CS3/CC) mentioned above. Secondly, two participants stated that they needed technical support from the training team. This related to aspects of device incompatibility, discoverability,

connections and charging as well as the understanding of file formats that can be handed in for the assignments. The third challenge mentioned was that participants needed technical support in the use of particular apps. Two participants mentioned this as a challenge.

Only one participant (C1) stated that they had a challenge with peer support (CU3). The support needed related to the participant needing their peers to review their lesson plan and give input on it.

4.2.1.5.   Governance challenges

Governance challenges are the last challenge brought forward by the literature, as shown in Figure 4.1. Table 4.7 below, shows a summary of the challenge and sub-theme, along with the number of accounts that rendered the related codes.

Table 4. 7: Summary of governance and policy challenges: Codes and Results

Challenge	Code	Subtheme	Code
Governance and policy	CG (1)	Political Influences	CG1 (0)
		Educational Policies	CG2 (0)

With regard to governance and policy challenges, one participant (C2) stated that they had a challenge convincing their school principal to support the use of technology in the school.

4.2.2. Emerging challenges: Discussion Boards

The discussions that follow relate to new challenges that were identified in the participants' responses on the discussion boards. From the analysis, three emerging challenges, namely challenges with the LMS, challenges of other commitments and challenges of time were identified along with a list of general challenges. The first of these challenges, challenges with the LMS (CC), is discussed in section 4.2.1.2. The remaining challenges are discussed below.

4.2.2.1.   Challenge of other commitments

Seven participants noted that they had challenges related to other commitments during the fulfilment of the blended learning course. These can be described as work-related commitments and personal commitments.

Table 4. 8: Summary of challenges of other commitments: Codes and Results

Challenge	Code
Other commitments	CW (7)

In terms of work-related commitments, participants noted in four accounts that they were caught up in work-related matters. Added to this, one participant noted that they were caught up in duties outside their teaching responsibilities having to set papers at the Department of Basic Education. Participants were also challenged by the fact that they had to attend to personal commitments. Here, two participants had to attend to emergencies. They did not specify the nature of the emergency.

4.2.2.2. Challenges of time

It was further noticed from participant accounts that time was an emerging challenge. As Table 4.9 indicates, it was seen that teacher time and learning time are subthemes that emerged from the challenge of time.

Table 4. 9: Summary of time challenges: Codes and Results

Challenge	Code	Subtheme	Code
Time	CT (6)	Teacher time	CT1 (5)
		Learning time	CT2 (2)

In general, six participants stated that they felt the need for longer training time in the face to face session of the blended learning course. This was stated because the participants felt that there was a need for more time to be spent with the "lecturers" (H1) so that they could go through all the activities that were planned in the course. They felt that there was a lot of content to cover (C4), and that time could be provided for the participants to present the lesson they planned to the group of participants (H4). Further, a participant (H3) stated that time had to be provided to go into more detail, and that should be worked into the training to assess individuals.

The challenge of teaching time was brought up in five participant accounts. Lesson time was brought up by three participants. One participant noted that they were "worried about how long [the lesson presentation] [would] take" (B2). Another (C1) stated that due to waiting for a strong internet connection (related to the challenge of access to ICT), a lot of time was wasted. Lastly a participant noted that they were challenged by the fact that their lesson was not at "least 50 minutes [long]" (C2).

Further, a participant (B2) stated that they needed more time to work with and explore apps. Two participants (B1 and C1) added that teacher's time is a challenge as it takes a lot of time to prepare for lessons, due to waiting for others' inputs (B1) and having to prepare materials like videos (C1).

In terms of the challenge of the lack of learner time, two participants (B2 and D4) noted the challenge. Both statements related to the fact that learners needed more time to finish the activities required to be done in class.

4.2.2.3. General challenges

Besides the challenges mentioned above, the participants also referred to other, more general challenges. Thirteen broad themes emerged from the analysis. Figure 4.4 shows the breakdown of these challenges in descending order of the number of accounts where the challenge was found.
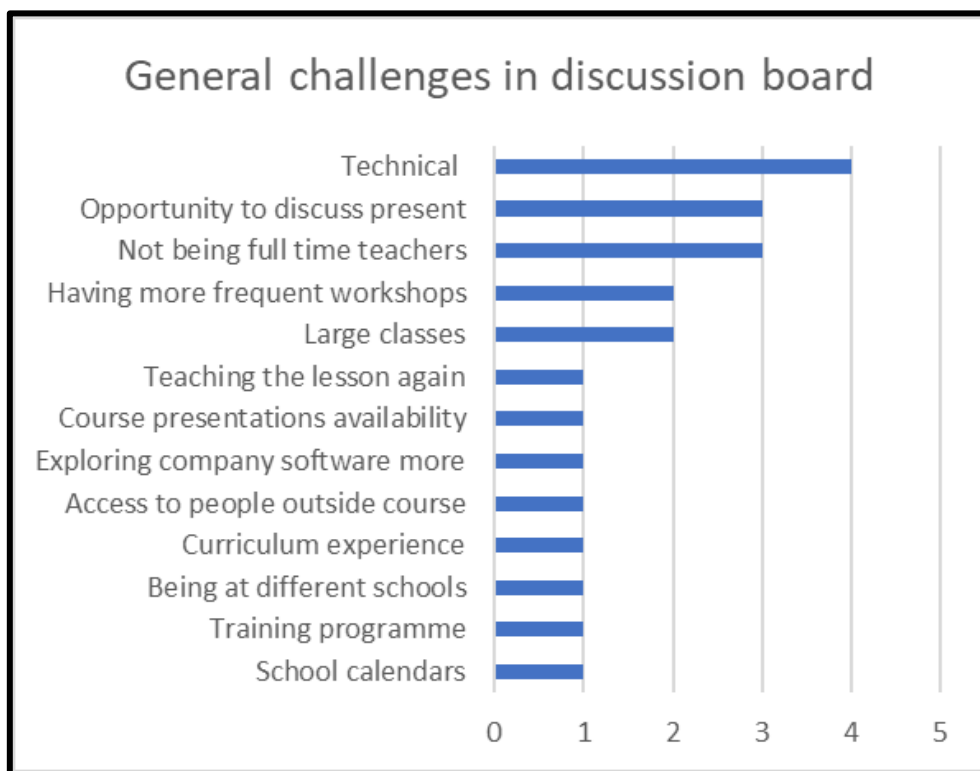
Figure 4. 5: General challenges in discussion boards

In terms of general challenges, 13 subthemes were identified out of the 23 accounts that indicated that participants experienced a challenge. They will be discussed in descending order of the number of mentions.

The first general challenge that four participants noted was **technical challenges**. Two participants noted that there was some technical fault with the devices that they used as a teacher (C3 and B1). The technical challenges also included the need for more screens in the classroom so that all learners could see (H1) and that the devices used for training were different from the ones available at schools (B1).

Three participants noted that they needed an **opportunity to present** their lesson at the face-to-face session of the course. The participants noted that they would have liked to discuss their lesson plans (B2 and H3) and present their lessons to the group at the course (C2 and H3). This related to the challenge of time noted in Section 4.2.2.2 above.

Not being full-time teachers was a challenge noted by three participants. This challenge was iterated in the fact that some participants were not teachers at all (H3). They did not spend spent their time as full-time teachers (E1) and that they were teachers while being school administrators.

The challenge of **large classes** was the next general challenge noted by two participants (C2 and B3). Both participants stated the need for smaller classes by (C2) noting that classes should have less than 30 learners. B3 noted that the classes needed to be smaller so that they did not have to be divided into groups to work with technology.

Two participants (B1 and C1) noted the need for having **more frequent workshops**. Both participants stated that this need exists for teachers to sharpen and improve their skills.

The challenges included **administrative challenges** such as different school calendars due to participants being from different countries (J4), the training programme interfering with the school's exam programme (C3) and being at different schools (H3).

Further, **teacher experience** seemed to be a challenge. This came up in terms of teachers needing more curriculum experience (H3) and the need to explore the company software more (B2).

The challenges then became more diverse. One Participant (D4) noted the need to have access to the people they worked with in the course, outside the boundaries of the course. Another (C1), stated they needed the course presentations to be available asynchronously so that they could work through them again. Lastly, one participant stated that they would have liked to reteach the lesson planned to improve the use of technology in the lesson (B1).

4.2.3. Summary: Literature challenges not in discussion boards

Up to this point, the challenges identified in the literature, as well as emerging challenges, were discussed. To address the Challenge Framework in terms of this study, it is important to consider the challenges that were not addressed by the data. Doing so requires a holistic view of the challenges that were not addressed in all the data available. The list below shows the challenges that were not present in the accounts of participants in the discussion boards.

- Access to affordable learning
- Challenges relating to teacher qualification
- Skills challenges of PCK and TPACK
- Administrative support challenges
- Professional support challenges
- Challenges of beliefs and attitudes
- Challenges of political influence
- Challenges of educational policies.

4.3. Final survey

From the final survey, two of the 17 questions related directly to the challenges that the participants faced during the run of the course. A discussion of the results of these questions follows.

Question 8: Which challenges did you experience during the online lesson planning process?

In response to this question, a range of responses were produced. This question was answered by 28 of the 33 participants who answered the survey. Figure 4.6 below shows the challenges that emerged from the analysis of the responses.
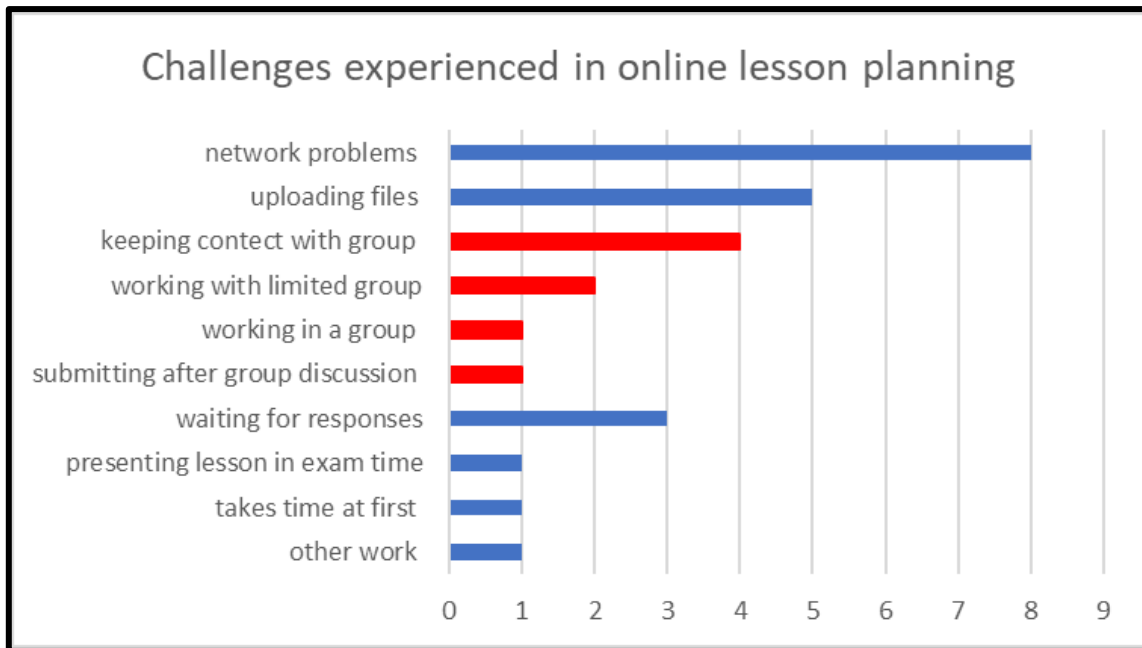
Figure 4. 6: Challenges experienced in online lesson planning

In Figure 4.6 one can see the challenges that emanated from the analysis of question 8 of the final survey. The challenges are shown in descending order with network problems being most often mentioned in participant accounts. The challenges indicated in red are linked to group challenges. Keeping this in mind, we now turn to the next question in the final survey related to challenges.

Question 10: Which challenges did you experience during the teaching of the lessons planned?

The responses to the second question related to challenges, shown above, were then analysed, and ten themes emerged. Figure 4.7 shows these themes in descending order of the number of accounts in which they were mentioned.
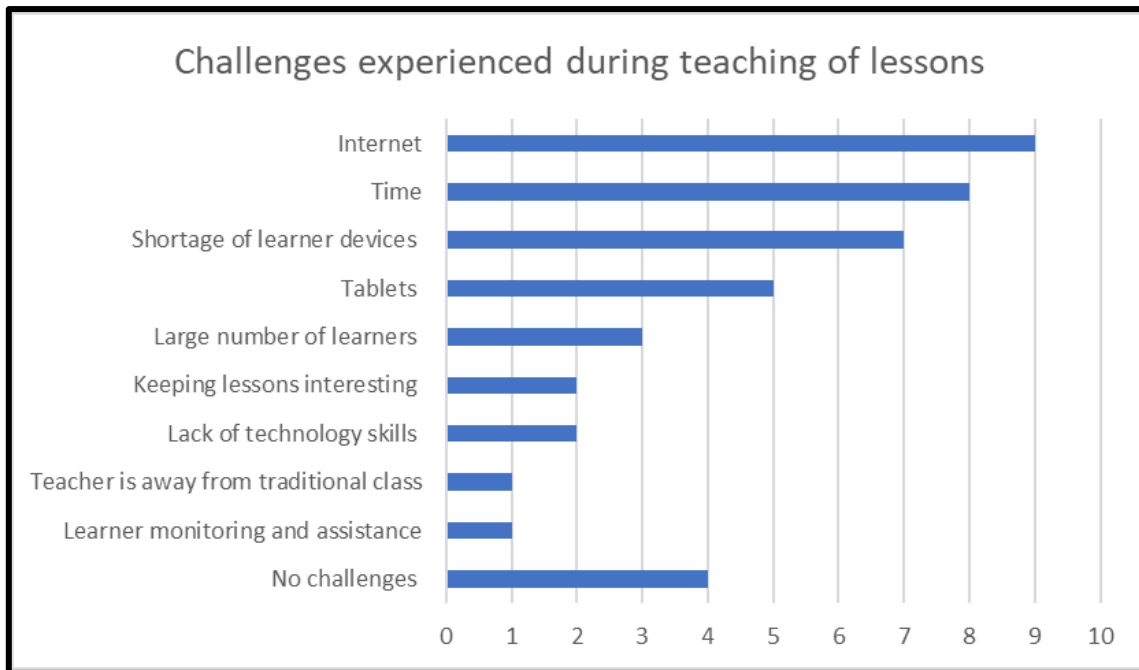
Figure 4. 7: Challenges experienced during teaching

In this figure, it is evident that internet connection was the most frequently mentioned challenge concerning this question. The list ends with two challenges that were mentioned by only one participant. Interestingly, out of those who answered the survey, four participants stated that they had no challenges during the teaching of the lessons they planned.

As in the preceding section, the challenges will now be discussed based on the existing challenges, followed by emerging challenges.

4.3.1. Existing challenges: Final survey
4.3.1.1. Challenges of Access
Question 8: Which challenges did you experience during the online lesson planning process?

In total, eight accounts mentioned network problems as a challenge during the online planning process. In four cases, the challenge iterated itself in the form of poor network conditions. Three participants mentioned that they did not have access to the internet, with another indicating that they did not have mobile data. One participant stated that the internet was down due to having no electricity at school.

Question 10: Which challenges did you experience during the teaching of the lessons planned?

Of the 29 participants who answered this question, nine (9) referred to the internet connection being a challenge when teaching the lesson. Of the nine participants, three commented on the lack of internet connection, whereas the others commented on the internet connection being a challenge in general.

A link exists between two themes that were further found in the answers to these questions. The first, a shortage of learner devices was brought up by seven participants. The second, tablets, was mentioned by five. A shortage of learner devices exists as a shortage of devices in general (2) or having no devices at all (2). Two participants also referred to a shortage of laptops. Three participants referred to a shortage of tablets in their classrooms when teaching their lessons.

4.3.1.2. *Challenges of skills*

Question 8: Which challenges did you experience during the online lesson planning process?

Five participants mentioned that they had a challenge with uploading files to the Learning Management System for their group members to see and for the assessors to assess. This was especially the case for three participants who struggled to upload videos to the LMS and another who could not manage to upload a large file to the system.

Question 10: Which challenges did you experience during the teaching of the lessons planned?

Lack of technology skills is a challenge that was mentioned by two participants. In both cases, the participants referred to the learners' unfamiliarity and lack of skills as the root of the challenge.

4.3.2. Emerging challenges: Final survey
4.3.2.1. *Challenge of other commitments*

Question 8: Which challenges did you experience during the online lesson planning process?

Being occupied in other work is a challenge stated by one participant in response to this question. The participant stated that other work commitments made it difficult to focus on the lesson planning process.

Question 8: Which challenges did you experience during the online lesson planning process?

One participant noted that following the online lesson planning process and compiling a form, challenged them as it took time to get through the process at first. They stated further that they took a day-to-day approach which made it less time-consuming.

Question 10: Which challenges did you experience during the teaching of the lessons planned?

Although eight participants referred to time being a challenge, the predominant argument from five of these participants was that there was not enough time for them to teach. This links to the challenge of teaching time, as discussed in the discussion boards. Further, the participants referred to time being a challenge in terms of preparation (1), the time at which the course's tasks had to be completed (1) and time being a challenge in general (1).

4.3.2.3.   General challenges

Question 8: Which challenges did you experience during the online lesson planning process?

Indicated in red in Figure 4.5, are issues related to the group work expected from the participants during the course. The first problem that four participants noted was that they were challenged in the lesson planning process when they struggled to keep in contact with their group members. Further, two participants stated that they were challenged by having a limited number of group members. Here, one had to work alone, whereas another had lost the support of group members due to them not being full-time teachers. One participant further stated that it was challenging to submit the lesson plans after group discussion. One participant stated that group work, in general, was challenging.

Three participants indicated that they were challenged by the fact they had to wait for responses from their group members. All of these participants stated that they were not online at the same time. One participant noted that it would sometimes take up to two days to receive a reply.

The course schedule was mentioned as a challenge in one participant account. The participants stated that they were challenged by the fact that the course expected them to present their lessons during the examination period in their school.

Question 10: Which challenges did you experience during the teaching of the lessons planned?

Three participants stated that they had a considerable number of learners in their classes. The participants clarified that the classes where between 45 and 60 learners (1) and that their classes were overcrowded (1).

Two participants stated that they had a challenge keeping their lessons interesting.

One participant referred to it being challenging for them to be away from their "traditional classroom" and having to teach in the new way required by the course. Another stated that one teacher was not enough to monitor and assist learners.

4.3.3. Summary: Literature challenges not in final survey

Question 8: Which challenges did you experience during the online lesson planning process?

The list that follows, indicates the challenges that were not brought up by the participants' responses to the question.

- Economic Challenges
- Support Challenges
- Challenges of beliefs and attitudes
- Governance challenges

Question 10: Which challenges did you experience during the teaching of the lessons planned?

The challenges listed below were not addressed by the responses that the participants had to this question:

- Economic Challenges
- Support Challenges
- Challenges of beliefs and attitudes
- Governance challenges
- Challenges related to the using of the LMS
- Challenges of other commitments

From the two questions, it can be seen that economic challenges, support challenges, challenges of beliefs and attitudes as well as governance challenges were not experienced (or at least not mentioned) by the teachers when planning the lesson. The results differed where the accounts of challenges faced when teaching the lesson included the challenge of other commitments. Table 4.10 below illustrated this.

Table 4. 10: Summary of challenges not experienced in planning and teaching of lessons

Planning	Teaching
Economic Challenges	Economic Challenges
Support Challenges	Support Challenges
Challenges of beliefs and attitudes	Challenges of beliefs and attitudes
Governance challenges	Governance challenges
	Challenges of other commitments

From the table (4.10), the similarities and differences in the challenges experienced during the planning and teaching of the lessons can be seen. This is further discussed in Section 4.5.3.

4.4. Lesson reflections

As mentioned in Section 4.1.1, lesson reflections were done at the end of the first and second LS cycle. In total, 14 reflections were submitted with the lesson plans that the groups prepared. Table 4.11 below indicates the lesson reflections that were received from the respective groups.

Table 4. 11: Lesson reflections submitted

	GROUP												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Cycle 1		X	X	X					X	X			X
Cycle 2	X	X	X	X				X	X	X			X

Figure 4.8 indicates the number of accounts that referred to challenges in terms of their category in the analysis of the lesson reflections.
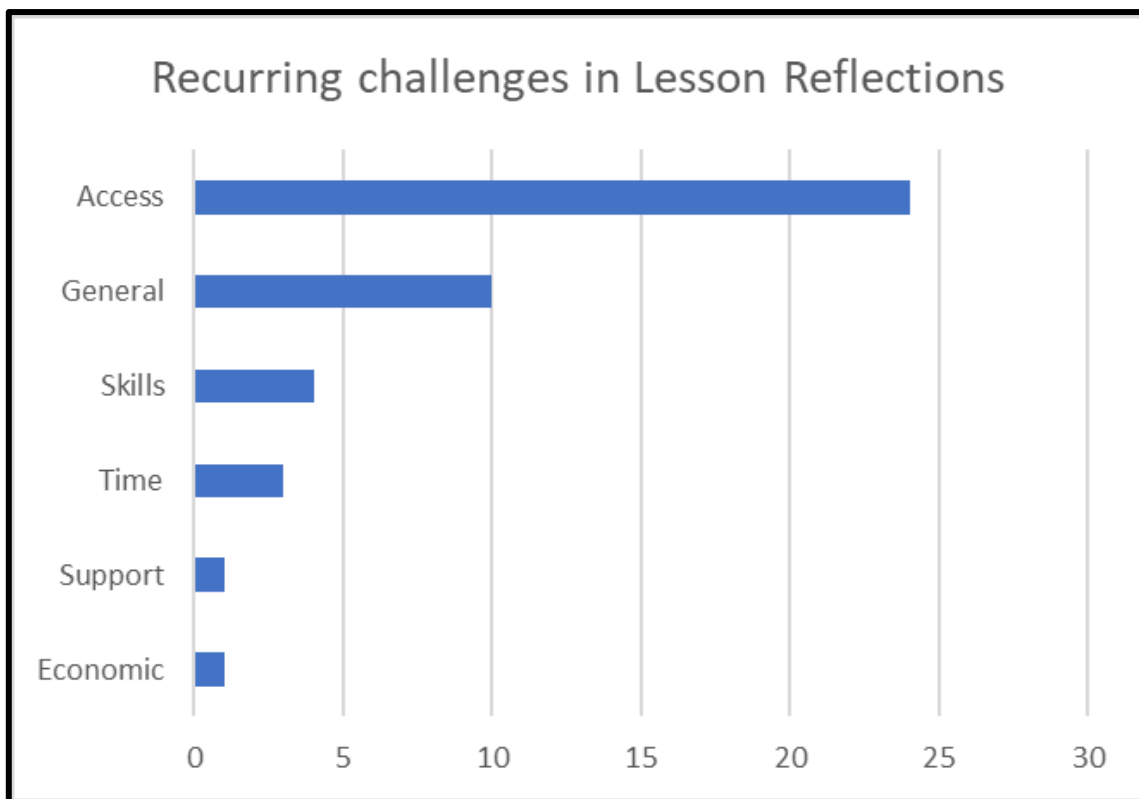
Figure 4. 8: Challenges in lesson reflections

From Figure 4.8, it can be seen that access challenges (CA) proved to be the most significant. Economic challenges were the least prevalent, with only a single account mentioning the challenge.

Again, the results from this data set will be discussed under the headings of existing as well as emerging challenges.

4.4.1.   Existing challenges: Lesson reflections
4.4.1.1.   Challenges of Access

During the analysis of the lesson reflections, 24 accounts referred to challenges of access to ICT. As with the results derived from the discussion boards, three themes emerged. These are challenges of access to the hardware (12), challenges of access to software (4) and challenges of access to the internet (8).

In terms of hardware, two themes emerged namely lack of access to learner devices and lack of access to teacher devices.

For groups who were challenged by the lack of access to hardware, it seems that access to learner devices was the predominant issue. This challenge is mentioned in 11 accounts in the group reflections. Five groups referred to a lack of access to tablets

108

(not having enough tablets) with only one group stating that there are schools that have no tablets. The other four groups stated that the tablets they had were not "enough […] to accommodate all learners" (Group C). Similarly, four groups referred to a lack of access to laptops. Here, three groups stated that there were not enough laptops. The remaining group stated having no access to laptops. Two group accounts stated that the groups were challenged by the fact that learners did not have their own devices, but rather had to use devices that had to be left at school.

Groups were further challenged by a lack of access to teacher devices such as smartboards (1), teacher tablets (1) and screens (1) in the classroom. Two groups, the one referring to smartboards and the one referring to teacher tablets, noted that they had no access to these devices. The group referring to screens stated in their reflection that they did not have enough screens "so that all learners [could see]" (Group C)

Four accounts in the group reflection mention a challenge in access to ICT in terms of software. All four groups stated that they were challenged by the fact that the devices they were using did not have specific software or apps installed. One group mentioned that they were challenged by the fact that they did not have access to the company's software. Two groups stated that they did not have the necessary apps installed on the devices in their classrooms. Another group stated that they would not have been challenged if they had access to different "interesting apps for the learners to use" (Group I).

In the group reflections that referred to groups that were presented with challenges related to internet access; three themes emerged. The first theme, brought up in four accounts, related to there being no internet access at the schools. The second theme, learner mobile data, was mentioned in two accounts. Here, the groups stated that they were challenged by the fact that the learners did not have "access to the internet every day" (Group D) and that learners should have access to the internet "during lessons and at home" (Group B). Two group accounts stated that although there was an internet connection in their classrooms, "connectivity [was] a problem" (Group M) and that a "high-speed internet connection" was needed.

4.4.1.2.   Challenges of skills

In four of the group reflections, reference is made to skills challenges being experienced. Two accounts by the same group (I), mentioned that teachers were challenged by their skills to use ICT (CS3) in that they did not "[familiarise themselves] with the equipment prior to the beginning of the lesson" (Group I). The other two accounts related to the teachers' skills to integrate ICT into their teaching (CS4). Here, one group (C) stated that they did not realise that they "could use [an app] to set introductory questions to their lesson" (Group C). The other group (Group D) stated that they realised that their lesson would have been more successful if they "introduced learners to different apps during the lesson" (Group D).

4.4.1.3.   Economic challenges

Here, as in the discussion boards, Group B once again voiced their challenge in not being able to "take learners on an outing", due to economic challenges faced in their schools.

4.4.1.4.   Support challenges

Only one account referred to a group being challenged because they needed technical support (CU2). This account referred to the group (M) needing technical support by "an assistant from [the Company]" (Group M) in terms of challenges they faced with the devices and the internet.

Two accounts related to the teachers having trouble monitoring and assisting their classes. Here both groups indicated that they needed additional personnel to "help with connectivity problems" (Group J) and to "monitor the technical side of the lesson" (Group C).

4.4.2.   Emerging challenges: Lesson reflections
4.4.2.1.   Challenges of time

Three accounts in the group reflections referred to the teachers being challenged in terms of time. Two of these accounts, both by group C, stated that they were challenged in terms of teacher time. Here, the accounts mentioned that lessons were too short and should "[run] for at least 50 minutes to a double period". Further, the groups mentioned that the teacher had to assist learners with technical issues and "could save time that is […] wasted on assisting each learner". One account stated that learners needed more time to finish with the task they were given in class.

4.4.2.2. General challenges

As with the analysis of the discussion boards and the final survey, the analysis of the lesson reflections also delivered a range of general challenges faced by the groups. Ten accounts showed statements related to general challenges being experienced by the group.

Of these accounts, two related to classes being overcrowded. Here, unlike with the other two data sets, the groups noted that "the mobile classroom [only catered] for 22 learners" (Group J) and that their classes had 45 learners. Another group stated in this regard that class sizes should be kept under "30 learners [per] class for effective control" (Group C).

Group I stated in both their reflections that they were challenged by the infrastructure in their classrooms, and that they needed "round tables for learners to be able to work in groups.

Group H mentioned that they were challenged by the fact that group members were not "close together so that other members could contribute" to the tasks they had to complete as a group.

One group stated that they were challenged by the schedule of the blended learning course as they needed "more learners [to be] available for the lessons" (Group J). This challenge was caused by the fact that some of the schools were already busy with exams by the time that the first lesson had to be presented.

Related to the access challenges mentioned above, an account by group C stating that they needed to have "two screens in the classroom so that all learners could [see]", was the technical challenge faced by the group. This challenge exists because the equipment that was provided to the schools was not effective for teaching.

Further, Group C added in their account that they were challenged in terms of teacher experience in that they needed "more practice with a specific app".

4.4.3. Summary: Literature challenges not in lesson reflections

It can be seen, in the list below, that the analysis of the lesson reflections did not show that groups encountered any of the following challenges:

- Challenges of beliefs and attitudes
- Governance challenges
- Challenges of other commitments

4.5. Findings for sub-research question 1

Looking at the results from the three data sets discussed in this chapter, we now turn to the findings that emerged from looking at the results holistically. In keeping with the format of the three preceding sections, the findings will be discussed in terms of existing challenges as well as the challenges that emerged from the analysis.

4.5.1. Existing challenges

Table 4.12 depicts how the three data sources that related to this research question link with the existing challenges. A detailed discussion follows in Section 4.5.1.1 – 4.5.1.6.

Table 4. 12: Summary of existing challenges found in the data sources

Challenge	Discussion boards	Final survey	Lesson reflections
Access	X	X	X
Skills	X	X	X
Economic	X	-	X
Support	X	X	X
Beliefs and attitudes	-	-	-
Governance and policy	X	-	-

4.5.1.1. Challenges of access

As discussed in Chapter 2 (Section 2.3.1), access is the availability of the amount and type of resources that are required by teachers and learners (Nkula & Krauss, 2014). Two challenges formed part of the challenge of access, namely the challenge of lack of access to affordable learning and lack of access to ICT. In the three data sources, however, the latter of these challenges was a notable challenge to the participants.

As shown in Table 4.12, the challenge of lack of access to ICT came up in all three of the data sources that were consulted for this research question. Throughout the sources, three themes recurred. These themes were lack of access to devices (CA21), lack of access to software (CA22) and lack of access to the internet (CA23). This can be seen in Figure 4.8.

Focussing on the lack of access to devices, it is noted that this challenge pertains to both teachers and learners.

In both the discussion boards and the lesson reflections, a lack of access to teacher devices was uttered as a challenge. Here, the participants mentioned that teachers are challenged by the fact that they do not have access to ICT such as laptops, tablets, smart boards and smart classrooms.

Learner access to ICT in terms of devices such as laptops and tablets were prevalent in all three of the data sources. One can see this challenge to exist on three levels. On the first, learners did not have access to these devices at all. Secondly, learners had access to some devices. This meant that there were devices available, but that all the learners did not have a device to use on their own or some gap in access existed. Lastly, the data from the lesson reflections added that a challenge of lack of access to learner devices existed as learners did not own the devices they were using. These devices would therefore have to be left at school and could not be used at home.

The lack of access to software, although less significantly, was a challenge that was noticed in both the discussion boards and the lesson reflections. This challenge was iterated in the fact that the teachers were challenged by the fact that the tablets and laptops in their classrooms were not preloaded with specific software. This was especially the case in the software that the company supplied to schools. Participants stated in the discussion boards and lesson reflections that they were challenged by the fact that they did not have access to this classroom management software.

Perhaps the most prominent challenge in terms of lack of access to ICT, is that of a lack of access to the internet. The challenge in its essence is that some have access to the internet while others do not. This challenge mentioned in all three the data sources is however more complex.

Having internet access alone does not overcome the challenge of lack of access to the internet. Those who have access to the internet mentioned (in the discussion boards as well as the lesson reflections) that a need exists for teachers and learners to have access to high speed reliable internet access. This was reiterated in the participant accounts that stated that although they have access to the internet, teachers struggled for them and their learners to connect to the internet.

The challenge of data was again two-sided as it affected teachers and learners. For teachers a lack of data meant that they were challenged in terms of planning their lessons. For learners however this challenge meant that although internet access is a possibility, a lack of data prohibited them from being able to access the internet at school and at home.

Considering the nature of the challenges expressed in the three data sources, the Challenge Framework can be amended to include the three sub-challenges explained above. Figure 4.9 shows the amended challenges that exist in terms of the lack of access to ICT.
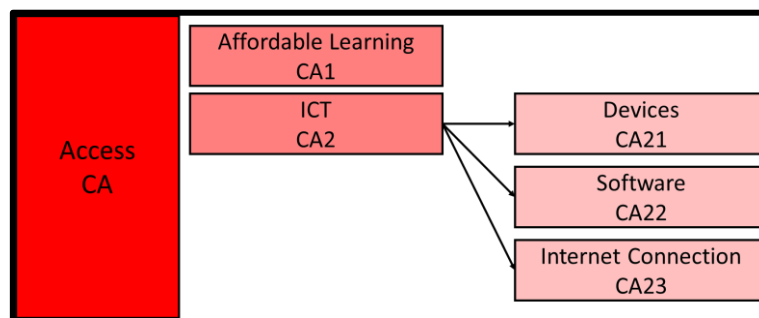
Figure 4. 9: Access Challenges Amended

4.5.1.2.   Challenges of skills

As mentioned in Section 4.2.1.2, there were no accounts by the participants mentioning challenges of teacher qualification (CS1) and challenges of PCK and TPACK (CS2). This might be due to how the participants were chosen (CS1) and that they might already have been qualified teachers. Further, the teachers were not trained (in this course) to identify gaps in PCK and TPACK.

Challenges in the typical skills to use ICT were a predominant theme in all three the data sources. Challenges existed in the participants' skills in the typical use of ICT due to unfamiliarity and lack of necessary skills. Further, participants clarified by indicating that even though they knew how the technology worked, they were unprepared. This led them to be uncomfortable with the technology that they wanted to use.

Challenges in the skills to use the LMS stemmed from this challenge. This was seen mostly in the discussion boards but was also mentioned in the final survey. The challenge manifested in the participants' abilities to navigate the LMS, upload files, log in to the LMS and approaching the online environment in general.

114

The last challenge of skills, ICT integration, was brought up by participants in the discussion boards and the final survey. This discussion was very similar in the two data sets and showed that participants were challenged in using apps in general, using a variety of apps for teaching and knowing when it was possible to use apps.

The Challenge Framework can now be amended to include the two sub-themes expressed in the results in terms of challenges to use ICT. (See Figure 4.10).
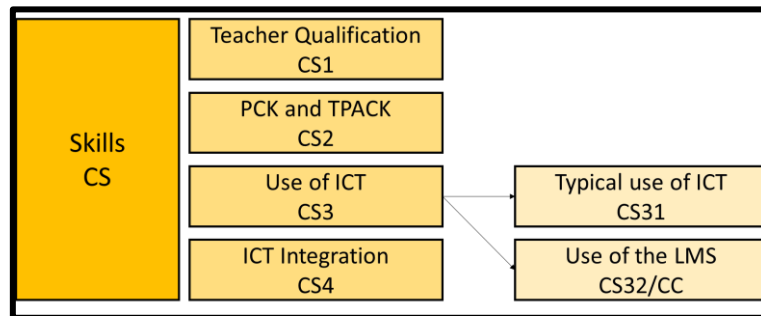
Figure 4. 10: Skills Challenges Amended

4.5.1.3.   Economic challenges

Economic challenges were of a lesser prevalence in the data. Nevertheless, the challenge emerged from the discussion boards and lesson reflections. In this regard, participants mentioned that due to their learners' economic conditions, they were unable to take their learners on excursions. This challenge was largely addressed in the participants' use of technology in their classrooms to expose learners to the information they would have gained on an excursion.

No amendments need to be made to the Challenge Framework based on the results for the three data sources. (See Figure 4.11).
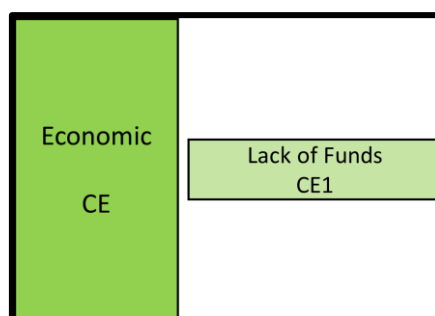
Figure 4. 11: Economic Challenges Amended

4.5.1.4.   Support challenges

As with the literature, the nature of support challenges was divided. In the results, however, it was found that two of the support challenges were not present in participant accounts and that a third challenge could be added to the existing challenges.

Technical support challenges were expressed in three ways. Firstly, the challenge was expressed as a need for support in the use of the LMS. This challenge links to the challenge in using ICT (CS3) mentioned in 4.5.1.2. Secondly, a need was exhibited for technical support from experts such as the University's training team as well as from the company. Lastly, a need was shown for technical support in the use of specific apps.

The challenge of peer support was brought up in a single account in the discussion boards. In this account, the challenge was expressed as a need for peers to assist in the review of lesson plans before submission. This challenge links to challenges in groups elaborated on in Section 4.5.2.

In the analysis of the final survey and lesson reflections, it was found that participants demonstrated a need for support to monitor and assist learners while teaching. In terms of this challenge, not mentioned in the Challenge Framework, the participants were challenged by not having anybody who could assist them during the teaching of their lesson. Participants felt they needed support to assist learners with technical problems so that they could focus on teaching lessons. This challenge links to the challenge of time and the challenge of overcrowding mentioned further in Section 4.5.2.2 and Section 4.5.2.4.

Notably, administrative and professional support were not present in the data sources.

Considering the addition of the challenge of monitoring and assistance support, the Challenge Framework can be amended to what can be seen in Figure 4.12
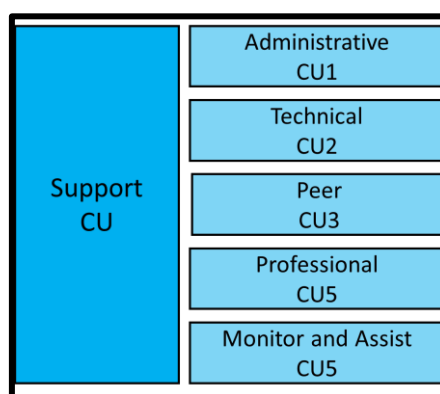
Figure 4. 12: Support Challenges Amended

4.5.1.5.   *Challenges of beliefs and attitudes*

As can be seen in the summary in Table 4.11, the results showed no evidence of participants who experienced challenges related to beliefs and attitudes. This,

however, does not mean that the challenge is irrelevant. Figure 4.13 shows the un-amended version of challenges of beliefs and attitudes from the Challenge Framework.
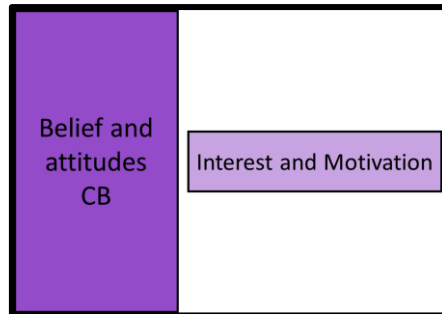
Figure 4. 13: Challenge of Beliefs and Attitudes Amended

4.5.1.6. *Challenges of governance and policy*

Governance and policy challenges were the least prevalent. The challenge was, however brought up in the discussion boards. Participants who experienced this challenge mentioned that it was difficult to convince the school principal of the usefulness of technology in their classrooms.

Seeing as there are no indications to the contrary, the Challenge Framework does not need to be amended in this regard (See Figure 4.14).
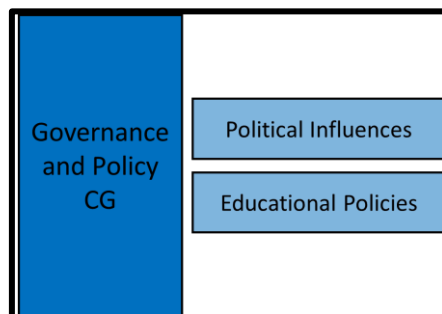
Figure 4. 14: Governance and Policy Challenges Amended

4.5.2. Emerging challenges

4.5.2.1. *Challenges of other commitments*

Being occupied with other commitments is a challenge that was brought up in the discussion boards and the final survey. The challenge mainly revolved around the fact that participants had other work-related matters to attend to in and outside the schools. This challenged them in committing to the tasks (See Figure 4.15).
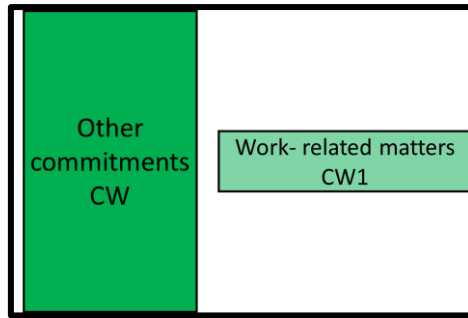
Figure 4. 15: Challenges of other commitments

4.5.2.2.   Challenges of time

Challenges related to time were exhibited in all three data sources. Two sub-themes emerged, namely teacher time and learner time.

The challenge of teacher time established itself as a need for time to prepare lessons incorporating technology and to explore more apps; time to teach a lesson (at least 50 minutes); and time to assist learners with the use of technology in class.

The challenge of learner time was explained in both the discussion boards and the lesson reflections. Here, it was shown that learners presented the need for more time to complete activities and tasks that were given to them in class (See Figure 4.16).
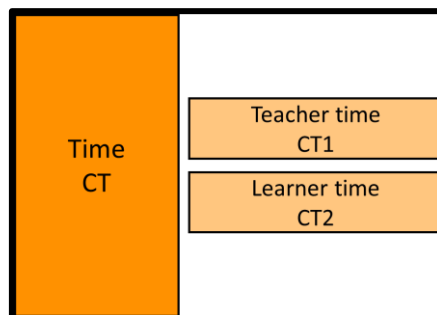
Figure 4. 16: Challenges of time

4.5.2.3.   Group challenges

Working in groups, as prescribed by the blended learning course, was a challenge that came up in all three data sources. The challenge can be characterised in three ways. Firstly, as struggling to keep in contact with group members, due to reasons such as members not being 'online' at the same time. Secondly, by only having access to a limited group as some members do not participate in the group activities and others are unable to participate as they are not full-time teachers. Lastly, the challenge can be characterised by the fact that people are isolated (not at the same school) and finding it difficult to function as a group (See Figure 4.17).

118
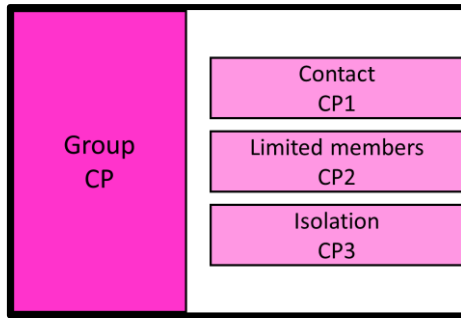
Figure 4. 17: Group Challenges

4.5.2.4. Challenge of overcrowding

Throughout all three data sets, the challenge of overcrowded classes emerged. In cases where this challenge was present, it was mentioned that classes were between 45 and 60 in numbers. This challenge was further aggravated by the fact that the mobile classrooms provided by the company only had space for 22 learners at a time. (See Figure 4.18).)
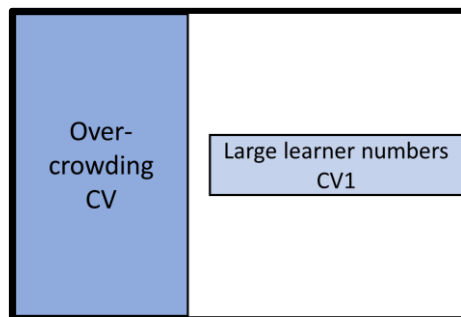
Figure 4. 18: Challenges of overcrowding

4.5.2.5. Technical Challenges

According to the results, the participants experienced technical challenges in terms of faulty devices and inadequate infrastructure. Faulty devices were mostly in the case of teachers not having a dependable or working device that they could use during teaching. The challenge of inadequate infrastructure, however, links with the challenges of access (4.5.1.1) and overcrowded classes (4.5.2.4). This challenge was present in the fact that participants needed more projection screens in their classrooms for learners to be able to see and follow their lessons (See Figure 4.19).
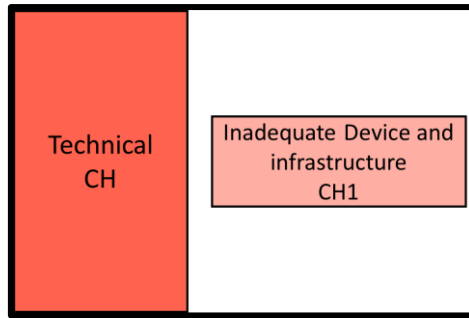
Figure 4. 19: Technical challenges

4.5.2.6.   Challenges with training

The blended learning course followed a meticulously planned programme that in some cases proved challenging. This challenge was revealed in that schools had different internal schedules and that the first month of the blended learning course ran during exams and school holidays. Further, the results indicated a need for the course to allow participants to present their lessons during the face-to-face session to provide feedback from the facilitators and their peers (See Figure 4.20).
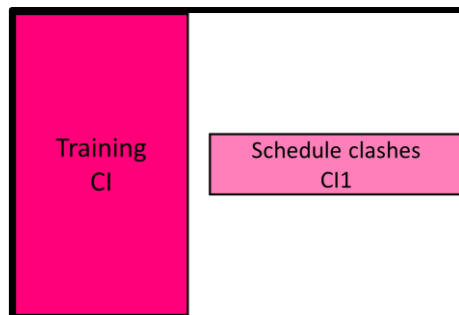
Figure 4. 20: Training challenges

4.5.2.7.   Teacher challenges

The results from the final survey and discussion boards indicated that participants felt challenged by their inexperience. This was shown in that participants felt inexperienced in terms of the curriculum they were teaching. Further, the results showed that the participants' inexperience in teaching led to them struggling to keep their lessons interesting (See Figure 4.21).
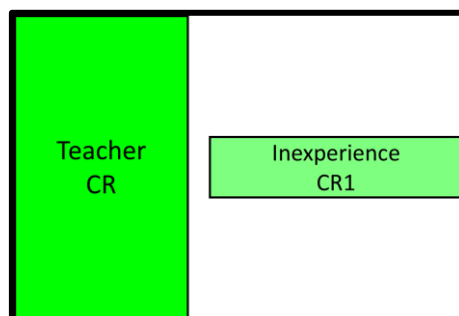
Figure 4. 21: Teacher challenges

4.5.3. Challenges summary

Figure 4.22 indicates the 13 challenge categories that were identified in the exploration of this research question. It goes further to show the challenges that were experienced in this regard and, in some cases, the different underlying challenges to each challenge.
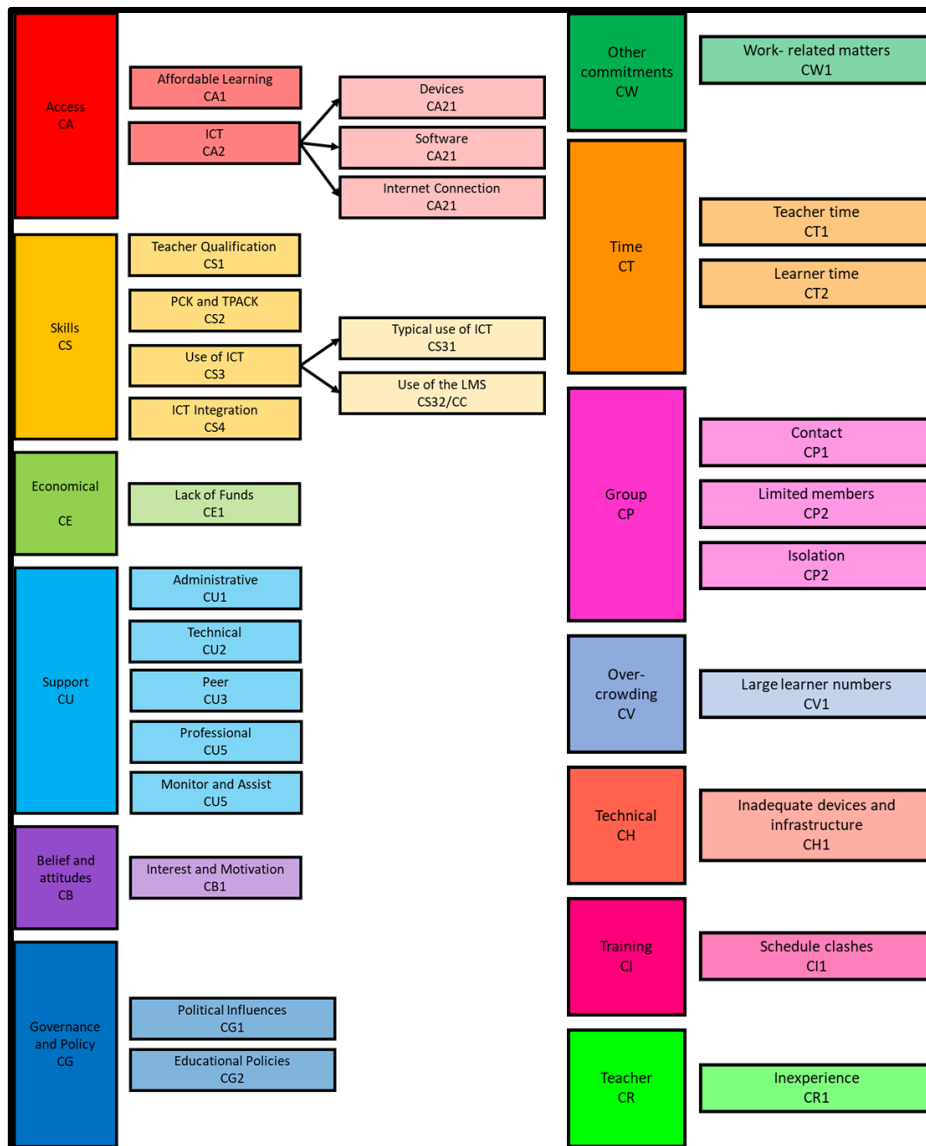
Figure 4. 22: Challenges summary

4.6. Conclusion

In this chapter, the results from three data sources were unpacked as they pertain to the first research questions: "Which challenges do teachers experience in a LS environment when teaching with technology?" The results were shared based on the existing challenges found in literature as well as new challenges that emerged from the analysis of data. Further, findings were unpacked in the same way.

In the next chapter, the results and findings in terms of the second research questions will be shared. Thereafter, in Chapter 6, conclusions will be made with regard to chapters 4 and 5.

5. Chapter 5: Aspects

5.1. Introduction

This chapter will focus (at outlined in Figure 5.1) on the second sub-research question stated below:

> Which aspects should be incorporated into the Lesson Study process to support isolated teachers in teaching with technology?
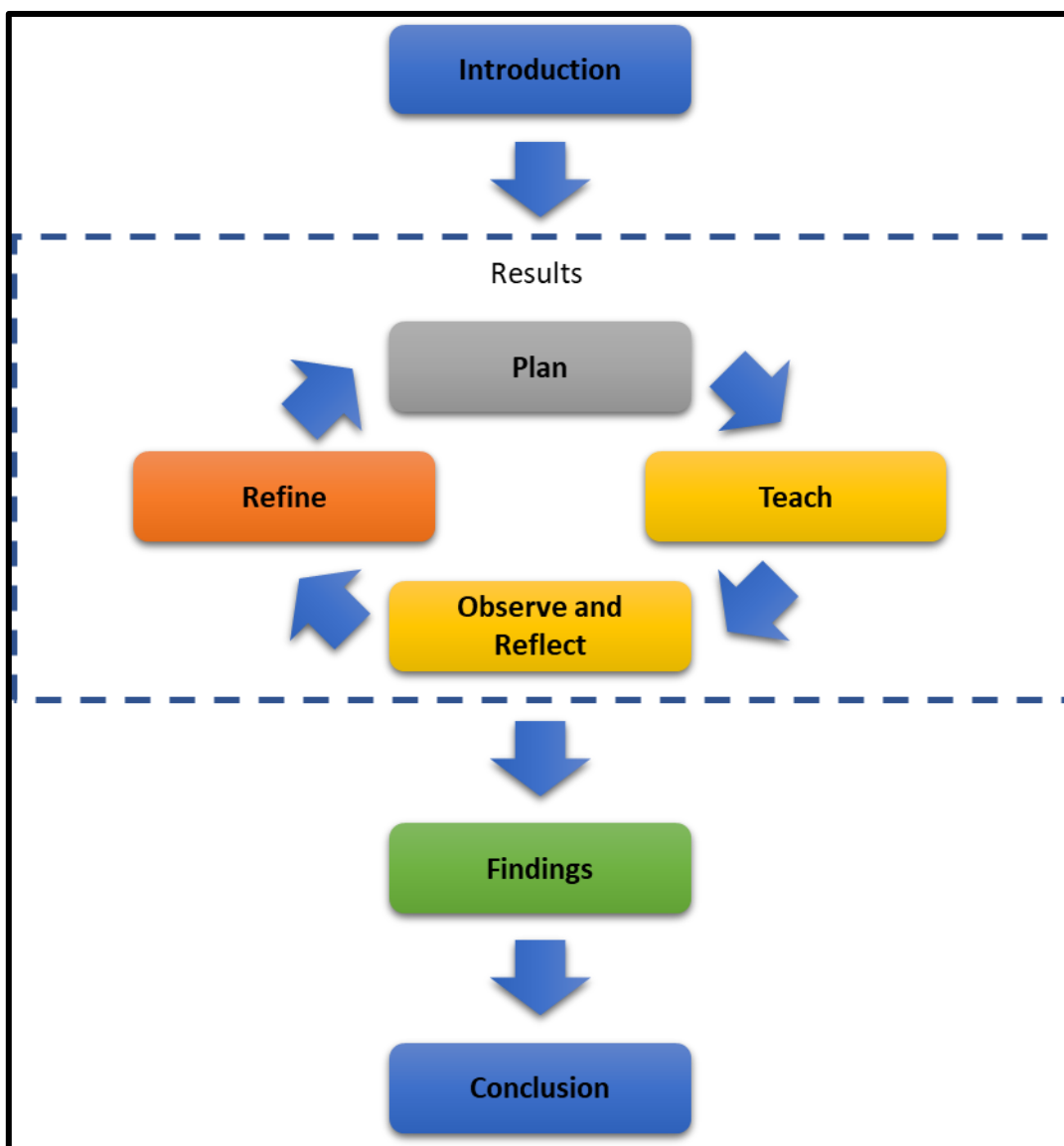
Figure 5. 1: Chapter 5 - Outline

The concept 'aspects' in this research question refers to essential elements that emerged during analysis of the research data and the literature. An aspect is typically something important which supports the Lesson Study (LS) process. When these aspects are absent or not functional, the LS process may not be able to function in such a way that teachers are supported in teaching with technology.

The investigation to identify aspects were structured according to the conceptual framework. Results from relevant data colleiction instruments in each step of the framework were analysed to find the emerging themes or codes. This was introduced in Section 3.10. Figures 3.14 and 3.15, for example, illustrate how aspects were identified from the survey questions.

Some aspects were identified from literature, after which participant data was scrutinized for references to these aspects. An example is the TPACK and Backward Design aspects as described in Section 5.2 (Plan).

Other aspects were identified through the coding of the participant data (as described in Section 3.10) and later linked to the findings from literature (for example in Section 5.2.5). Some new aspects, that did not emerge from literature, were also identified from participant data. An example of this can be seen in Section 5.2.4.

The next section describes the data collection instruments as linked to the framework, elaborating on the discussion in Section 3.10.2 (summarised in Figure 3.10). After this, the results of each section of the conceptual framework is presented in detail.

5.1.1. Data sources

To explore the aspects, four data sources were utilised. This included the group discussion boards, the final survey, completed lesson plans and the observation schedules based on them.

All the group discussion boards (13) were used to explore these research questions. The participant accounts in this regard contributed to the aspects that follow in the discussions below.

From the final survey, the responses to 10 questions (listed in Table 5.1 below) contributed to the understanding of various aspects. The questions are listed below:

Question 1: Which technology interventions are in your school?
Question 2: How did you access the LMS?
Question 3: How did you experience the online collaboration during the post-course section of the Company course?
Question 4: How often did you access the LMS to collaborate with your group members?
Question 5: What did you do when accessing the LMS?
Question 6: How did you experience the online facilitation process?
Question 7: How did you experience the process of lesson planning - first plan a lesson with others, then teach the lesson, then refine and submit a final lesson plan?
Question 9: How did you experience the use of the lesson planning form for the planning and refinement of the lessons?
Question 10: Which challenges did you experience during the teaching of the lessons planned?
Question 15: How did the course impact on your teaching practice?

As mentioned in Chapter 3, four sets of lesson plans were submitted by the participants during their completion of the blended learning course. The lesson plans from two of these sets were analysed to extract the results that are unpacked in this chapter.

The observation schedule was used to analyse the lesson plans. The six items (1.1, 1.2, 1.3, 1.4, 2 and 3) were used to guide the researcher in isolating certain parts of the lesson plans to unearth any aspect that might emerge from the analysis.

5.1.2. Conceptual Framework

To investigate the aspects that need to be incorporated when planning to teach with technology, especially in the context of Lesson Study, the Technology Integration Planning (TIP) model (explained in Chapter 2) was used as a guideline. This led to the development of the Conceptual Framework depicted in Figure 5.2 (A copy of Figure 2.14) seen below. The Conceptual Framework, as it was derived from the literature gave some valuable insights as to the aspects that can be incorporated when planning to teach with technology in the LS context. This included aspects from the TIP model and the LS process and the nature thereof. The blended learning course also had some aspects that could be considered valuable to include as aspects. Further, the participants in their accounts knowingly or not, also indicated some aspects important for the process to be effective.
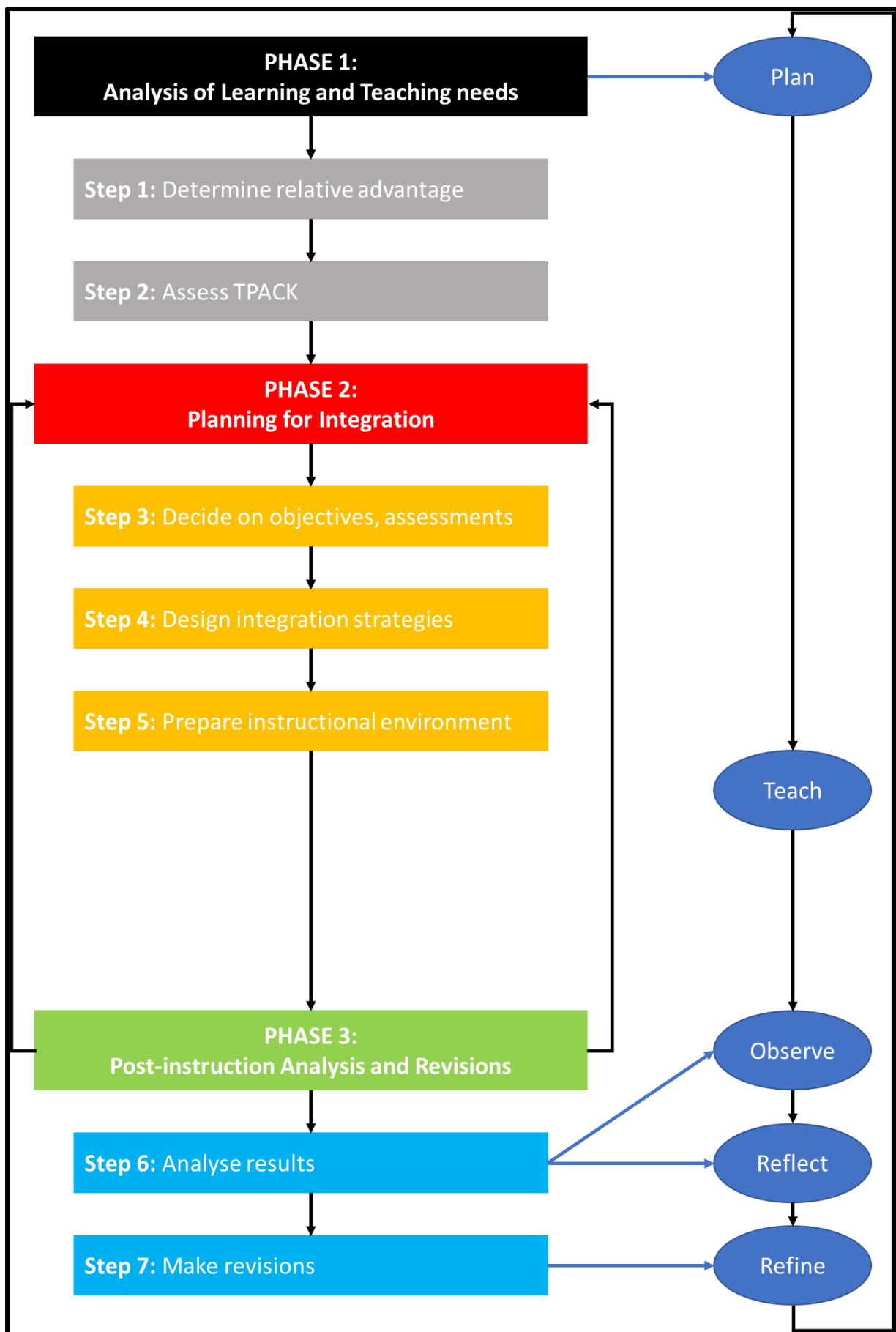
Figure 5. 2: Conceptual Framework

5.2. Plan

If we take the Conceptual Framework as shown above and isolate the planning phase of the LS process (to allow further elaboration in a limited printing space), the planning phase and the TIP model can be depicted as in Figure 5.3. The illustration below shows two important aspects of the planning process, namely the Technological Pedagogical and Content Knowledge (TPACK) framework and the Backward Design. The TIP model further brings in the aspect of technology in step 1, as explained in Chapter 2.
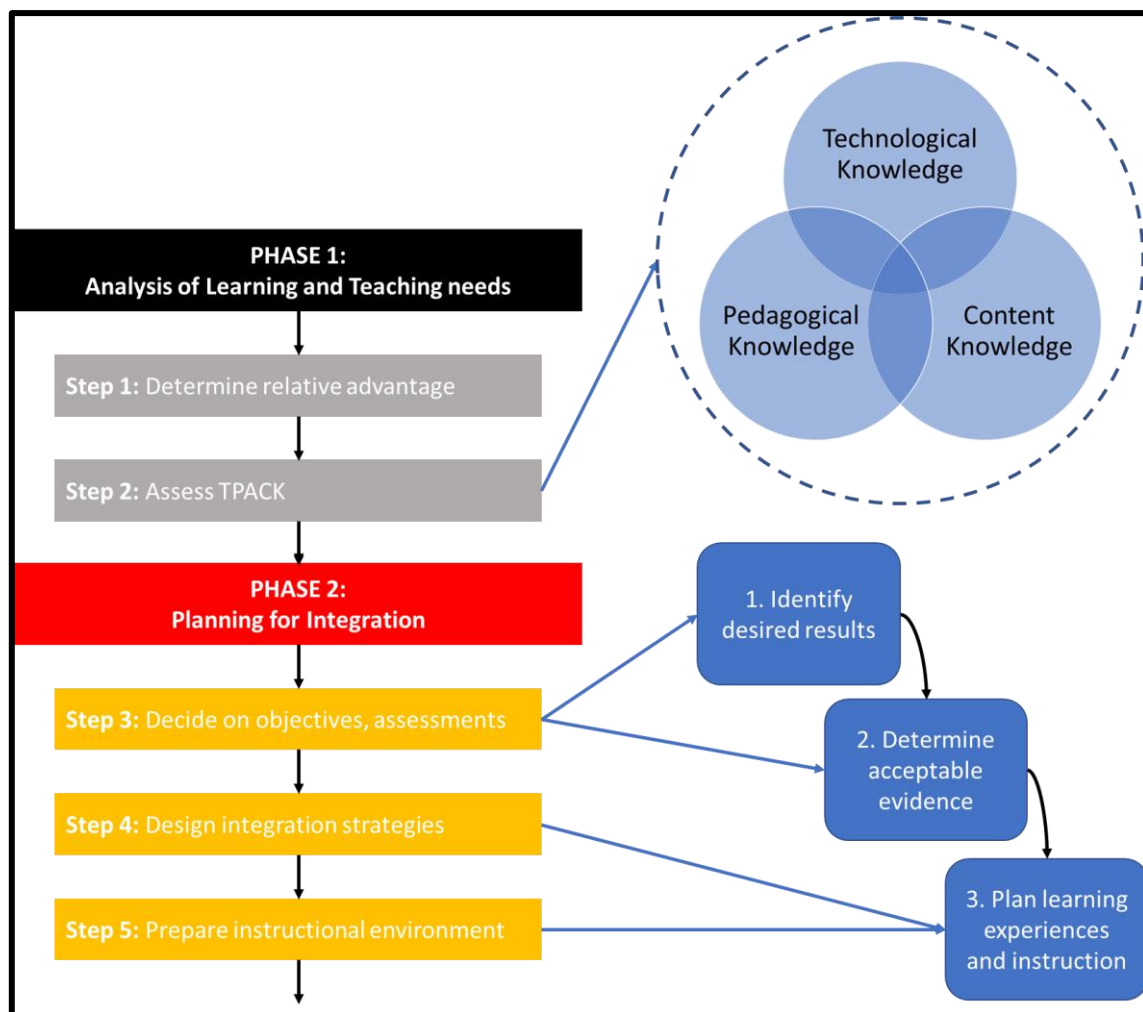
Figure 5. 3: Planning phase and TIP model

The discussions that follow will show the results found in the various data sets in terms of aspects that relate to the planning phase of the LS process. The TIP model will be used as a basis to order the discussion of the results and findings made in terms of the aspects. The first discussion will, therefore, be around the first step that the TIP requires namely "Determine the relative advantage" and the aspects that this step brings to the LS process.

5.2.1. Step 1: Determine relative advantage

All the group discussions were used to find as many as possible accounts that refer to the teachers determining the relative advantage of using a technology-based approach. Ten accounts were noted to refer to the aspects related to determining the relative advantage of a technology-based approach. Using the three considerations found in the literature, namely motivation, advantage and impact (discussed in Section 2.6.1), the accounts were coded. The results of this analysis follow.

Source: Discussion boards

In the first consideration, motivation, three participant accounts noted a clear problem that motivates both teacher and learners to select a specific topic for the LS process. The issue mainly revolved around the fact that "many people [found] the topic […] boring" (B2) and the teacher felt that it was "up to [them] to make it interesting" (B2) and "alive" (B1). Another teacher stated that the "topic [was] not complicated" (H1) and therefore, the teacher was motivated to make it interesting.

The second consideration, advantage, was brought up in five accounts. Two participants noted that the use of technology would enhance learning by bringing a real-life example to learners (B2) and that the lesson "should [therefore] be technology and computer-related" (D2). Two accounts further stated that a technology-based approach would be beneficial in that teachers have "easy access to apps" (A1) and can "download relevant videos" (A1). One participant (B2) stated that despite the expense of a certain product, it was still worthwhile for them to include it in their lesson.

The third consideration, impact, was indicated by only one participant. They noted that the use of apps impacted on their lesson by "make[ing] it easy for learners to grasp the content" (L1).

5.2.1.1 Aspect: Technology

The aspect of technology was informed by two data sets. Firstly, a question in the final survey was used to determine the technology that schools had available to them. Secondly, the lesson planning forms indicated the technology that teachers chose to include in their lesson

The question stated below was used to determine the availability of technology in the schools. Out of the 33 participants' accounts, five interventions were mentioned.

Question 1: Which technology interventions are in your school?

In the responses, four interventions were noted. The first intervention is that of the company. Nineteen of the 33 participants indicated that this intervention was present in their schools. Two of these schools mentioned that their classrooms, provided by the company, were solar-powered. Secondly, two participants noted that they were supplied with technology through a municipal intervention. Thirdly, two participants noted that their school had "Smart Classrooms" of which one mentioned that this entailed that these classrooms are equipped with "internet-connected tablets". Lastly, the Gauteng online initiative was mentioned by one participant as well as an e-learning classroom initiative. Notably, only one of the 33 participants stated that their schools did not have any technology available.

The participants further mentioned the devices that are available in their schools. In this regard, the participants mentioned tablets (7), laptops (3) and desktop computers (2). In terms of tablets, six participants confirmed that all their learners had tablets, with another stating that only some learners had tablets. Two participants mentioned in their accounts that their learners have laptops. The other participant mentioned that only the teaching staff had laptops. Those participants who stated that their schools were supplied with technology from the municipality both stated that they had desktop computers available. It should be noted here that according to four accounts the, intervention by the company included tablets and/or laptops, smart televisions or smartboard (interactive flat panels) and internet connectivity.

Taking this information into account the researcher then turned to the lesson plans to see which technology the participants chose to include in their lessons.

Four sets of lesson plans were compiled by the participants during the two LS cycles. For the sake of finding out which technology the teachers preferred to include in their lessons, only the two refined lessons were used (that is the second and fourth sets). The second set contained 10 lesson plans and the fourth contained 11. Figure 5.4 is a graph of the technologies chosen by the groups for inclusion in their lessons. In this table, one can see the technologies ranging from lowest to highest frequency of inclusion in the lesson plans.
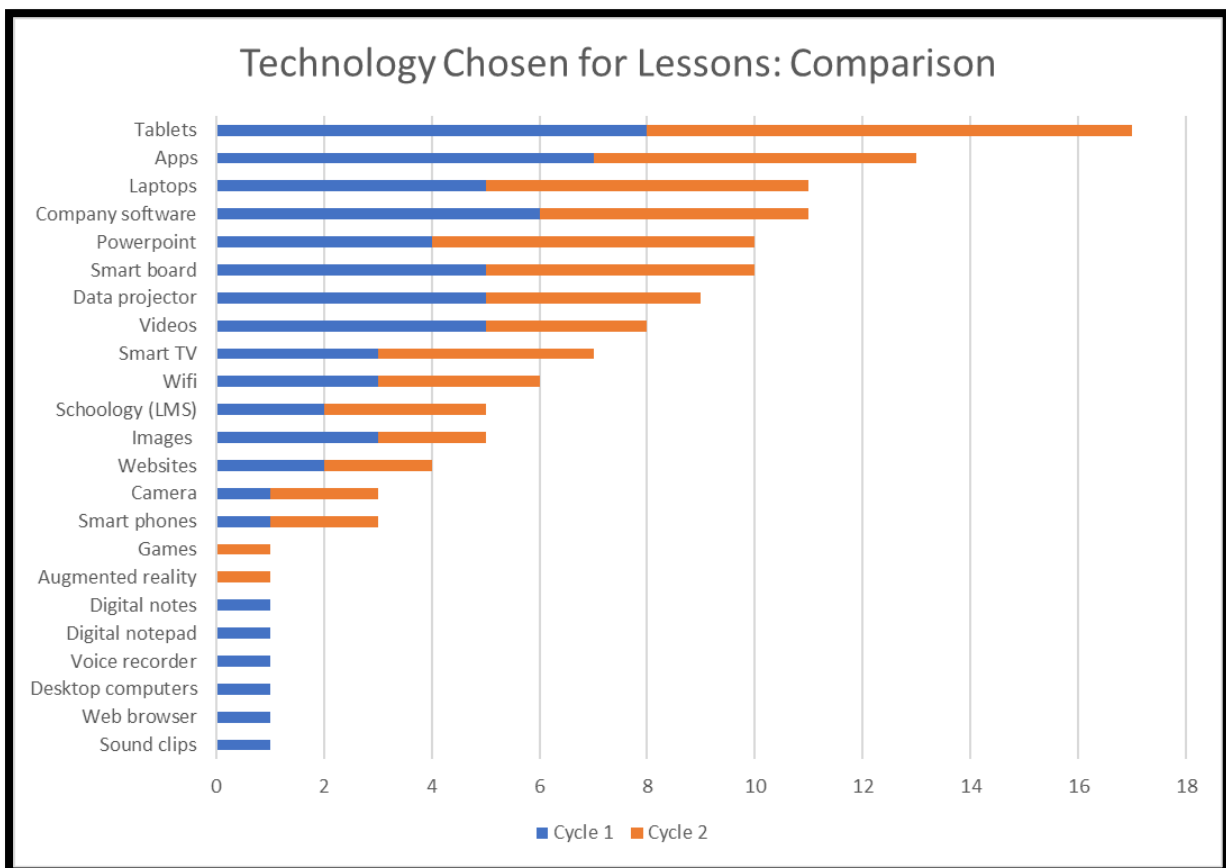
Figure 5. 4: Technology chosen - 2 Cycle comparison

The most frequently used technological devices were tablets (17) often substituted by laptops (11). To a lesser extent, teachers also included smartphones (3) and desktop computers.

Further, the technology choices were more related to the software and applications that were included in the lessons. These included apps (13), the company's classroom management system (11), and MS PowerPoint (10). Some also made use of other open-source learning management systems (Schoology and Socrative).

Teacher technologies (for lack of a better word) that featured quite prominently in the lesson plans included smart boards (10), data projectors (9) and smart TVs (7).

Teachers made use of other digital resources such as videos (8), images (5), websites (4), digital notes (1) and sound clips (1). Some lesson plans (6) also made use of the basic features already available on tablets, laptops and smartphones, namely the camera (3) notepad features (1) voice recorder (1) and web browser (1).

Notably, only 6 of the 21 lesson plans pertinently stated that a Wi-Fi or internet connection was needed for the lesson.

5.2.1.2 Group

It was noted that group is an aspect in this step of the TIP model as participants had to determine the relative advantage of the technological integration collaboratively. This aspect is discussed in more detail in Section 5.2.4.1.

Figure 5.5 below shows the links between the aspects technology and group as they relate to the first step of the TIP model.
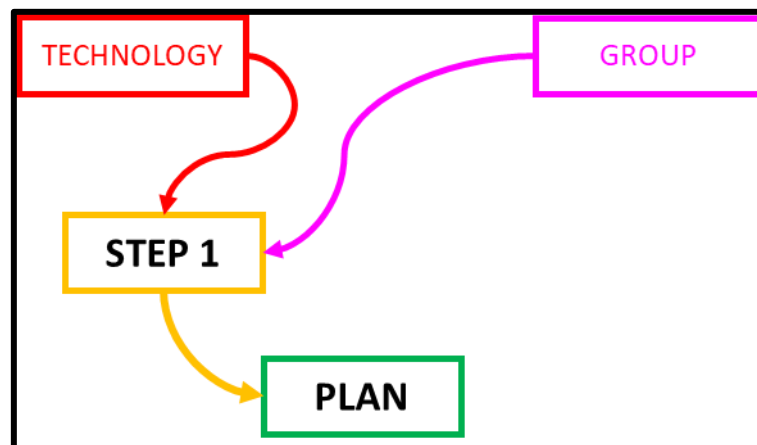
Figure 5. 5: Aspects related to Step 1 of the TIP model

5.2.2. Step 2: Assess TPACK

The TPACK framework was elaborated on in Section 2.4.5, as well as the second step of the TIP model linked with the planning process of the LS process. The course made use of the framework to assist participants in choosing technology that can support their pedagogical and content choices. This was done by using the lesson planning form (provided to the participants) to facilitate TPACK integration

Source: Observation Schedule

To analyse the participants' interaction with the TPACK framework, the observation schedule was used to analyse the lesson planning forms. The observation schedule was used in this case to find out whether participants were able to choose technology to support Pedagogy and Content.

Observation 2: Could the participants choose technology to support pedagogy and content?

The observation schedule in this regard allowed the researcher to make a binary statement (Yes or No) and comment on the decision. The decision was based on the participants' choice of technology in each activity to support their content and pedagogy choices. Table 5.2 below summarises the results from this question.

Table 5. 2: Observations of TPACK

Group	Cycle 1	Cycle 2
A	Yes	Yes
B	Yes	Yes
C	Yes	Yes
D	No	No
E	No lesson plan	No lesson plan
F	Yes	Yes
G	Yes	No
H	No lesson plan	No
I	No	Not indicated
J	No	Yes
K	No lesson plan	No lesson plan
L	Yes	Yes
M	Yes	Yes

From the first LS cycle, the observation schedule was used to analyse 10 lesson plans. Here, as shown in the table above, 7 lesson plans showed that the participants were able to choose technology to support their content and pedagogical choices. From the second LS cycle, 11 lesson plans were analysed, but interestingly, the results were the same. Here, seven lesson plans were noted to contain evidence that the technological choices supported the content and pedagogical choices. It is, however, more important to consider the nuances that exist within the data. From the first to the second LS cycle, one group managed to change their application of the TPACK so that their technological choices were in line with that of their content and pedagogy.

Further, the observation schedule guided the researcher to determine whether the pedagogical choices included the mobile learning strategies proposed by the course.

Observation 3: Were the participants able to apply mobile learning strategies?

Here again, the observation schedule allowed for a binary answer (Yes or No) with a comment on the decision.

Table 5. 3: Observations of mobile learning strategies

	Cycle 1	Cycle 2
A	Yes	Yes
B	Yes	Yes
C	Yes	Yes
D	No	No
E	No Lesson Plan	No Lesson Plan
F	Yes	Yes
G	Yes	Yes
H	No Lesson Plan	No
I	Not included	No
J	Not included	No
K	No Lesson Plan	No Lesson Plan
L	Yes	Yes
M	No	No

From the 10 lesson plans of the first LS cycle, six lesson plans showed evidence that mobile learning strategies were followed. The other five lesson plans were divided into those that showed no evidence of mobile learning strategies (2) and those who did not include this section in their lesson plans (2). As with the section above, the second LS cycle's 11 lesson plans indicated results that were much the same as the first cycle. Six lesson plans contained evidence of mobile learning strategies being implemented. Although there was now one more lesson plan, and more groups that included this section in their lesson plan, the other five lesson plans did not implement ML strategies.

Figure 5.6 below, shows the aspects that were identified to link with the second step of the TIP model.
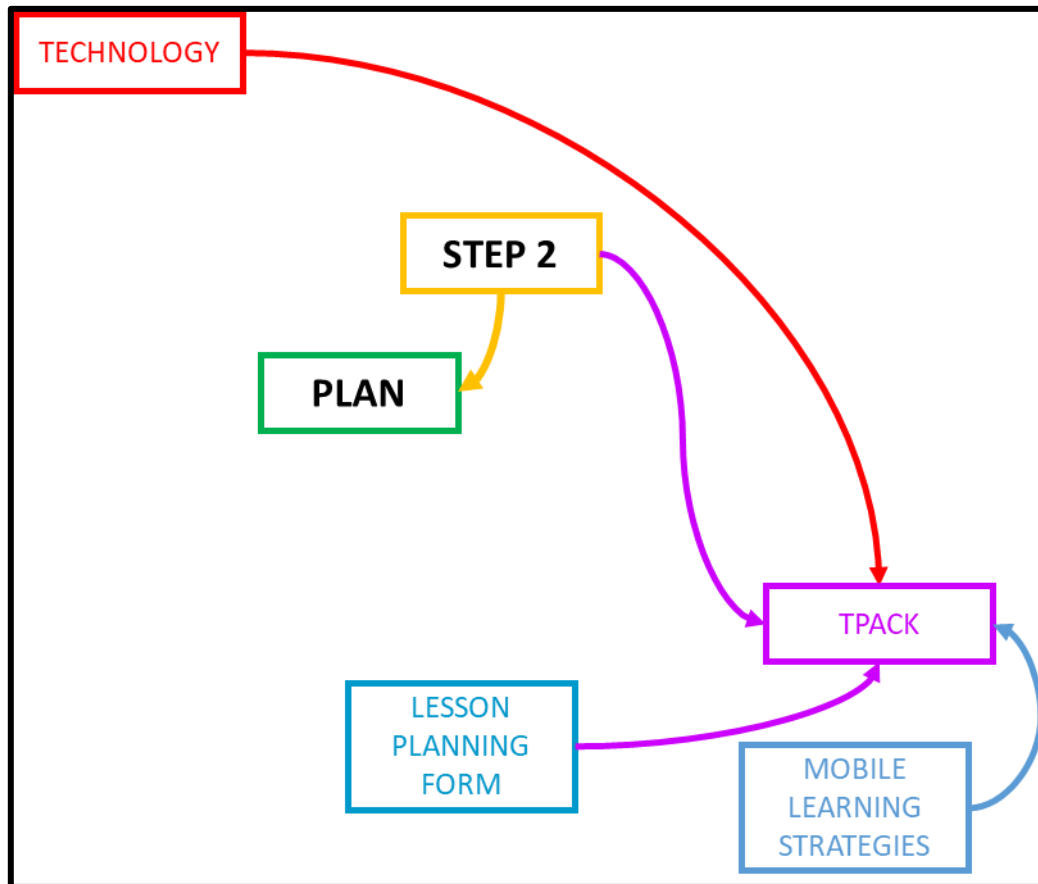
Figure 5. 6: Aspects related to Step 2 of the TIP model

Here, it can be seen that the TPACK framework, lesson planning form, mobile learning strategies and technology were aspects linked to the second step of the TIP model. Firstly, the technology that was identified (discussed in Section 5.2.1.1) formed the basis of the **T**PACK assessment that participants had to do during their planning. The mobile learning strategies, secondly, formed part of the pedagogical choices that participants had to make in their assessment of the T**P**ACK. The lesson planning form linked with the TPACK in that it helped to facilitate the process for participants. The lesson planning form as an aspect is discussed in detail in Section 5.2.4.4.

5.2.3.   Step 3 – 5: Objectives, Assessments; Strategies and Instructional environment

As illustrated in Figure 5.2, Steps 3 to 5 of the TIP model are synonymous with the three steps of the backward design process. This link is also explained in length in Section 2.6.2.

The discussion in terms of the backward design will, therefore, focus on all three steps of the process, namely outcome, assessment and teaching. Seeing that the lesson planning form was used to facilitate the Backward Design process, the observation schedule (Same as above) was used to guide the researcher through the analysis of the lesson planning forms. In the observation schedule, the researcher used Bloom's taxonomy as a means to assess the level of the Outcome, Assessment and Teaching and as an instrument to check the alignment of the planning process.

Source: Observation schedule
Observation 1.1: Outcomes

LS Cycle 1, where ten lesson plans were analysed, delivered the results shown in Figure 5.7 It is important to note that participants were not asked to note a certain number of outcomes, neither were they given advice on the outcome cognitive levels.
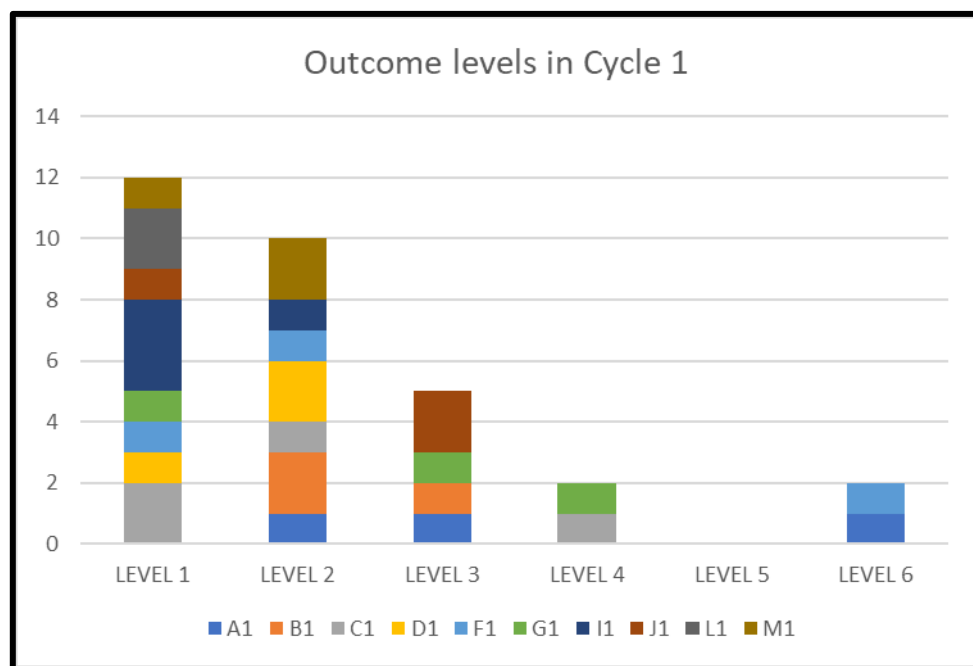
Figure 5. 7: Outcomes observed - Cycle 1

The graph above shows the levels of Bloom's taxonomy on which the groups stated their outcomes. The analysis as explained in section 3.10.2 made it possible to link the outcome level to the group that set the outcome. Note that the outcomes were mostly on the lower levels of Bloom's taxonomy and that the higher levels were sparsely used. It is also interesting to see that no lesson outcomes in this phase were on the "Evaluate level of Bloom's taxonomy.

We now turn to the second LS cycle. Here the distribution of the lesson outcome levels looks quite different.
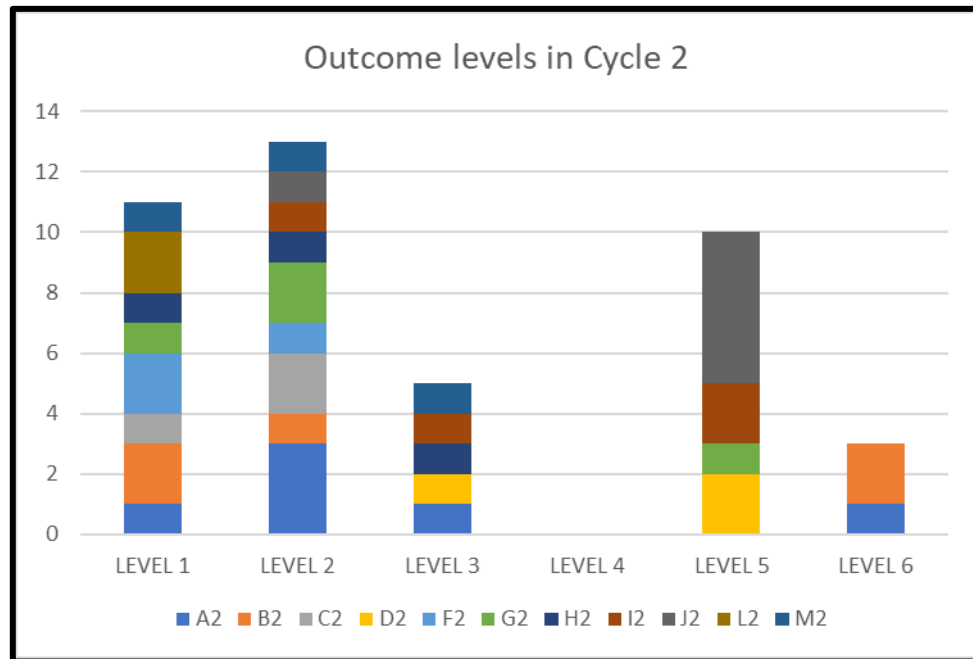
Figure 5. 8: Outcomes Observed - Cycle 2

It can be noted from this graph (Figure 5.8) that the lesson outcome levels were more distributed than in the first cycle. The lesson in this phase, however still mostly positioned on the lower three levels of Bloom's taxonomy, now included more high-level outcomes. Note that in this cycle no lesson outcomes were on the analyse level. Comparing the lesson outcome levels of the two cycles, shown in Figure 5.9 below, we can see the difference in the outcome levels in the two cycles.
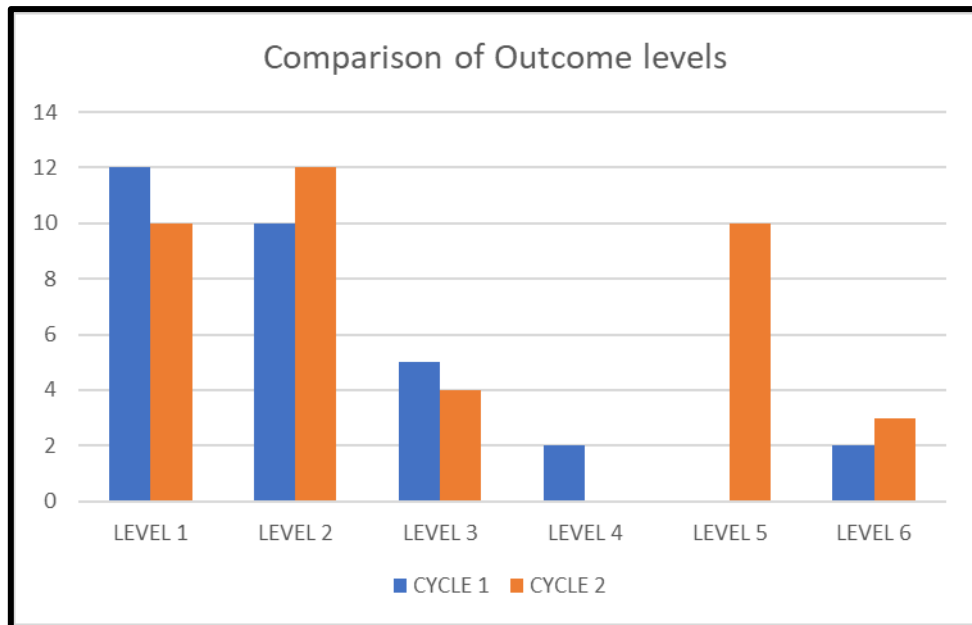
Figure 5. 9: Outcomes observed - Comparison

Given that the results from the two cycles are quite different, and the fact that there were no concrete guidelines given to the participants as to what their outcomes should look like, the cycles seem too distinct for one to consider a comparison. One observation, however, is that the lower level outcomes (Level 1 to 3) seemed to be used at more or less the same frequency in both cycles, but that the use of higher-level outcomes (Level 4-6) almost tripled. The outcomes in general, therefore seem to be positioned higher in the second cycle. This could show that the teachers were more comfortable with this process of planning and expected more from their learners due to their newfound comfort.

Observation 1.2: Assessment

The observation schedule analysis of the lesson plans revealed that the participants made use of 11 assessment strategies to determine whether or not the outcomes were reached, as depicted in Figure 5.10. As before, there is a difference between the number of strategies used in the first cycle (marked in blue) versus that of the second cycle (marked in orange).
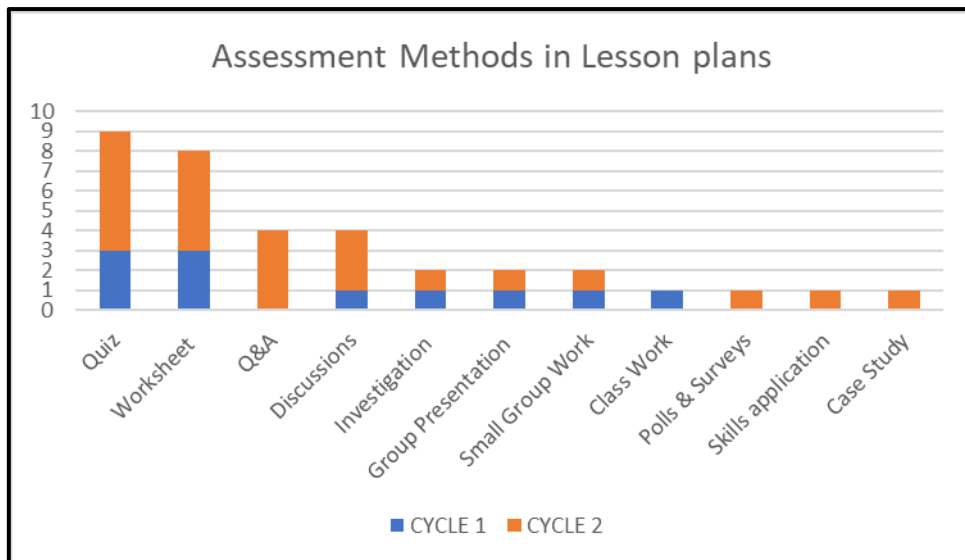
Figure 5. 10: Assessment methods in lesson plans

Nine groups used quizzes (electronic quizzes) to assess their outcomes. Further, eight lesson plans relied on worksheets to assess whether the outcomes were reached. Question and answer, as well as discussions, were noted in four lessons respectively. Classwork, polls, surveys, skills application and case studies were methods used only by single groups. The second cycle brought with it four assessment strategies that were not mentioned in the first cycle, namely Question and Answer, polls and surveys, skills application and case studies.

Observation 1.3: Teaching

The participants chose diverse teaching methods to include in their lessons. In total 20 different teaching strategies (shown below in Figure 5.11) were mentioned by the participants in their lesson plans.

Figure 5. 11: Teaching strategies in lesson plans

It is evident from the graph above that the participants relied heavily on direct instruction as a means of teaching. Six participants noted that they planned to make use of interactive teaching strategies and group work in their lessons respectively. Discussions, as a means of teaching, were mentioned in five lesson plans. Individual learning (4) and collaborative learning (4) were the next most prominent teaching strategies followed by mobile learning (3), active learning (3), demonstrations (3) and investigations (3). Activity-based learning and peer instruction both featured in two lesson plans. Learner-centred approach, learning networks, information classification, gamification, gallery walk, question and answer, quizzes and drill-and-practise were all mentioned in single lesson plans only.

Although it was important for the researcher to get an overview of the outcomes, assessment strategies and teaching strategies that the groups included in their lesson plans, it was more important to determine whether the backward design process was aligned.

Observation 1.4: Alignment

Looking at the alignment of the backward design process, the researcher used Bloom's taxonomy as a means of determining the level of the outcome, assessment and teaching strategies respectively. The two LS cycles were considered on their own and a judgement was made as to the alignment of the process, as reflected in Figure 5.12.
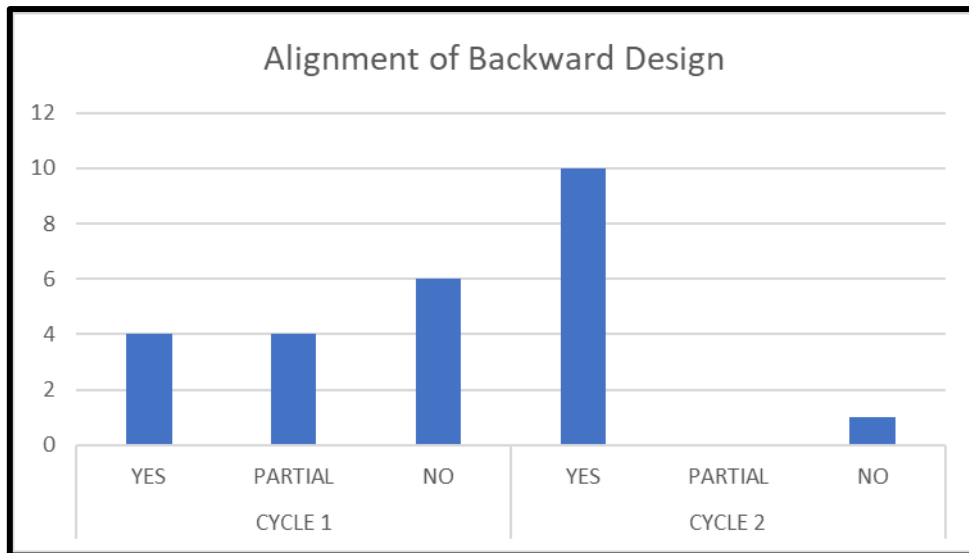
Figure 5. 12: Alignment of Backward Design -2 Cycle comparison

In the process of analysing the backward design process of the first cycle, it was noticed that only four of the ten lesson plans had been designed in an aligned fashion. Upon closer investigation, it was found that six lesson plans were not aligned while four were partially aligned. This could be, for example, that the outcome and teaching align well, but the assessment strategies are misaligned. In the end, two lesson plans were not aligned at all.

Moving on to the second LS cycle, it could be seen that the participants fared better in their attempts to align their backward design. In this case, ten of the 11 lesson plans contained a fully aligned backward design. In this cycle, there were no partially aligned lessons and only one lesson plan that was misaligned. Interestingly, this group (D) also did not have an aligned lesson in the first cycle.

As discussed in Section 5.2, the links that exist between the Backward Design and steps 3 to 5 of the TIP, are clear. As with the TPACK framework, the lesson planning form was used as a means to facilitate the planning process for participants while planning their lessons. This link, as well as the link between the backward design and Step 3 to 5 of the TIP are shown in Figure 5.13 below.
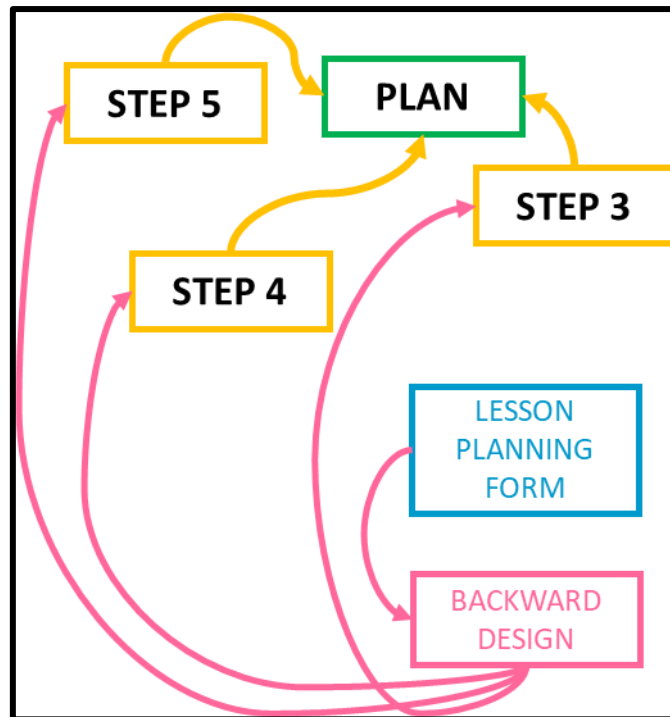
Figure 5. 13: Aspects related to Steps 3-5 of the TIP model

In Figure 5.13, the two aspects related to this section of the TIP model can be seen. Backward design and especially the alignment of outcomes, assessment and teaching emerged as an important aspect of the planning phase of the LS process. The lesson planning form that facilitated the backward design process was, therefore, an underlying aspect. The lesson planning form is discussed further in Section 5.2.4.3.

5.2.4. Overarching aspects

5.2.4.1. Aspect: Group

The group aspect, brought on by the nature of LS in communities of practice, was investigated in two questions of the final survey.

Source: Final survey

Question 3: How did you experience the online collaboration during the post-course section?

The first question: "How did you experience the online collaboration during the post-course section?" was used to see if there were any aspects that stood out for the participants. The responses to this question could easily be distinguished into three groups, namely positive, divided and negative.

Of the 29 participants who answered this question in the survey, 17 indicated having only positive experiences. Most (6) of the participant accounts in this regard stated that participants found the process of working online "interesting". Although the

participants rarely explained the reason as to why their experience was positive, some aspects did emerge. Participants stated that the online collaboration was a pleasant experience due to the "interaction with the facilitators and other groups", "sharing ideas" and "getting feedback {…} because it was motivation". Notably, three participants commented on the fact that the participants were isolated from each other. They mentioned that the online collaboration was "the best way in which [they] could communicate given the distance between everyone", that they had an "amazing experience interacting with my colleagues from [other parts] of the country" and that they "learned to work as a team irrespective of the distance between [them]".

Nine participants indicated that their experience was divided amongst positive and negative experiences. Four participants noted in this regards that their negative experiences were mainly at the beginning of the online collaboration phase and "but as time went on" they managed to "overcome the challenges and continue with the course". Group cooperation, for two participants, caused an otherwise "enjoyable" experience to be divided due to "late replies" and the fact that "group [members were] not cooperative". Further, two participants were divided in their experience due to being new to the online environment. One participant stated that despite their "lack of internet access" they still had a pleasant experience.

Only three participants noted that they experienced online collaboration with their groups as completely negative. For two, this experience was negative as their group members did not participate in the LS process. For one, however, the experience was difficult because of network issues and technical difficulties with their personal device.

Question 4: How often did you access the LMS to collaborate with your group members?"

The second question was used to determine how often group members were able to collaborate, given the fact that they were isolated.

The graph below (Figure 5.14) shows the responses from the 29 participants who answered this question in the final survey.
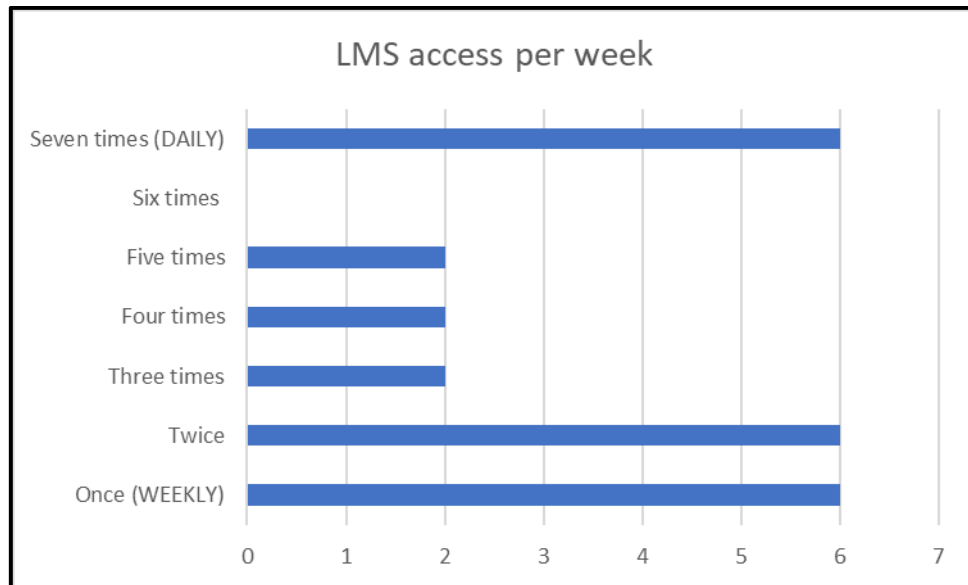
Figure 5. 14: LMS - Access per week

In this graph, one can see that the frequency of accessing the LMS varied. The same number of participants (6) state that they were on the LMS daily, twice a week and weekly (once a week). Similarly, two participants were noted in the categories of three times, four times and five times a week. No participants indicated that they were on the LMS six times per week. Although these numbers are quite different, it indicated that, at least for those who answered the final survey, it was possible to meet online at least once per week to collaborate with their group members.

Notably, three participants indicated that they very seldom accessed the LMS. Two of these participants stated that their group was unresponsive and therefore, they had no reason to use the LMS. The other participant stated that they had network difficulties.

From these results is can be seen that the group aspect, despite some challenges, is important to the planning phase of the LS process. This aspect allowed participants to plan collaboratively and discuss their ideas with other teachers. As shown by the results from the second question in this regard, the LMS has a significant role to play. With the use of the LMS, most participants indicated that they could be in contact with their groups every week.

From the answers to the previous questions, it is notable that the LMS is an important aspect of the planning phase of the LS process. Taking the previous section into consideration, we now turn to two questions that related to the LMS in general.

Source: Final survey

Question 2: How did you access the LMS?

The first question had three sub-sections namely, place of access, device and mobile data/ internet connection.

In the first category, place of access the participants had to state where they accessed the LMS. The graph in Figure 5.15 below shows the results.
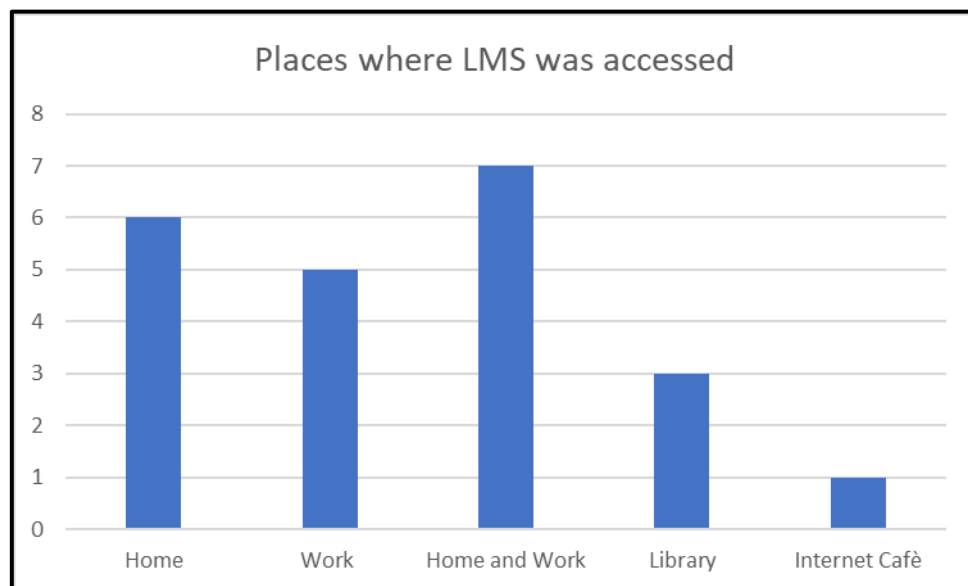
Figure 5. 15: LMS – Places accessed

It is interesting to note that seven participants (of the 32 that answered the question) had an internet connection at their home and at work. Six participants only had internet access at home and five only had access to the internet at work. Three mentioned that they accessed the internet at their local library. One participant noted that they had internet access at an internet café.

Secondly, in terms of devices, 30 participants (of the 31 who answered this question) indicated the devices that they were using to access the LMS. The results in Figure 5.16 below, shows that there were participants who had access to more than one device.
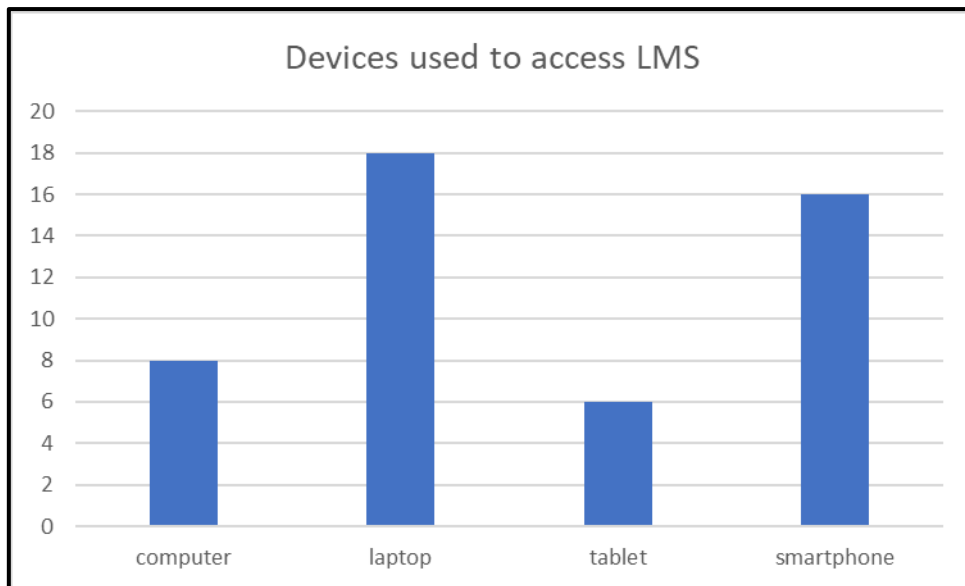
Figure 5. 16: LMS – Devices for access

It can be seen in this graph that most participants have access to laptops (18) and smartphones (16). Only eight participants mentioned the use of computers to access the LMS. Six participants noted using their tablets to access the LMS. Two participants noted using three devices to access the LMS. In both cases this was a computer, laptop and smartphone. Fourteen participants noted using two devices to access the LMS. Here, the predominant combination (in 9 accounts) was participants that used laptops and smartphones. The 14 participants who only had one device to access the LMS consisted of six with laptops, four with computers, two with tablets and two with smartphones.

Lastly, in terms of the mobile data/ internet connection that participants used to access the LMS, 11 used their personal data accounts to access the LMS. Seven participants stated that they used the internet access available to them in public places such as school Wi-Fi (3) libraries (3) or other public access points (1).

Question 5: What did you do when accessing the LMS?

The second question posed in relation to the LMS gave participants some pointers as to what they needed to answer. From the results in Figure 5.17 below, the responses in red were of the examples given and those in blue represent the participants own responses.
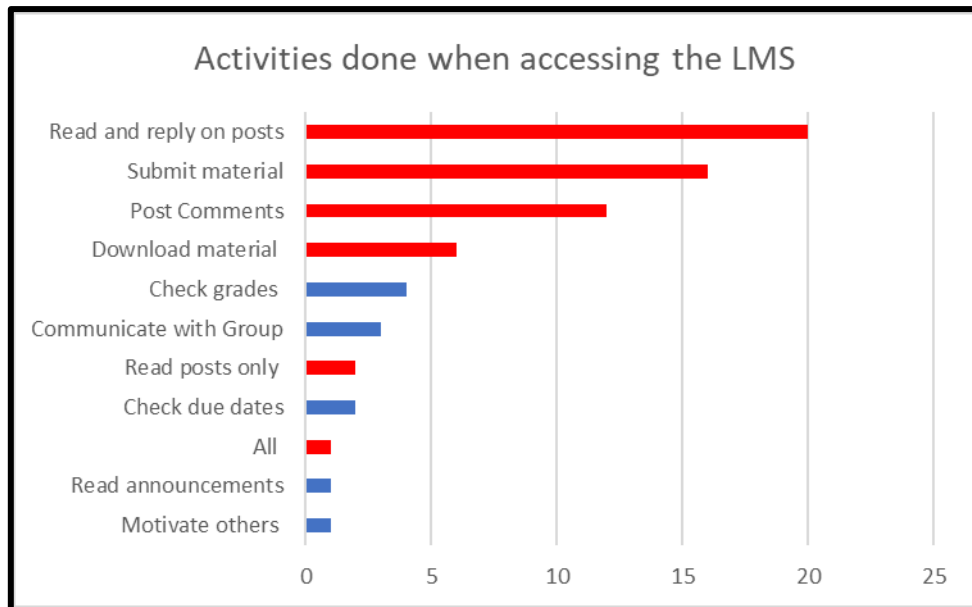
Figure 5. 17: LMS - Activities

Noticeably, most of the responses were in the categories of those given as examples, however there were activities that participants noted more often than some of the examples. The most common activity that participants did on the LMS was to read and reply on the posts of others (20) followed by submitting material (16), posting comments (12) and downloading material (6). Four participants noted that they accessed the LMS to "check [their] grades", an answer that was not expected to be important. Further, three participants noted that they accessed the LMS to communicate with their groups. Two participants noted the next example in that they accessed the LMS only to read posts by other participants. Two participants further noted that they accessed the LMS to "check the due dates of assignments". Single participants stated that they accessed the LMS to do all the activities in the examples. One participant stated that they accessed the LMS to read announcements while another stated that they accessed the LMS to motivate other participants.

5.2.4.3. Aspect: Online facilitation

Beyond the interaction of the participants with the LMS, the LMS also served as an enabler of the online facilitation of the blended learning course. This is due to the fact that the LMS provided a platform for the facilitators to access and interact with the participants to monitor their progress and help where necessary. The online facilitation process is discussed next.

The researcher turned to the responses of participants to question 6 in the Final survey to explore the importance of the online facilitation process as an aspect that has to be included in the lessons study process to support isolated teachers in teaching with technology.

Question 6: How did you experience the online facilitation process?

Of the 28 participants who responded to this question, 21 participant accounts indicated that the aspect is necessary to include in the LS process for four reasons. Firstly, the participants (7) stated that the use of online facilitation "assisted" the blended learning course. Secondly, the participants (6) explained that the online facilitation made use of "clear instruction" that was "effective", "efficient" and "monitored". The third reason that participants (4) provide is that the use of online facilitation provided them with the experience to be online facilitators themselves. Participants (4) lastly stated that working online was challenging at first but became easier due to the online facilitation that was at their disposal.

It was further noted from the participant accounts that the participants distinguished between two sets of facilitators in the online facilitation aspect. The first set referred to was the online facilitators that were discussed in Chapter 3. Participant accounts clarified that the duties of this group of facilitators was to "monitor" (4) their interactions on the LMS, provide assistance (2) with technical issues as well as misunderstandings related to the blended learning course, and to give feedback (1) were necessary. Notably, one participant stated that it was useful for them that the assistance from the online facilitators always came on time. Interestingly, a second set of facilitators emerged from the participant accounts. This set included members of the participants' groups, both from the smaller subject groups and the large group of participants. Participant accounts noted that the online facilitation allowed these facilitators to "share [their] ideas" and provide support in order to "overcome challenges"

5.2.4.4. Aspect: Lesson planning form
The lesson planning form being a prescribed structured document in the course, served as a facilitator for the Backward Design process and the TPACK framework as discussed earlier. It served as a commonality for groups planning lessons together so that their discussions surrounding the planning could be focussed.

Question 9: How did you experience the lesson planning form for the planning and refinement of lessons?

In the final survey, the participants were asked about their experience with the lesson planning form. The 27 responses were mostly positive with only three participants indicating that they had some challenges.

Seven participants mentioned in their accounts that the lesson planning form was easy to use for planning (4), teaching (2) or both (1). This was because the lesson planning form in their opinions was "confined to one document" (5) in that it contained all the necessary aspects to be considered for their lessons. Further, six participants mentioned that the lesson plan served them as a guide. Of these participants, two stated that the form guided them in planning, whereas four stated the planning form as a teaching guide.

Participants who were challenged by the planning form were challenged in diverse ways. One participant stated that the lesson planning form is "difficult to use when your school has no technology". Another participant stated that the A3 paper format of the form was too big to work with the document easily. One participant stated that they "didn't understand why [they] had to include [symbols] in the lesson plan. This statement was contradicted by another participant who stated that the symbols meant they "didn't have to write everything in detail".

Figure 5.18 below, shows the link between the three overarching aspects, group, LMS and Lesson planning form and the planning phase of the LS process.
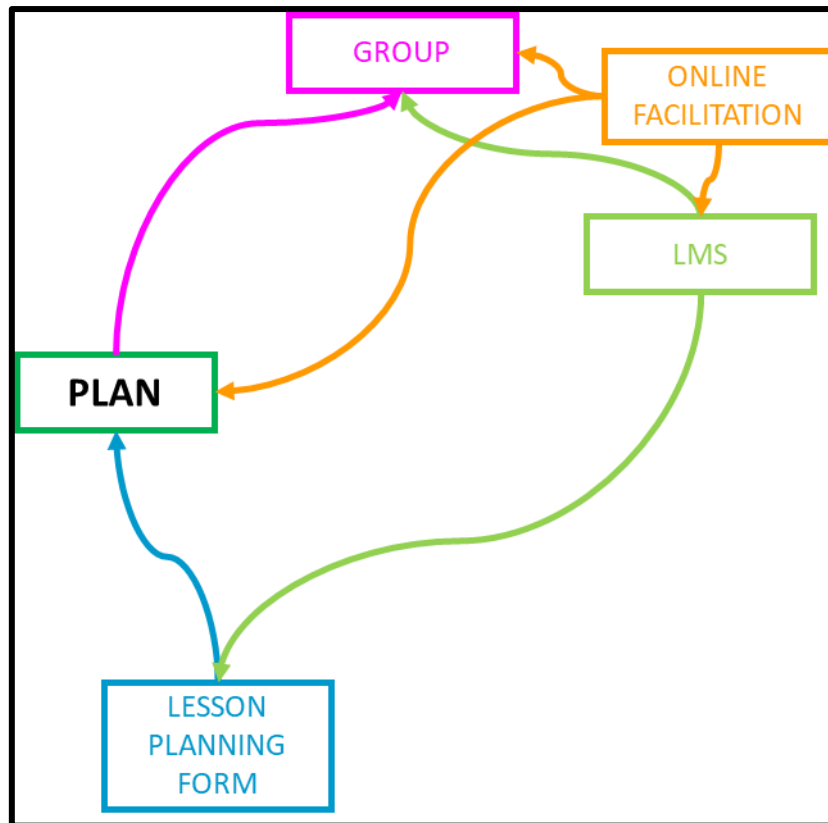
Figure 5. 18: Overarching aspects: Plan Phase

5.2.5. Conclusion for Plan

The LS process, given the nature of LS, also brought in the element of group work (through collaborative planning). Further, the blended learning course brought in the elements of technology, learning management system (LSM), the lesson planning form prescribed to the teachers and the mobile learning strategies that teachers were asked to incorporate into their teaching.

Therefore, when considering the planning phase of the LS process, seven aspects were uncovered. These include technology, the group, the learning management system (LMS) and the lesson planning form with the TPACK and Backward Design and mobile learning strategies components.

It is perhaps easier to consider the aspects identified in Table 5.4 below. The table shows the seven aspects that can be attributed to the planning phase of the LS process as well as the origin of the aspect.

	TIP	Lesson Study	Course
Lesson planning form			X
Technology	X		X
Group work		X	X
LMS			X
TPACK	X		X
Mobile Learning Strategies			X
Backward Design	X		X

Note that all the aspects, however not exclusively, linked in some way to the blended learning course. Some (3) aspects were derived from the TIP model, one correlated with LS and four were important only in the setting of the course.

Taking all of the above-mentioned aspects and their origins into account, one can now start to see the relationships that exist between these aspects. Figure 5.19 below shows the relationship between these aspects.
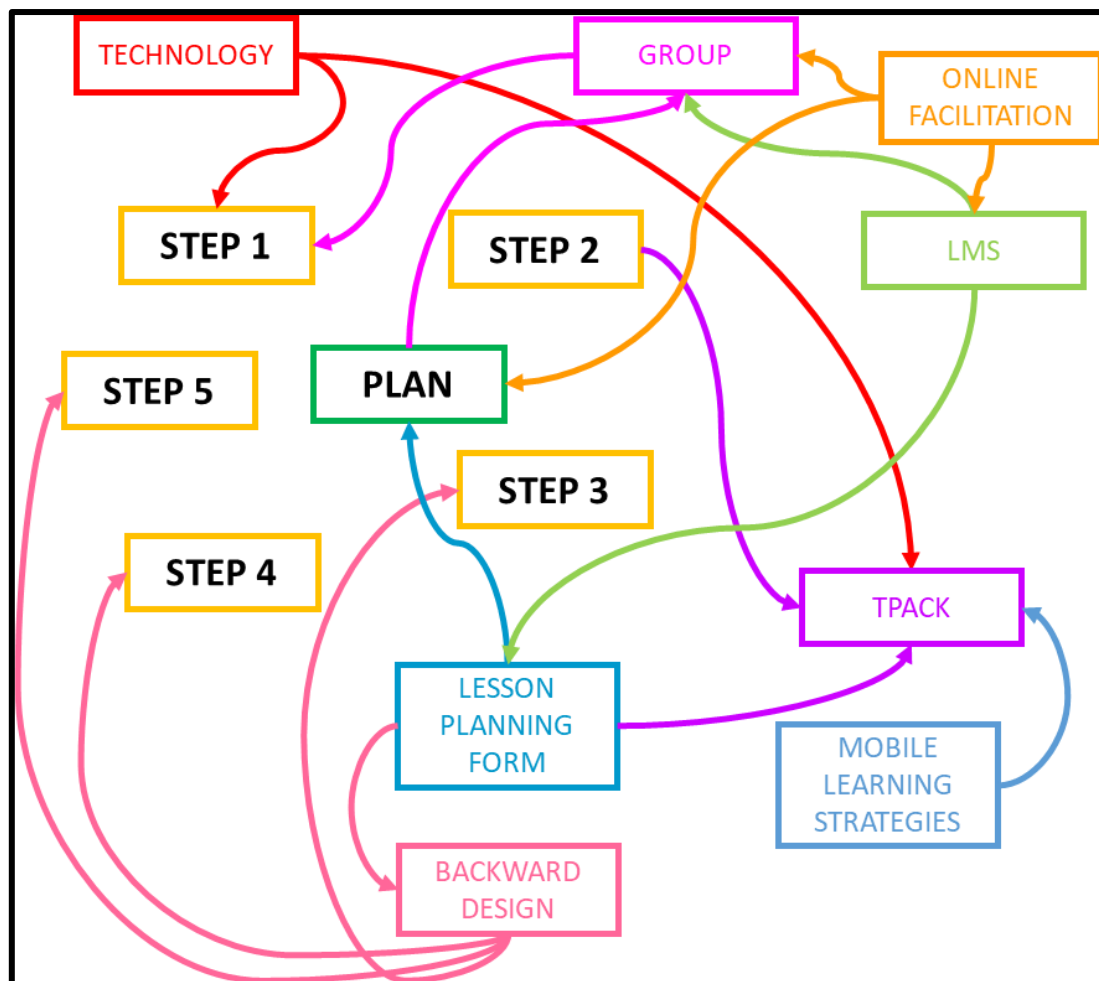
Figure 5. 19: Aspects: Plan phase

In this figure, it can be seen once again that the first five steps of the TIP model link to the planning phase of the LS process (also visible in Figure 5.1). The first step: "Determine relative advantage", links with technology in that the use of a technology-based approach can affect the lesson produced. Step 2: "Assess TPACK", links inevitably with the TPACK framework, Technology (as it is included in the **T**PACK) as well as the mobile learning strategies expected to be included in the planning as part of the course and as part of the T**P**ACK. Step 3 to 5 link to the backward design as it asks the planner to identify outcomes, decide on assessment strategies and then make decisions in terms of the teaching strategy and instructional environment.

Further, the aspect of the group is brought in by the inclusion of the LS process. This is because the teachers (participants) are expected to work in communities of practice to produce their lesson plans.

The blended learning course made use of two aspects to facilitate the planning phase of the LS process. Firstly, the LMS was used to manage and facilitate the group work expected by LS and to be a platform for the communities of practice. Secondly, the lesson planning form facilitated the processes and considerations required for the participants to plan by using the TPACK and Backward Design frameworks. The LMS was also a place for the participants to share and upload their lesson plans for group comments or assessment.

5.3. Teach

Moving over to the next phase of the LS process, teaching, it is noticeable that unlike the previous phase of the LS process, teaching does not form part of the TIP model. Figure 5.1 illustrated this. In this instance, the aspects were not as easy to derive from the TIP model and relating literature, but rather emerged from the fact that teaching resided within the LS process, with the blended learning course also bringing forward some aspects.

5.3.1. Aspects in teaching

In this section, the aspects that were unearthed in terms of the teaching phase of the LS process will be discussed.

Three questions from the final survey brought out technological aspects that needed to be present when teachers wanted to teach with technology.

Question 10: Which challenges did you experience during the teaching of the lessons planned?

Technology featured as an aspect in two ways from the challenges mentioned. Firstly, the shortage of learner devices meant that teachers had to resort to alternative strategies when teaching. Two participants noted in their accounts that they had to divide their classes into groups for the learners to get the opportunity to work with technology. Secondly, it was mentioned that the learners (in 2 accounts) did not have the "technological skills" to use the devices that were available in the class. Here again, the nature of teaching changed as the teacher now also had to be a technical consultant to "monitor" learners that struggle with the use of technology. It is notable from both these challenges that the teacher's role in teaching needs to change. The availability of technology, as well as the learners' skills surrounding the use of technology will influence the teaching phase of the LS process.

Question 7: How did you experience the process of lesson planning – first plan a lesson, then teach the lesson, then refine and submit a final lesson plan?

From the participant accounts in response to this question, it was noted that technology was a noticeable aspect of the teaching phase of the LS process. Five accounts mentioned that the availability of technology was a motivator for the learners (4) as well as the educators (1). The participants noted that the learners enjoyed (1) their lessons because it included the use of technology and (2) they were excited by technology integration in the lesson. One participant further mentioned that the availability of technology in their classroom made it possible for them to explore new teaching strategies and move away from old habitual classroom strategies.

Question 15: How did the blended learning course impact your teaching practice?

From seven accounts in response to this question, technology emerged as an important aspect during the teaching phase of the LS process. These participants mentioned that the blended learning course influenced their teaching practice in such

a way that they were now including technology in their teaching. One participant mentioned further that after the blended learning course, technology "is part of [their] system if teaching now".

5.3.1.2. Aspect: Group
Source: Final survey

Participant responses to the question stated below, indicated that the group was an aspect that attributed to the teaching phase of the LS process.

Question 7: How did you experience the process of lesson planning – first plan a lesson, then teach the lesson, then refine and submit a final lesson plan?

From the responses to this question, it became clear that the presence of the group aspect had an important effect on the teaching that occurred. The participants (3) firstly mentioned that the availability of a group allowed them to share ideas with others. One participant mentioned that "the ability to share "play[ed] a huge role in developing [themselves] when it comes to teaching". The participants (2) further noted that the group influenced their teaching as they could gain information from their group members and were able to explore new teaching strategies with their groups. Two participants mentioned that working as a group made their teaching easier. One participant further stated that the guidance from their group was the reason that they could "teach [their] lesson with success".

5.3.1.3. Aspect: Time
Source: Final survey

From the discussion in Section 4.2.2, time emerged as an aspect to consider during the teaching phase of the LS process.

Question 10: Which challenges did you experience during the teaching of the lessons planned?

It was noted from the analysis of the responses to this question that the participants viewed time as a challenge during the teaching of their lessons. It is noticeable in the fact that five (of the 8) accounts mentioned that there was not enough time for them to teach. Digging deeper into the responses, most participants did not elaborate on the reasons why there is not enough time to teach. Two participants, however, stated that the lack of time results from a lack of learner devices. This is also mentioned in Section 5.2.1.1.

The questions, stated below, unexpectedly brought forward the lesson planning form as an aspect during the teaching of the lesson.

Question 9: How did you experience the lesson planning form for the planning and refinement of lessons?

In their responses, four participants noted that the lesson planning form served as an important guide during the teaching on their lesson as "it is a guide on how to go about teaching" (3).

5.3.2. Conclusion for teach

Four questions from the final survey were used to guide the exploration of emerging aspects from participant accounts. The questions are listed in bold below with a discussion of the emerging aspects under each question.

Question 10: Which challenges did you experience during the teaching of the lessons planned?

Although this question was already discussed in length in Section 4.2.2, there are some aspects that emerge from this discussion as the challenges related to the teaching of the lesson. These aspects are Technology (and the availability thereof), connectivity and time.

Question 7: How did you experience the process of lesson planning – first plan a lesson, then teach the lesson, then refine and submit a final lesson plan?

Looking at this question form a teaching point of view, two aspects emerged namely the availability of technology and the group.

Question 9: How did you experience the lesson planning form for the planning and refinement of lessons?

As explained in the previous section (5.3) participants noted, unexpectedly, that the lesson planning form was an important aspect during the teaching phase of the LS process.

Question 15: How did the blended learning course impact your teaching practice?

This question, being the only question directly relating to the teachers' practice, was quite important in determining any emerging aspects that should be incorporated into a lesson planning process for teaching with technology. Here, from the participant accounts, the emerging aspects were technology and e-resources.

From this exploration, four aspects were identified. Their interrelatedness to one another can be seen in the concept map (Figure 5.20) below.
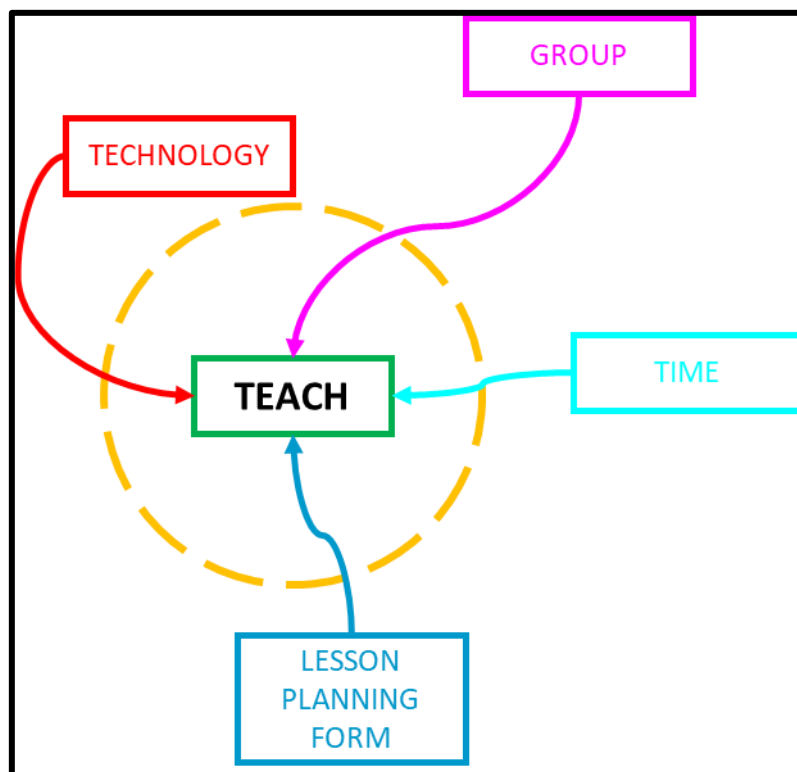
Figure 5. 20: Aspects: Teach Phase

In this concept map, the four aspects namely Technology, group, time and lesson planning form are indicated.

Continuing with the TIP model as guidance, the next step "Analyse Results" links with two steps in the LS process, namely Observation and Reflection.

5.4. Observe and reflect

The LS process now moves into the observation phase which is followed by reflection. These two steps will be discussed in unison in this section as they form part of one step (Step 6) of the TIP model. This step, "Analyse results" requires participants, this time within LS, to observe lessons and then reflect on what transpired during their teaching.

5.4.1. Step 6: Analyse results: Observe

5.4.1.1. Aspect: Photos, videos and reports

Source: Discussion boards

Participants were not physically in each other's classrooms, nor did they observe the lessons that were taught, in a synchronous manner. The participants were however asked to share their lesson experiences with their group but were not told how they should share their lesson with one another. However, looking at the interaction of participants on the discussion boards, three methods were used by participants to share their lesson observations with each other. Figure 5.21 below depicts the number of accounts in the discussion boards that used each of the methods shown as observation tools in their lessons.
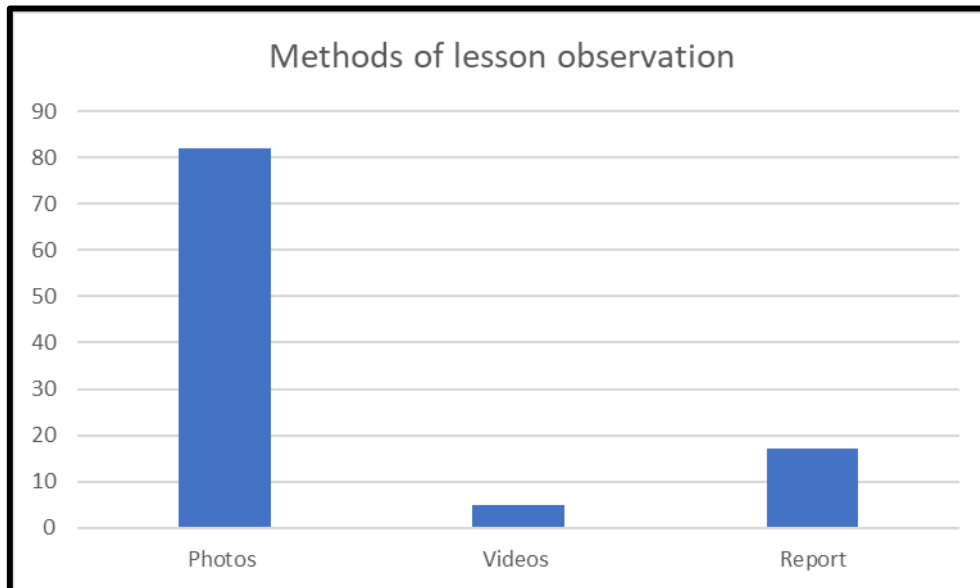
Figure 5. 21: Methods of lesson observation

In the graph, the three methods namely photos, videos and reports can be seen. Here, it can be seen that 82 accounts showed participants sharing their lesson observations with photos, five accounts with video and 17 accounts through reports.

Going through the discussion boards, it was noticed that many individuals made use of the reflections as a way to share their lesson observation with their groups. Because participants were asked to reflect on their lessons using three headings, it was easy to see reflections done on the discussion boards. These heading included "What went well", "Even better if" and "Target". It was found in 35 accounts that participants posted their individual reflections on the discussion board. This is depicted in the Figure 5.22 below.
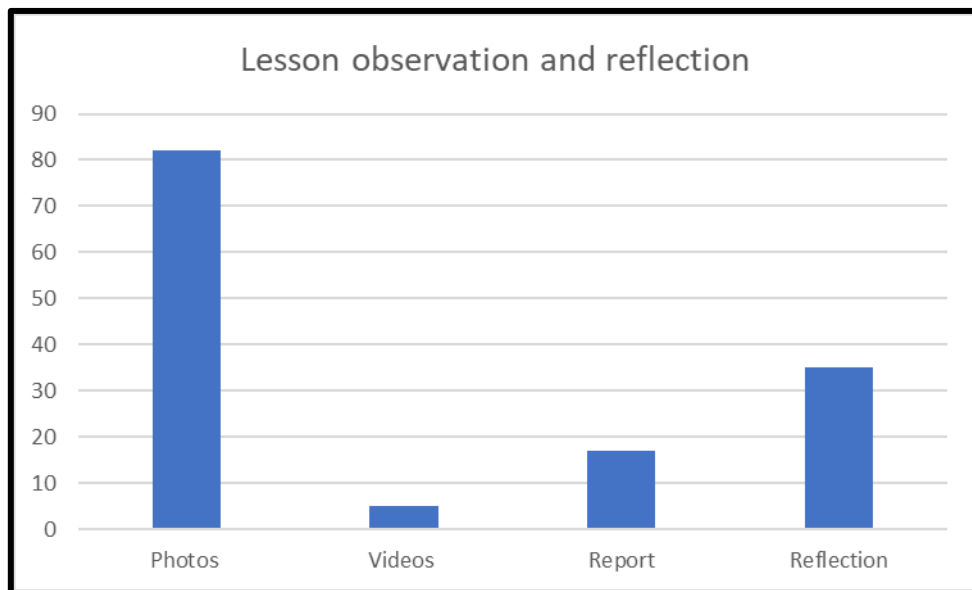
Figure 5. 22: Lesson observation and reflection

5.4.1.2. Aspect: Reflection Questions

Considering the fact that the participants could now observe the lesson based on detailed reflections given by their group members, these reflections can also be considered reports of the lesson. Accumulating the field reports and reflections, then renders the Graph shown in Figure 5.23 This accumulation can be done because of the individual nature of the reflections done. LS usually sees reflection being done in a group setting.
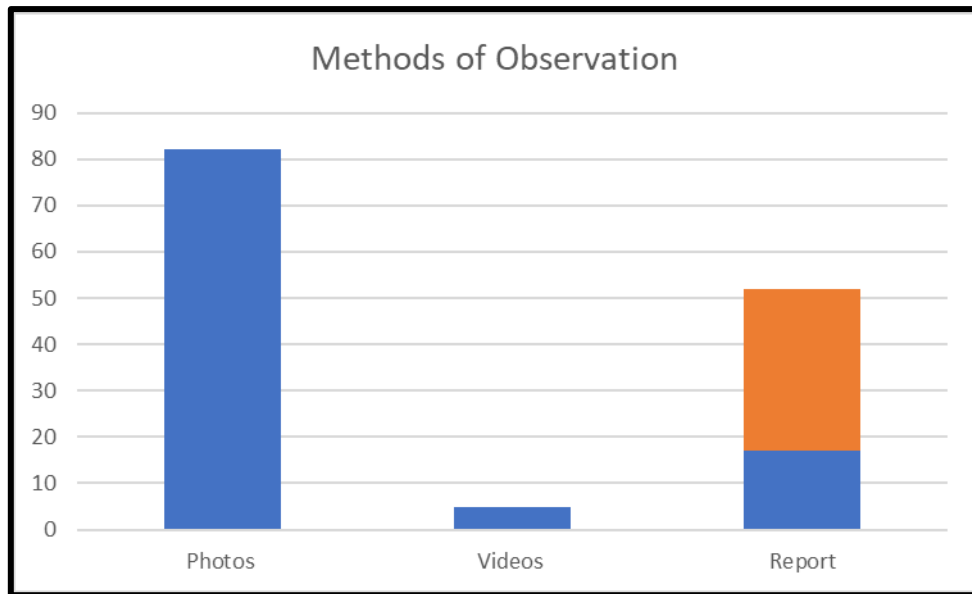
Figure 5. 23: Methods of observation

From this graph, it can be seen that by considering reflection as a method to share observations of lessons, 52 accounts (over the previous 17) can be considered for participants who use reports to share lesson observations.

5.4.2. Step 6: Analyse results: Reflect
5.4.2.1. Aspect: Reflections Questions

In the previous section, the reflection questions were mentioned as a way given to the participants to structure their reflections. As mentioned in the previous discussion, the reflection questions emerged as an unexpected aspect of the observation phase of the LS process. Yet these questions proved to be a way for participants to share their individual observations with their groups.

The participant groups were asked to include a reflection at the end of their refined lesson plan. A discussion of the results from these lesson planning forms follows.

Source: Lesson planning forms

As mentioned before the participants completed four sets of lesson planning forms. Two of these were refined lessons, the second and fourth sets. In each of these refined lesson plans, participants were asked to reflect on the LS process to that point. They were given three headings by which to organise their reflections. This is also explained earlier in this section.

Table 5.5 below summarises the lesson plan reflections submitted.

Table 5. 5: Summary of lesson plan reflections submitted

GROUP	CYCLE 1		CYCLE 2	
	Lesson plan submitted	Reflection added	Lesson plan submitted	Reflection added
A	X	-	X	X
B	X	X	X	X
C	-	X	X	X
D	X	X	X	X
E	-	-	-	-
F	X	-	X*	-
G	X	-	X*	-
H	-	-	X	X
I	X	X	X	X
J	X	X	X	X
K	X	-	-	-
L	X	-	X*	-
M	X	X	X	X
TOTAL	10	6	8 (3*)	8

It is important to note the discrepancy that can be seen in the data in terms of lesson plans that were submitted to this point. In the second cycle, we see that there are eight lesson plans instead of the 11 reported in the discussion so far. The remaining three lesson plans (marked *) were taken from the third lesson plan set, as participants did not feel the need to refine their lesson plans after teaching.

Considering the table, the results of the inclusion of reflections can seem monotonous. In the first Cycle, ten refined lesson plans were submitted of which six included a reflection. In the second cycle all eight lesson plans submitted in the fourth lesson plans set, had a reflection included. Interestingly, the three that were not refined did not include a reflection, most likely as this was not part of the brief given as part of the blended learning course.

This shows that contrary to the first impression of the results, the inclusion of reflections increased. Groups A and H that did not include a reflection before, did so in this cycle. Notably, group H also did not submit a refined lesson plan in the first cycle.

5.4.2.2 Groups

The group aspect emerged from the investigation of this phase through the fact that the groups shared their observations and reflected as groups. Once again, this is a vital part of Lesson Study (LS), as discussed in Section 2.5 and the notion of communities of practice as brought on by the practice of LS.

5.4.2.3 Aspect: Online facilitation

This aspect, discussed in detail in Section 5.2.4.3, is also of considerable importance for the reflection phase. This is because the online facilitators, as well as the group members, could provide their thoughts and opinions based on the reflections of participants. Facilitators could, therefore, give more insight into discussion brought up in reflections based on their experience or ask relevant questions to explore reflection items further.

5.4.3. Step 6: Analyse results: Overall

5.4.3.1. Aspect: LMS

As can be seen in the discussions above, the LMS served as an important aspect in these two phases of the LS process. This is because the LMS managed the groups and created a space where observations and reflections could be shared.

5.4.4. Conclusion for Observe and Reflect

Figure 5.24 below shows the different aspects related to this part of the LS process.
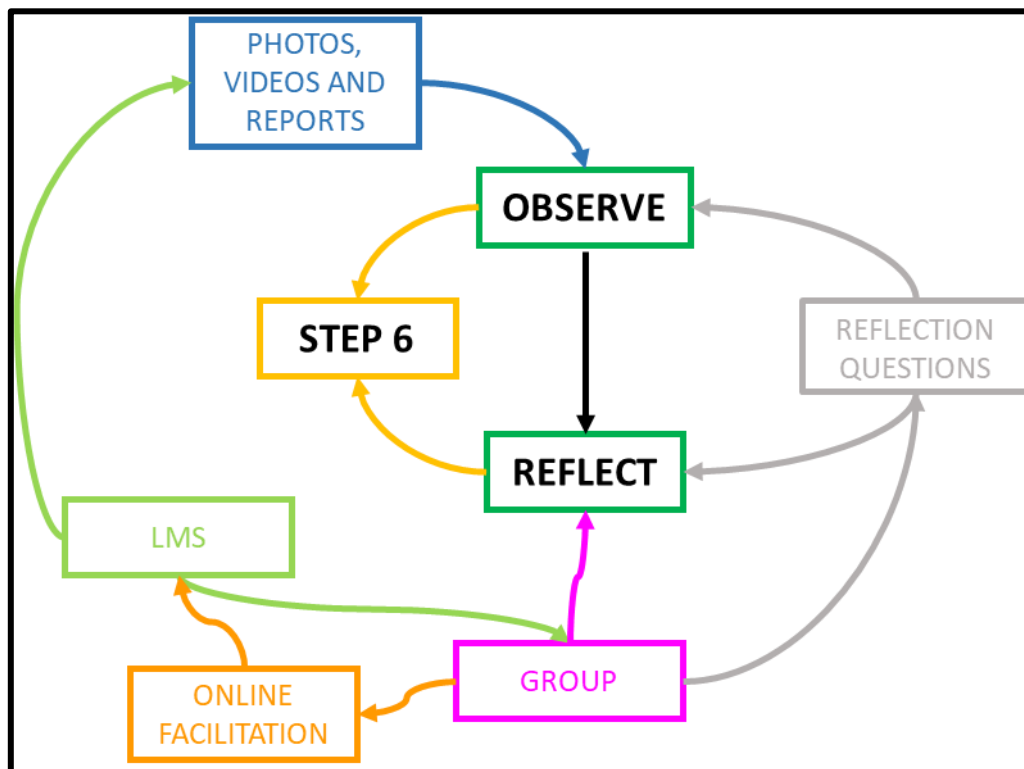
Figure 5. 24: Aspects: Observe and Reflect phase

5.5. Refine

The last step of the LS process deals with the refinement of the lesson that was presented. In this phase, participants rely on the observations and reflection on the lesson to ultimately make changes to the lesson for the next time it will be taught.

5.5.1. Step 7: Make revisions

5.5.1.1. Aspect: Group

The group element, sprouting from the nature of LS, once again emerged as an aspect pertaining to the refine phase of the process. One question from the final survey, also discussed in other sections, contained elements relating to this phase of the LS process.

Question 7: How did you experience the process of lesson planning – first plan a lesson, then teach the lesson, then refine and submit a final lesson plan?

In their response to this question, nine participants referred to their experience in terms of the reflection of the lesson. Remarkably, all nine of these accounts state that their experience was positively influenced by the fact that participants were working in groups.

In eight of these accounts, the consensus seemed to be that the participants found that their collaboration (4), feedback (2), communication (1) and sharing of ideas (1) lead to their positive experience of the group as an aspect in the refine phase.

Interestingly, one participant mentioned that they did not have any support from their group and struggled to come up with a refined lesson. The participant further stated in their response to this question that having access to the larger group, and also seeing the work that those participants did "[they] had an idea of what to do and was able to post [their final] lesson plan."

This shows that the group in terms of the collaborative qualities and communication is an aspect in the refinement on lessons.

5.5.1.2. Aspect: Lesson planning form

The question stated below rendered responses that linked the lesson planning form as an aspect in the refinement phase.

Question 9: How did you experience the lesson planning form for the planning and refinement of lessons?

This question prompted five responses from the participants in this regard. Firstly, the participants stated that they have a positive experience as they could use the lesson planning form to "see what worked and gave [them] an opportunity to improve" (1) to "correct each other before [submitting]" a refined version. Further, a participant stated that the lesson plan being introduced to them in the face to face part of the blended learning course made it easy for their group to refine their lesson plan. Lastly, participants added that the lesson planning form provided "structure and guidance" in their refinement of the lesson plan as it showed them "what was expected" (1) and "work wonders if you want to share the lesson with [others]" (1).

5.5.1.3. Aspect: Reflections

Unexpectedly, two participant accounts in a question of the Final survey indicated that the reflections were an aspect in the refinement phase.

Question 9: How did you experience the lesson planning form for the planning and refinement of lessons?

This question also addressed in the previous section highlighted reflection as an aspect of the refinement phase. The first of the two participants whose accounts mentioned this stated that refining the lesson was eased by the fact that they could refer to the reflection done before. The second participant went further to say that the reflection questions delivered "elements" that could be developed after reflecting on the lesson.

5.5.1.4. Aspect: LMS

As with the preceding sections, the LMS aspect again emerged as an important aspect for the refine phase of the LS process. The LMS here, as before, served as the facilitation tool for the groups to collaborate and share files and ideas to refine their lesson plans.

5.5.1.5. Aspect: Online facilitation

Seeing that refinement of lesson plans within LS, strongly supports the idea of group members going through this process collaboratively, online facilitation and the group members' duties (as explained in Sections 5.2.4.3) as facilitators became an important aspect to this phase. Once again, the LMS served as a vehicle for interaction to take place between the facilitators (both the online facilitators and group members) to share ideas, provide feedback and support where necessary to enhance the lesson plan that was taught based on the observations and reflections.

5.5.2. Conclusion for refine

In Figure 5.25 it can be seen that four aspects were identified in the execution of this phase.
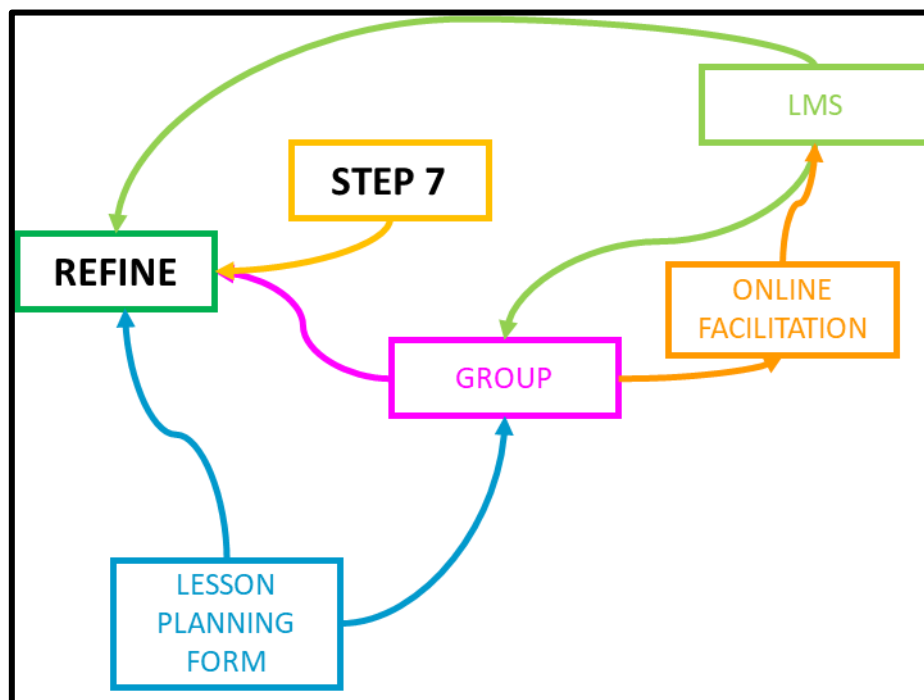
Figure 5. 25: Aspects: Refine phase

Evident from the figure the three aspects namely group, lesson planning form and LMS form a part of the refine phase of the LS process.

5.6. Findings for sub-research question 2

Throughout the previous sections, eleven aspects were identified that needed to be incorporated into the LS process to support teachers in teaching with technology. Table 5.6 below indicates the 11 aspects with the LS phases where they originated.

Table 5. 6: Aspects as they relate to the Lesson Study phases

Aspect	Plan	Teach	Observe	Reflect	Refine
1. Technology	X	X			
2. Group	X	X		X	X
3. LMS	X		X	X	X
4. Online facilitation	X			X	X
5. TPACK	X				
6. Mobile learning Strategies	X				
7. Lesson planning form	X	X			X
8. Backward design	X				
9. Time		X			
10. Photos, videos and reports			X		
11. Reflection Questions			X	X	X

It can be noted from the table above that the aspects were diverse in their nature. Some only presented in one LS phase, where others came up as important aspects in up to four phases. Those indicated in green, only occurred in one of the phases. The aspects will be discussed in descending order of the number of phases in which they appeared.

The **group** aspect was presented in four phases of the LS process. It is important to note that this "group" has two sides. Firstly, there is the general group of participants who all had access to communicate with each other and the facilitators using discussion forums on the Learning management system. Secondly, the participants were in their respective subject groups consisting of a smaller (3 to 5 participant subject groups) group where participants teaching the same subject worked together in Lesson Study. Given their isolated nature, the teachers did not have their groups present in their classes when teaching their lessons; however the influence and ease of their teaching improved due to the collaborative nature of the planning phase. From the results, it was seen that the groups provided participants with an opportunity to interact (with facilitators and groups), share ideas and receive feedback from their group members. This interaction allowed teachers to develop themselves by learning from others and even exploring new teaching strategies.

Participants mentioned that because they were not close together, the LMS facilitated their collaboration online. This allowed for weekly interactions of group members despite the distance between them. These interactions were facilitated by the LMS (discussed below) to allow the facilitators to monitor the process.

Another necessity shown in the results is that group numbers need to be monitored to assure that participants are not left on their own in a group leading to participants decreasing their activity in the LS process.

The **Learning management system** (LMS), proved to be an invaluable aspect in four phases of the LS process, namely Plan, Observe, Reflect and Refine. The LMS was not an important aspect for the teaching phase in the Lesson Study, as the teachers' participation in the blended learning course became more individual in this phase.

From the results, it was noticed that participants accessed the LMS at home, work and even in other places where internet access was available. It further seemed useful to the participants that the LMS was also available on their mobile devices. The results show that participants mostly used the LMS to read and reply to posts and post comments of their own. Further, participants used the LMS to download and submit material to the LMS.

As mentioned above, the LMS played a vital role in the management of groups and their interactions online. The LMS was also a place to share lesson observations and documents with their groups and the facilitators.

Online facilitation, an aspect that was firstly seen in the planning phase, also emerged in the "reflect" and "refine" phases. This aspect (as with the LMS aspect) did not reflect strongly in the teaching and observation phases. This could be due to the fact that during the teaching phase teachers were mostly "offline" in terms of the blended learning course. Further, in terms of the observation phase, the sharing of individual observations (in either form) did not require assistance from either the online facilitators or the groups.

It can be seen in the results that the online facilitation aspect played a strong role in the planning phase as online facilitators and other participants could share ideas to include in the planning of lessons. The same can again be said for the reflection and refinement phase as facilitators could monitor the interactions in terms of these phases and provide feedback where necessary.

The **lesson planning form**, an aspect brought on by the blended learning course, and its importance as an aspect in the LS process, emerged in three phases. This included plan, teach and refine.

The lesson planning form was used by the blended learning course as a facilitator of the backward design process and TPACK (discussed below). It also served as a guide to the planning, reflection and refinement processes.

The results indicate that the lesson planning form allowed planning to be confined to a single document. It was also found that participants used this planning from as a guide during the teaching of their lessons. The compact nature of the lesson planning form meant that those who use it do not have to write in extensive detail. Further, the results showed that by using the same document to plan their lessons, groups could have focussed discussions to better their lessons.

Reflection questions, an aspect that emerged in the observe, reflect and refine phases, made use of three questions (or headings) that the participants could use to structure their reflections. These questions were introduced by the blended learning course. Using these questions, made it easier for group members, facilitators and the researcher to identify reflections in the lesson plans and discussion boards.

In relations to the statements above, it was seen in the observation phase that the reflection questions gave structure to the sharing of lesson observation reports. Here, the reflections were mainly individual using the questions as a guiding tool. Using the heading provided by the blended learning course, groups were able to collate and compile a reflection that combined the results of the entire group's experience in teaching the lesson planned. The reflection in general, also allowed groups to identify parts of their lessons that could be improved upon in future teaching.

It can be seen that there is a strong relationship between the aspect of reflection questions and group.

Technology, an aspect of the planning and teaching phase, along with its three sub-categories that emerged proved vital to the LS process.

The final survey shed light on some of the technology that schools had available. The lesson plans then allowed the researcher to see the technologies that teachers used and needed in their classrooms to teach using a technology-based approach.

Throughout the reviewing of the results three sub-themes were identified. Firstly, teacher and learner devices, such as tablets, laptops and desktops were indicated to be used in the execution of lessons. Limited use of smartphones (almost a quarter of the use of laptops) was indicated. Secondly, Internet access emerged as a necessity. This was especially the case in the teaching phase where teachers and learners needed to have internet access to resources (like videos and websites) as well as to download apps and other software onto devices. The third sub-theme that emerged, entailed the use of e-resources. This includes apps, software, videos games and other needed resources as discussed in Section 5.2.1.1.

Technology had a strong link to both the lesson planning form (discussed above) and the TPACK integration (discussed hereafter).

TPACK, the first aspect that links to a single-phase (plan) of the LS process is an aspect that brought forward by the blended learning course. The blended learning course made use of the lesson planning form to facilitate the TPACK integration. It is for this reason that the observation schedule was used to determine the importance of this aspect as well as the participants' abilities to use the lesson planning form to achieve TPACK integration.

From the results, it was evident that the majority (70%) of the groups that submitted lesson plans, were able to integrate TPACK into their lesson plans. This meant that the participants were able to allocate the technology they had available and make use of appropriate mobile learning (or other) strategies to convey the content of their lessons to the learners.

TPACK, therefore, was influenced, by the aspects of technology (discussed above) and mobile learning strategies (discussed hereafter).

Mobile learning strategies is an aspect brought on by the blended learning course due to the fact that participants were encouraged to use these strategies in their instruction.

In observing the lesson plans, it was seen that the majority (63%) of the lesson plans that were completed in such a way that the teaching strategies were clear, were able to integrate mobile learning strategies in teaching.

As discussed before, the mobile learning strategies aspect influenced the TPACK integration aspect. This is due to the fact that these strategies were the encouraged pedagogy for the TPACK integrations.

The **backward design** aspect, as with the TPACK and mobile learning strategies aspects, only emerged in the planning phase.

It was noted that between cycles one and two, groups raised the level at which their outcomes were pitched. In terms of assessment, a wide range of assessment strategies were applied to determine whether the desired outcomes were reached. Although the participants further utilised a variety of teaching strategies (often varying their strategies throughout the lesson) participants relied heavily on direct instruction. This related to the groups that showed that they did not make use of mobile learning strategies that are mostly more learner-centred.

In terms of the alignment of outcomes assessment and teaching, it could be seen in the results that as the participants became more acquainted with the use of the lesson planning form, they had more success with the alignment of the backward design process. This could also indicate that participants became more advanced in the use of the lesson planning form.

There is a strong link that exists between the backward design and lesson planning form aspects. This is because the process was also facilitated by the lesson planning form (as discussed above).

In the teaching phase, **time** emerged as a vital aspect. The results indicate that teaching time is a consideration that needs to be made when opting to teach with technology.

Photos, videos and reports were seen in the results of the discussion boards as an important aspect of the observation phase. Of the three methods to share observations of lessons that transpired, photos, and reports (sharing through words) were predominant.

This aspect links with the use of the reflection questions (to structure reports) and the LMS, as a means to share observations of any kind.

Throughout the discussions above it was noted that the **blended learning course was** also a vital aspect to the success of this process. This is because the course created an environment for the LS process to occur in. It also structured the activities and interactions between facilitators and participants both online and face-to-face. This made the online facilitation aspect of this application of the LS process possible.

Based on the discussions above, the following Figure (5.26) was compiled to show how the 11 aspects with the inclusion of the blended learning course relate to the phases of the LS process.
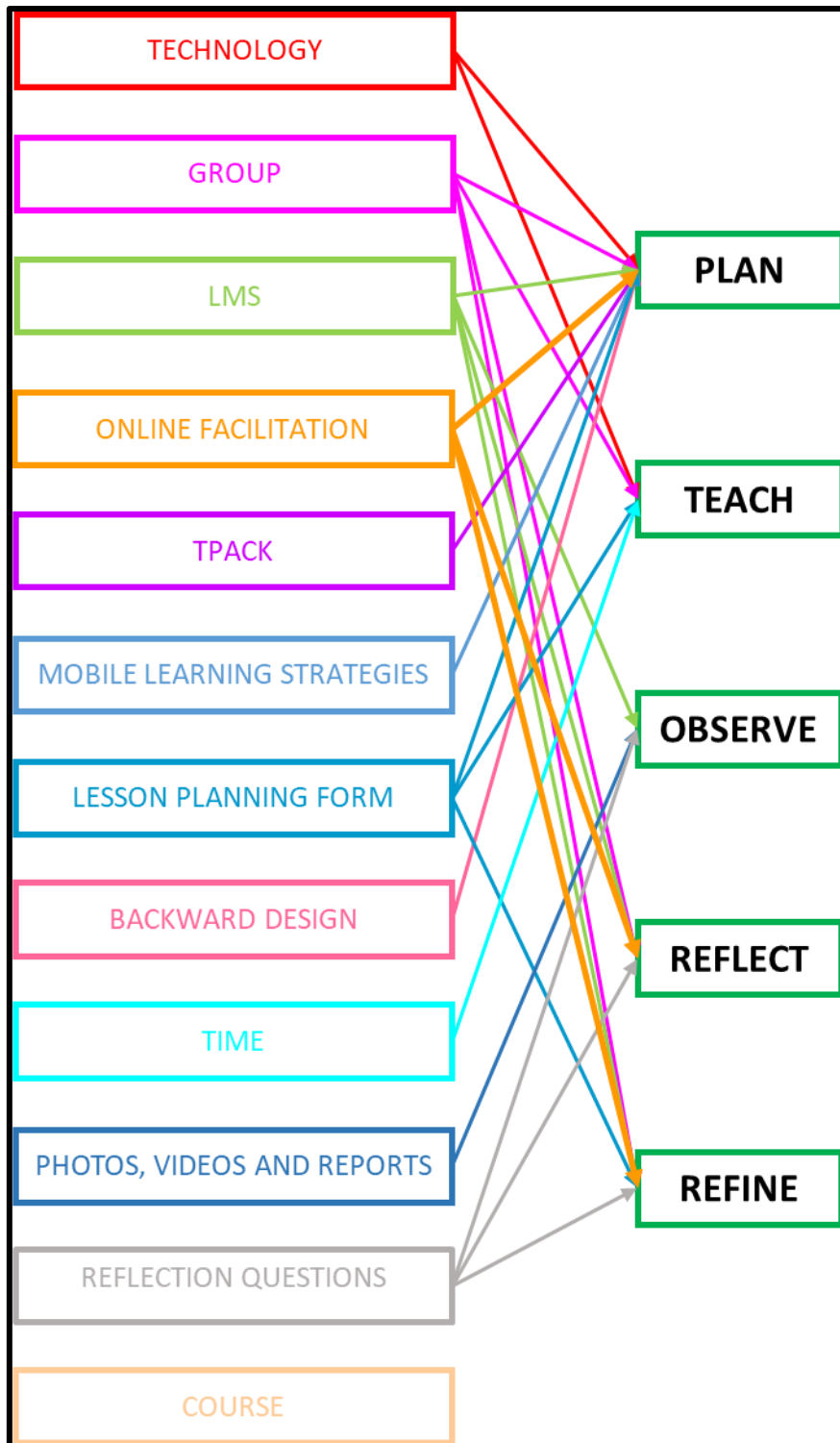
Figure 5. 26: Aspects and Lesson Study process

Taking this into account, the concept map that follows (Figure 5.27), shows the relationships that exist between the various aspects. The discussions provided above elaborate on the relationships that are indicated by the curved lines.
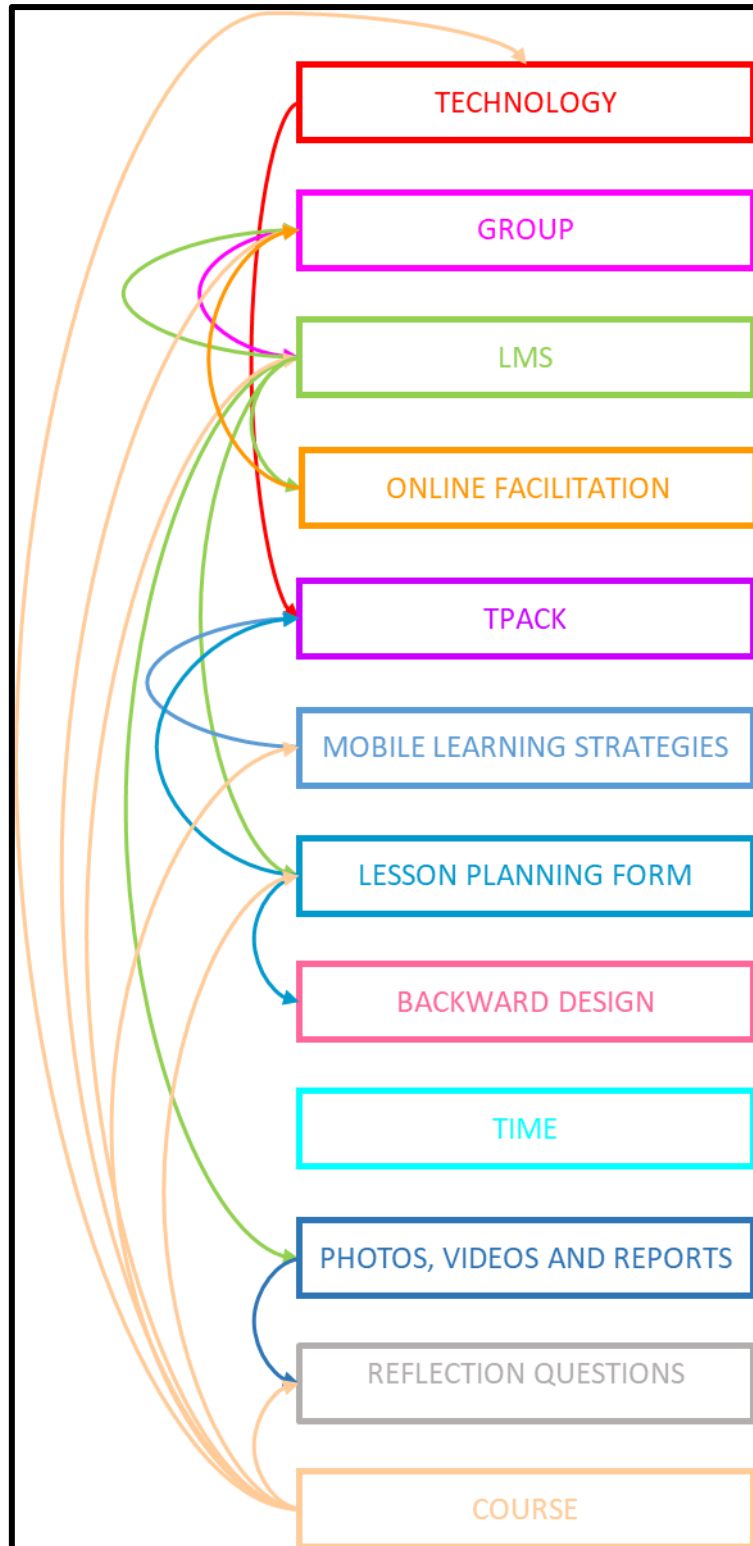
Figure 5. 27: Interrelatedness of aspects

The result of merging these figures can be used as an alternative to the Conceptual Framework discussed earlier. This delivers a complex web of relationships between the aspects and the LS process, as well as the interrelationship between the aspects themselves. Figure 2.28 illustrates this.
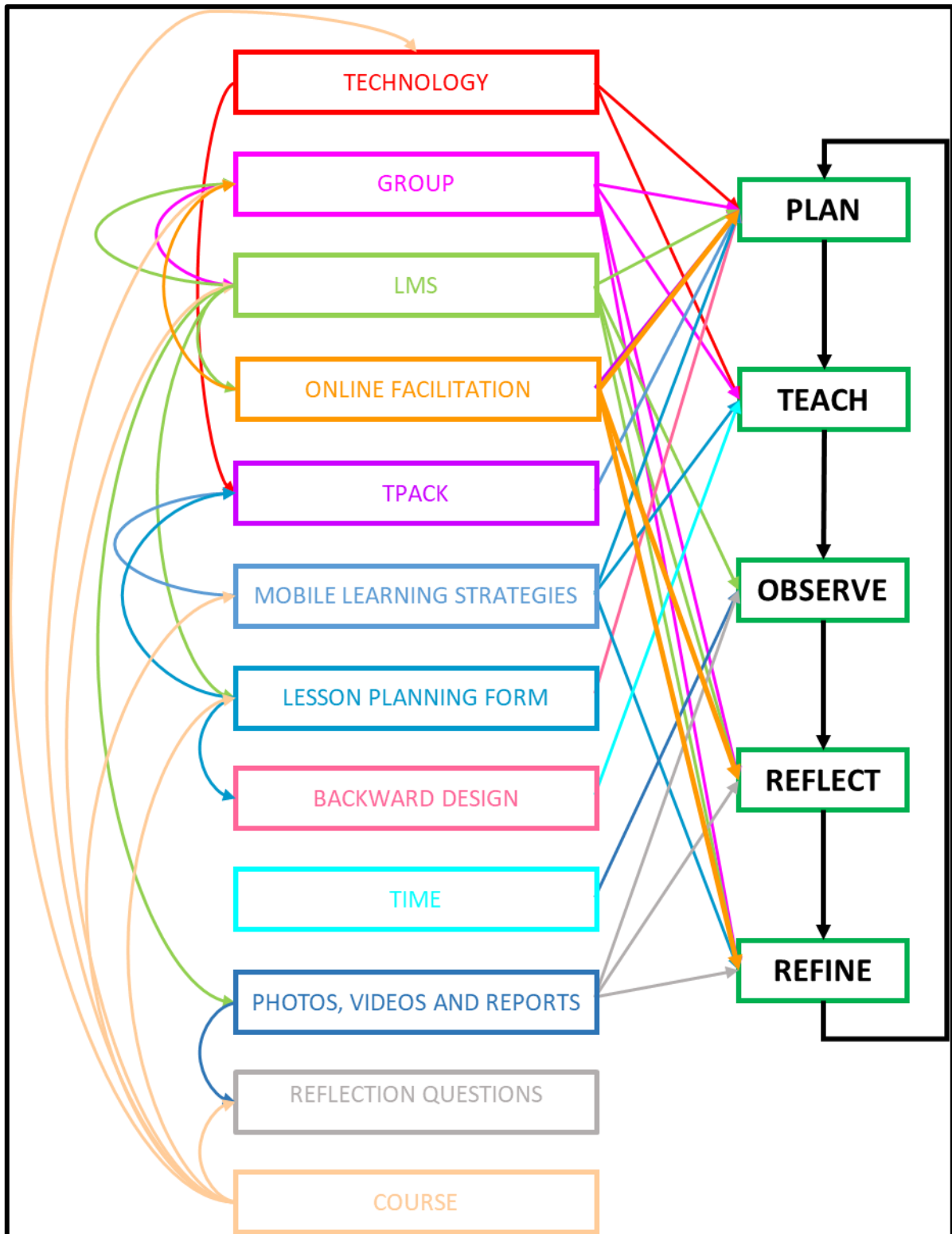
Figure 5. 28: Relationships between aspects and Lesson Study process

5.7. Conclusion

In this chapter, the results from four data sources were synthesised to deliver the aspects that needed to be incorporated into the LS process to support teachers in teaching with technology. The results informed the creation of three iterations of interrelationships between the 11 aspects and the LS process.

In the next chapter, the findings from Chapter 4 and 5 will be used to conclude the findings of this study. Further, the main research question will be addressed in terms of the findings made in these two chapters.

6.   Chapter 6: Findings

6.1. Introduction

In this chapter, the discussions from Chapters 4 and 5 will be used to address the links that exist between the challenges and the aspects and of how they relate to the Lesson Study (LS) process.

The four sections that follow (6.2 to 6.5) aim to address the main research question. It can be seen in Figure 6.1 below, that the chapter will very briefly revisit the findings of Chapters 4 and 5 before moving on to address the main research question in Section 6.4. The chapter will be concluded in Section 6.5.
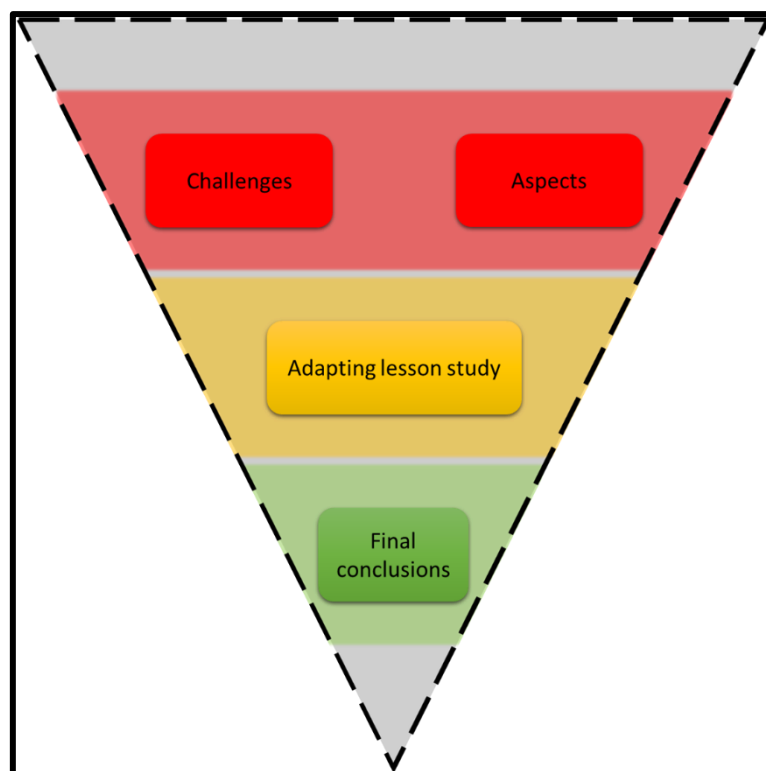
Figure 6. 1: Chapter 6 - Outline

6.2. Sub-research question 1: Challenges

The aim of the first sub-research question was to identify challenges that teachers face when teaching with technology in a LS environment. Chapter 4 was concluded with 13 challenge categories that teachers experienced.

SQ1:

Which **challenges** do **teachers** experience in a Lesson Study environment when **teaching with technology**?

Figure 6.1 depicts the challenges that were identified in Chapter 4 as they were compiled from the compilation of existing and emerging challenges.
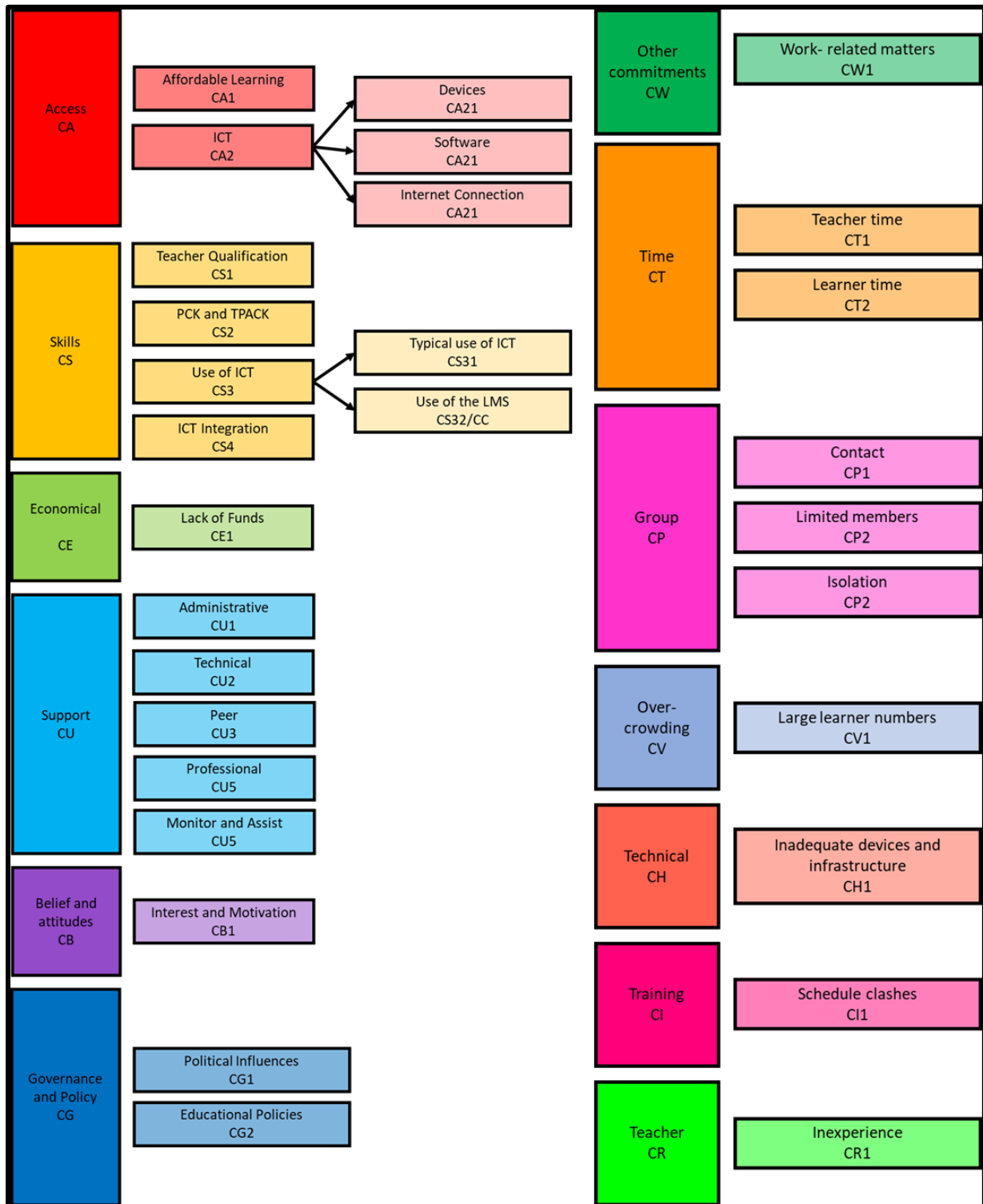
Figure 6. 2: Challenges experienced

From the figure, it can be noted that the challenges that teachers experience when teaching with technology in a LS environment are quite diverse. In total 28 challenges were identified in Chapter 4. The latest information can be used to inform not only the main research question but also add to the challenges found in the literature.

From the challenges above four broad categories can be seen. Firstly, contextual challenges include access challenges, economic challenges and technical challenges, Secondly, skills challenges, beliefs and attitudes, time challenges and teacher inexperience make up the teacher-related challenges. The third category of challenges related to support and management, entails support challenges, governance and policy, other commitments and overcrowding. Lastly, challenges related to the blended learning course are made up of group challenges and training challenges.
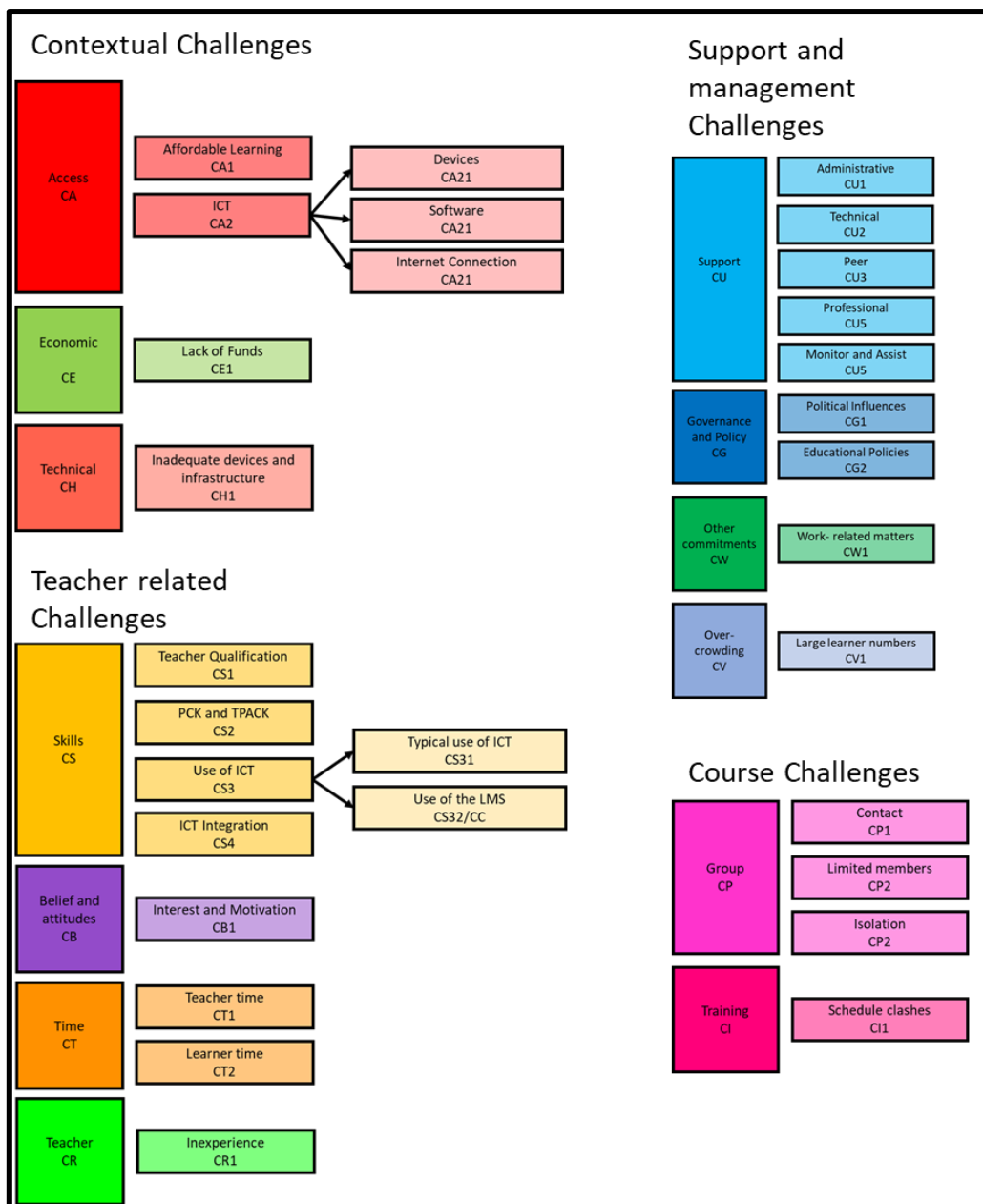
Figure 6. 3: Challenges grouped

In Figure 6.3, the four broader themes of challenges can be seen. The first, contextual challenges consists of access, economic and technical challenges. These challenges as discussed above are largely due to systemic issues. The second theme, teacher-related challenges, is made up of skills, beliefs and attitudes time and teacher challenges. The third theme, support and management challenges, is made up of more systemic challenges like support, governance and policy, other commitments and overcrowding challenges. The last theme, course challenges, consists of challenges that were illuminated by or somehow brought on by the blended learning course. This theme includes group challenges and training challenges.

6.3. Sub-research question 2: Aspects

The second research question aimed to explore the aspects that need to be present in the LS process to support isolated teachers in teaching with technology. Consider the second sub-research question below.

SQ2:

Which aspects should be incorporated into the Lesson Study process to support isolated teachers in teaching with technology?

Figure 6.4 below, indicates the 11 aspects that were identified in Chapter 5. The figure also indicates how various aspects link with the LS process as discussed in Chapter 5.
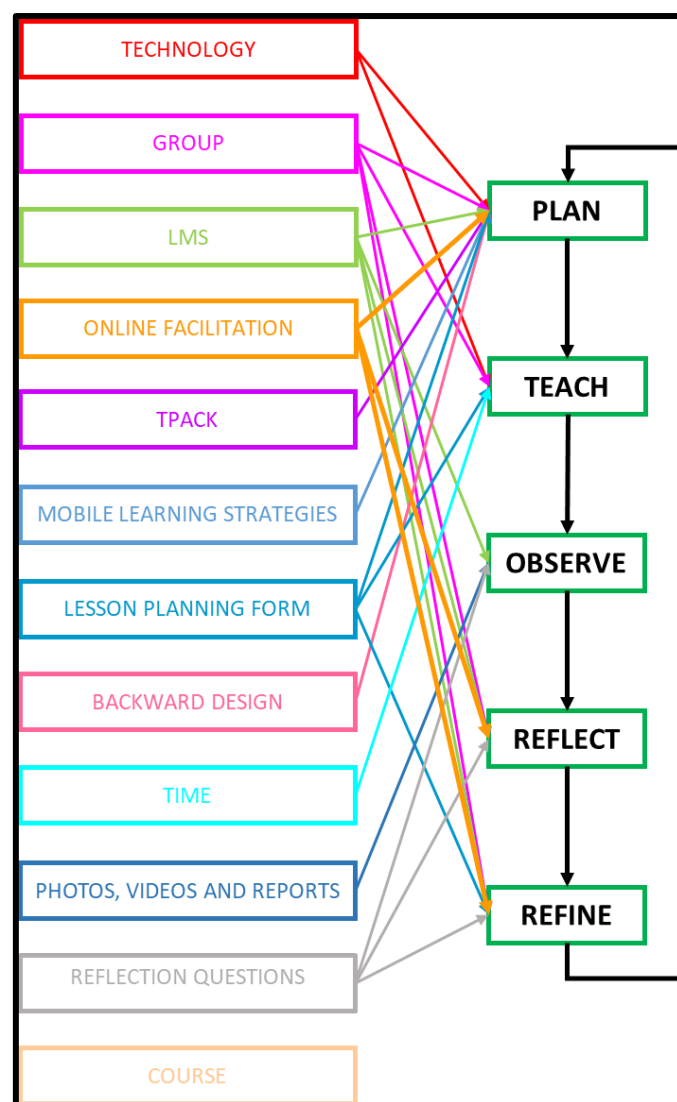
Figure 6. 4: Aspects required in the Lesson Study Process

In this figure, it is evident that the relationship between the various aspects and the LS process is multi-faceted. As discussed in Chapter 5 there are also relationships that exist between the various aspects. Although these relationships will be discussed in-depth in the next section the following table summarises them.

Table 6. 1: Relationships between aspects

Aspect	Impacts	Reason
Technology	TPACK	Technology available for integration
Group	LMS	Group aspect makes the LMS necessary as a management tool
LMS	Group	Facilitates group interactions in an online format
	Lesson planning form	Platform for sharing lesson plans
	Photos, videos and reports	Platform for sharing photos, videos and reports
Online facilitation	Group	Group members become part of the online facilitation team
TPACK	None	
Mobile learning strategies	TPACK	Teaching strategies (pedagogical knowledge) for TPACK.
Lesson planning form	TPACK	Facilitates technology integration in the lesson plan
	Backward Design	Facilitated the backward design process.
Backward design	None	
Time	None	
Photos, videos and reports	Reflection questions	Photos, videos and reports inform the process of answering the reflection questions
Reflection questions	None	
Course	Technology	Course makes it a requirement for teachers to teach with technology
	Group	Divided participants into groups
	LMS	Chose to make use of the LMS
	Mobile learning strategies	Course makes it a requirement for teachers to make use of mobile learning strategies
	Lesson planning form	Introduced the lesson planning form to teachers to use when planning to teach with technology
	Reflection questions	Course introduces the reflection questions as a means to structure reflection

In Table 6.1 it can be seen that some of the aspects have an impact on one or more areas while others do not. This, however, does not mean that these aspects are less important. The reason is that the focus is on which aspects need to be incorporated into the LS process to support isolated teachers in teaching with technology.

Therefore, the impact of the aspects on the LS process is more important than their influence on each other.

6.4. Main research question

In this section, the main research question will be explored. Consider the question below:

> **RQ:**
>
> How can Lesson Study be adapted to a blended approach that supports isolated teachers for teaching with technology?

Discussing this question, one needs to consider the link between the challenges and the aspects that influence the LS process. To explore this, the researcher looked at each aspect individually and considered the challenges that can have an influence on that aspect based on the findings made in Chapters 2 and 4. The discussion that follows will be structured using the 11 aspects as the basis. The link between the challenges and the aspects as described by the literature, results and findings of this study will then be unpacked. Concluding remarks will be made on the influence of aspects on each other and the implications this has towards the LS process. It is useful to consider Figure 6.4, as it also indicates the links between the aspects and the LS process discussed below.

6.4.1. Technology

The technology aspect includes the devices, software, internet connection and e-resources needed to teach with technology. This aspect is influenced by five challenges namely, access to ICT (CA2), lack of funds (CE1), administrative support (CU1), educational policies (CG2) and inadequate infrastructure (CH).

When the challenge of access to ICT is present, the technology aspect is challenged. This leads to the integration of technology being inhibited (Afshari et al., 2014; Hossain et al., 2016; Mandoga et al., 2013; Mehdipour & Zerehkafi, 2013; Nkula & Krauss, 2014). This case was present in this study as pointed out in the results of the final survey.

The lack of funds challenge (CE1) includes the provision of infrastructure (Afshari et al., 2014; Mingaine, 2013a) and the maintenance (Mandoga et al., 2013) thereof. The challenge affects the technology aspect in that a lack of provision and maintenance

will mean that devices are not provided or kept in working order, and internet connections are not available and working. A lack of funds will influence the access to ICT (CA2) and therefore affect this aspect.

The fact that school management must support the integration of technology (Afshari et al., 2014; Hossain et al., 2016) can prove challenging to this aspect. The results indicated that one teacher had to convince the school principal that teaching with technology was needed.

Educational policies need to allow technology to be used in education. This means that the policies need to require and allow teachers to use technology in their teaching (Desta et al., 2013; Koh et al., 2014).

The last challenge that influences the technology aspect is that of inadequate infrastructure (CH1). From the discussion in Section 2.5.2.5, a link exists between this challenge and the challenges of access to ICT (CA2), economic challenges (CE), and overcrowding (CV). This challenge, however, manifests in this aspect as teachers and learners can have access to ICT but need the infrastructure to be addressed differently. In the case of this study, teachers indicated that although they had access to projectors and screens that worked, the need existed for more of these screens to be available in the classroom so that learners could see. This challenge can possibly be aggravated by the challenge of overcrowding (CV).

The technology aspect is, however, a direct influence on the TPACK aspect as its presence allows for technological knowledge to be included in the pedagogical and content considerations of the teacher. The presence of this aspect, therefore, means that TPACK integration becomes possible. This is discussed further in Section 6.4.5.

6.4.2. Group

The group aspect as explained in Chapter 5, entails two groups, namely in general the group of participants and the subject groups. These groups had access to each other through the LMS. The group aspect is largely influenced by three challenges. The first of these, group challenges (CP), challenges of peer support (CU3) and schedule clashes (CI1) also influence the group aspect.

Group challenges, as explained in Chapter 4, entail the challenges of group contact (CP1), limited group members (CP2) and isolation (CP3). The first of these, contact (CP1), proved a challenge because members were not online at the same time. This could be because teachers are busy with other things and cannot cooperate (CW) or do not have the time to participate in the group (CT1). This challenge can, therefore, heighten the challenge of group motivation and interest (CB1). The second sub-challenge, having access to a limited group (CP2), was also seen in the results. This challenge could be a sign that participants lack the motivation or commitment (CB1) to participate in the group (Ang'ondi, 2013; Desta et al., 2013). The blended learning course assured that the participants were allocated to groups of four (where possible) although some participants were not full-time teachers leading to groups with fewer numbers. The third sub-challenge to group challenges, isolation, only came up in one case, but should be considered important in the light of this study as group members struggled to keep in contact due to the distance between them.

Peer support challenges (CU3) could play a role in the group aspect as teachers need to support each other in matters where they have superior knowledge, experience or skills (Cakir & Yildirim, 2013). Lack of peer support will lead to the inability of teachers to function as a collective in their collaborative practice.

Schedule clashes is a challenge that also needs to be considered in terms of the group aspect. This is especially the case where schools have different internal schedules. It was seen in this study that in some cases some schools were busy with exams or had already started their school recess while others were still teaching.

The group aspect, however, alleviates some of the strain caused by the challenges of skills (CS) and teacher inexperience (CR1) due to the fact that teachers are exposed to others who can be of assistance and be "knowledgeable others". The availability of the group aspect within this study showed that participants were able to provide Technical, Peer and Professional support to each other (Nkula & Krauss, 2014), but could not provide administrative support (CU1) or support in the monitoring and assistance of learners (CU5). The group aspect could further be seen to affect teacher time (CT1) in that teachers could divide the workload affiliated with lesson preparation amongst each other.

The group aspect influenced the aspect of online facilitation through the fact that group members were included as facilitators. This is explained in more detail in Section 6.4.4.

6.4.3. LMS

The learning management system (LMS) based on the Blackboard learning management system offered a place for participants to communicate with each other (synchronously or asynchronously) and share files with each other. The LMS gave participants access to their subject groups as well as the larger general group of participants in the blended learning course. Further, the LMS was a place for the online facilitators to stay in touch with participants and monitor their interactions in terms of the course. The LMS as an aspect is influenced by two challenges, namely access to the internet (CA23) and skills to use the LMS (CS32).

The challenge of internet connection (CA23) is one that persists in Chapter 4. It can be seen from the results that the challenge of access to the internet affects both teachers and learners alike. Because it affects teachers, this challenge affects the LMS aspect. Due to the heavy reliance of being online, the LMS aspect, when influenced by this challenge, can cause a vicious cycle. This was seen in the fact that to access the LMS; participants needed to be able to access the internet. This affected their access to the groups and in turn, influenced the group challenges (CP). It was, however, seen that participants who did not have access to the internet at home, accessed it at work, or went to other public places (like libraries or internet cafes) to access the internet.

The skills challenge of using the LMS (CS32) was also quite persistent, as shown in the results of the discussion boards and the Final survey. It was seen, however, that the challenge was somewhat managed through peer support where group members assisted each other in being able to use the LMS. This challenge can also (possibly) be alleviated through training the participants in the use of the LMS or using a more familiar system (like WhatsApp) that participants are more comfortable with.

The inclusion of the LMS aspect relieves some of the strain that is placed on teachers in terms of group challenge (CP). The first group challenge that is addressed by the LMS is that of contact (CP1). In this regard, the LMS provides a platform for group members to stay in contact with each other regardless of the distance between them. The problem is this regard, however, is that the use of the LMS was reliant on the

blended learning course. The platform was not available after the completion of the blended learning course. The second group challenge that is addressed by the LMS, isolation, was seen to be addressed from the responses to the final survey. Participants stated that the use of the LMS was an appropriate way to address the fact that teachers were not close to each other.

The LMS aspect influences five other aspects through the fact that it is a platform for participants to communicate and exchange files. The first aspect that the LMS influenced is the group aspect. The influence is because the LMS manages the division of participants into groups and provides a place for groups to communicate and share files. Further, the aspects lesson planning form and photos, videos and reports and reflection questions are influenced by the presence of the LMS aspect as the LMS provided a place to share files. Lastly, the LMS also served as a platform for the online facilitation, discussed in the next section, to be conducted.

As hinted on in this section, the LMS can easily be replaced by an alternative system that is more user-friendly or familiar to the participants. It should, however, be noted that the replacement platform should be able to address the same aspects as the LMS while not prompting further challenges.

6.4.4. Online facilitation

As pointed out in previous sections, the blended learning course made use of online facilitation through the use of the LMS for online facilitators to support participants in the LS process. It was, however noted in Chapter 5 that participants also considered other participants as facilitators in the online facilitation process.

The online facilitation aspect is influenced by three challenges namely Access to ICT (CA2), Use of the LMS (CS32) and Teacher time (CT1).

In terms of the access to ICT (CA2), it is mentioned in Chapter 4 that access to ICT affects both learners and teachers. It is further mentioned that a strong link exists between the LMS aspect and the aspect of online facilitation. For this reason, it can be said that if teachers do not have access to the necessary devices or internet connection (Elkaseh et al., 2015), they will be unable to access the LMS and, therefore, be unable participate in the support and feedback activities facilitated online. This could also further affect the challenge of a limited group (CP2)

The link between the LMS and the online facilitation further illuminates the fact that any challenges faced in terms of the LMS, or similar system (as discussed before) will influence the online facilitation aspect. Being unable to use the LMS will again aggravate the challenge of a limited group (CP2).

Teacher time is a challenge that exists due to the link between the online facilitation aspect and the group aspect. This is due to the "duties" that participants have to fulfil when participating in online facilitation, as explained in Chapter 4. These duties can place a further strain on the limited time that teachers already have available for their day to day tasks.

Online facilitation elicits the idea that participants are provided with support. In the case of the blended learning course, this meant that participants were provided with technical and professional support in an attempt to relieve challenges such as skills to incorporate PCK and TPACK (CS2) as well as the Skills to integrate technology (CS4) in their classes. Due to the availability of the online facilitation aspect and therefore "knowledgeable others", those who experience challenges related to teacher experience (CR) now have access to more experienced individuals who can assist them.

The online facilitation aspect is affected by two other aspects. The first of these aspects, group, refers to both the general larger group of all participants in the blended learning course as well as the subject groups. Members of these groups have certain "duties" that they have to fulfil, and therefore, a dependency exists between the aspect of online facilitation and group.

Further, the online facilitation aspect awakens a need for an aspect like the LMS or something similar. Notably, facilitators should be able once again to fulfil their duties as online facilitators (discussed in Chapter 5) on the replacement system chosen.

6.4.5. TPACK

The challenges from the technology aspect should be considered with the aspects of TPACK because the TPACK aspect is influenced by technology (as discussed in Section 6.2.3.5). Technology needs to be available for technological knowledge to be integrated into the TPCAK framework.

Besides these challenges, the TPACK aspect is also affected by the skills challenges, teacher qualification (CS1) as well as PCK and TPACK (CS2). The TPACK integration was facilitated by the lesson planning form provided to participants by the blended learning course.

The first challenge, teacher qualification (CS1) can affect TPACK as an aspect if teachers are either not properly prepared by the higher education system (Hammett & Phillips, 2014) or professional development like the blended learning course (De Clercq, 2013; Kamau, 2014). TPACK can also be affected by the fact that teachers are expected to be able to integrate their technological, pedagogical and content knowledge (Ahmad et al., 2013). This means that teachers should be empowered to integrate technology into their teaching through informed decision making (Koh & Divaharan, 2013; Tondeur et al., 2016) which could be further affected if teachers lack the skills to integrate technology (CS4). Teacher inexperience (CR1) can also pose a challenge to the integration process in terms of teachers' content knowledge.

The fact that the blended learning course included this aspect and facilitated it through the lesson planning form meant that teachers could consider the content and methods of their teaching (Christmas, 2014) and align it with the available technology (Cakir & Yildirim, 2013). It can be seen in the results pertaining to this aspect in Chapter 5, that most groups were able to work with this aspect successfully.

6.4.6. Mobile learning strategies

Mobile learning strategies is an aspect that was introduced by the blended learning course. These strategies were prescribed to participants to use in their teaching, and adhere to the ideas that teachers should make use of learner-centred methods that assured learner achievement and could be tailored to the learners' abilities (Estes et al., 2014; Jones et al., 2013; Schraudner, 2014).

The mobile learning strategies aspect is influenced by three challenges namely PCK and TPACK (CS2), administrative support (CU1) and time (CT)

In terms of the challenges related to PCK and TPACK, Chapter 4 illuminates that Mobile learning strategies form part of the pedagogical content knowledge of the teacher (Christmas, 2014). Linking with the challenge of teacher inexperience (CR), teachers need to be experienced and empowered to integrate technology into their

teaching (Tondeur et al., 2016). In the case of this study, this integration was done through the use of mobile learning strategies.

In terms of administrative support, like with the technology aspect, the use of mobile learning as an aspect is something that has to be approved and supported by school management (Afshari et al., 2014; Ang'ondi, 2013; Hossain et al., 2016; Mingaine, 2013a). Should this support not be available (CU1) this aspect would be impossible to incorporate. Notably, this challenge links to the need for educational policy (CG2) to allow for the use of these strategies in education.

Both teacher and learner time (CT1 and CT2) are challenges that can affect the mobile learning strategies aspect. As it could be seen from the discussions in Chapter 4, teachers needed more time to prepare when using mobile learning strategies at first. This could be because teachers are inexperienced (CR) or, as the literature points out in similar cases, that teachers still need to get used to the new methods (Xiaofeng et al., 2015).

The presence of this aspect means that mobile learning strategies provide an option for the pedagogical knowledge that teachers can use for TPACK integration. While the mobile learning strategies aspect is influenced by the challenge of PCK and TPACK (CS2), the aspect also serves as a way to enable teachers to integrate technology into their teaching (Tondeur et al., 2016).

6.4.7. Lesson planning form

The blended learning course chose to make use of what Naresh (2013) refers to as a structured lesson planning form. The lesson planning form consisted of different components of lesson planning that was built into a single document (Seyyedrezae, 2014). Fürstenberg and Kletzenbauer (2015) support this idea as it assists teachers in writing down their lesson plan.

The lesson planning form aspect is influenced by three challenges identified in Chapter 4. These include educational policies (CG2), teachers time (CT1) and schedule clashes (CI1).

Using the lesson planning form is influenced by challenges relating to educational policies as these policies can dictate the format and components of the lesson plan (Seyyedrezae, 2014).

The lesson planning form aspect is affected by and affects teacher time challenges. The results (discussed in Chapter 4) indicate that similar to the findings of Estes et al. (2014) and Xiaofeng et al. (2015), using the form meant that teacher preparation took longer at first. The results indicate, however, as these authors predicted, that with repeated use of the lesson planning form preparation took less time. Further, the results indicated the challenge of a limited group (CP2) further influences the challenge of teacher time (CT1) as it takes longer for participants to complete a lesson plan without group input.

The challenge of schedule clashes (CI1) affects the lesson planning form aspect such that groups that do not follow the same schedule might have difficulty compiling a lesson plan collaboratively. This is because some schools have exams or school holidays while others continue with normal teaching.

The challenges of PCK and TPACK (CS2) and ICT integration (CS4) were both addressed by the use of the lesson planning form aspect. This is because the lesson planning form facilitated the process of accessing the TPACK and therefore made technology integration easier.

The lesson planning form was also used to facilitate the backward design process discussed hereafter.

6.4.8. Backward Design

As explained in Chapter 2, the backward design process entails planning in the sequence of outcomes, assessment and teaching. It further required the need for these three aspects to align (Wiggins & McTighe, 2005).

The backward design aspect is influenced by two challenges, PCK and TPACK (CS2) and teacher time (CT1).

Because the backward design requires teachers to make decisions in terms of teaching and assessment strategies as they relate to their subject content (Ndongfack, 2015; Wiggins & McTighe, 2005), it implies the need for them to apply their pedagogical content knowledge (PCK). Therefore, teachers who do not have the necessary skills to apply PCK will have difficulty in aligning their backward design decisions (Christmas, 2014).

As with the link between the TPACK aspect and the lesson planning form aspect, the link between the backward design process and the lesson planning form affects and is affected by the challenge of teacher time. This is because the (possibly) new way of planning their lessons might take longer at first. In this regard, teacher inexperience (CR1) could be a possible aggravator to challenge of teacher time, where less experience might mean that a teacher takes longer to plan. It was seen, however, that as the teachers continued their use of the lesson planning form, their alignment of outcomes, assessment and teaching became better, and it took them less time to complete the lesson plan.

As mentioned above, the backward design process was facilitated by the lesson planning form built into the blended learning course in an effort to assist the alignment of instructional design decisions. Chapter 5 illuminates the fact that due to the use of the lesson planning form, and online facilitation, the participants were able to align their decisions by the second LS cycle.

The challenge of teacher inexperience could be relieved by the use of the backward design aspect in conjunction with the aspects group, online facilitation and lesson planning form. The reason for this is that teachers are now assisted through the process in a step-by-step basis and also have knowledgeable others who can assist them where their inexperience confronts them.

6.4.9. Time

The discussions of Chapter 5 indicate that teaching time is an important consideration that needs to be made when attempting to teach with technology through a process like this.

In terms of the aspect of time, it was seen that the challenge of teacher time (CT1) (as in a lack of time) had a direct impact. Teachers indicated that teaching with technology takes longer. It is seen in Chapter 4 that this is due to factors such as having to wait for acceptable internet speeds (CA23) and having to assist learners with the use of technology (CU5). This aspect was further impacted on by learner time (CT2) as learners (and particularly those who do not have personal devices (CA21)) will struggle to finish tasks given to them in class. The challenge of teacher time CT1 can further be aggravated by the challenges of other commitments (CW) and overcrowding (CV).

If the time aspect is considered and lessons are at least 50 minutes long (as indicated in the results), the challenges of teacher time (CT1) and learner time (CT2) can be alleviated.

6.4.10. Photos, videos and reports

Photos, videos and reports are three methods (pointed out in Chapter 5) that participants used to share their lesson observations with each other. With regard to this aspect, two challenges need to be considered, namely use of the LMS (CS32) and limited group (CP2).

As discussed in Chapter 5, a strong link exists between this aspect and the LMS aspect. This means that any challenges linked to the LMS will impact on this aspect.

Further, the challenge of a limited group (CP2), will have a negative impact on this aspect. This means that there might be nobody for participants to share their experiences with that can be of assistance or share ideas. The aspect of online facilitation, however, means that there are others, such as the online facilitators and the larger group of participants that can be of assistance.

The inclusion of this aspect into the LS process, however, solves two problems. The challenge of isolation (CP3) is relieved by this aspect as group members do not have to be in close proximity to be able to observe each other teaching. Further, teacher time (CT1) is also taken into consideration by this aspect as teachers do not have to be in each other's classes, and therefor loose time at their own schools. Using photos videos and reports shared through a platform like the LMS teachers can now observe each other's lessons asynchronously in a time that suits them.

The use of photos, videos and reports as a means of observation also affects the reflection questions aspect (discussed next) as it informs all the group members of the events that transpired during the teaching of the lesson. This enables the group to address the reflection questions as a collective.

6.4.11. Reflection questions

It is important to note the link between the reflection questions and the group aspect. The link exists based on the fact that the reflections required a group collective recollection of the lesson that was taught. As mentioned before the reflection questions consisted of three questions that participants could use to structure their thoughts, namely "What went well?", "Even better if?" and "Target".

Two challenges need to be considered in terms of this aspect. This includes using the LMS (CS32) and having a limited group (CP2).

Because the LMS was used to manage the subject groups and provide them with a platform to discuss their reflections, the challenges related to the use of the LMS (CS32) will affect this aspect. Group members who have difficulties in accessing or using the LM will be unable to share their experiences with the group leading to an incomplete recollection of the groups' teaching.

The link between this aspect and the aspect of group, as hinted on in the preceding paragraph, means that having access to a limited group (CP2) will make the answering of these questions redundant. This challenge can be worsened by the fact that group members might lack the motivation or commitment (CB1) to participate in the reflections.

Although the inclusion of the reflection questions cannot be seen to alleviate any challenges, it affects the aspect of photos, videos and reports. This is due to the fact (as pointed out in Chapter 5) that participants used the reflection questions as a means to structure their observation reports.

Up to this point, the blended learning course's contribution to the aspects has been integrated into the discussion of the other aspects. It was found that six aspects, technology, group, LMS, online facilitation, planning form and reflection questions were aspects that could not have been present without the blended learning course.

6.4.12. Blended learning course

Figure 6.3 below shows an attempt to visualise the impact of the course on the six aspects. Further, it shows how these six aspects link to other aspects that have already been discussed. Lastly, the figure indicates the impact that the blended learning course had on the LS process through the various aspects if affected.
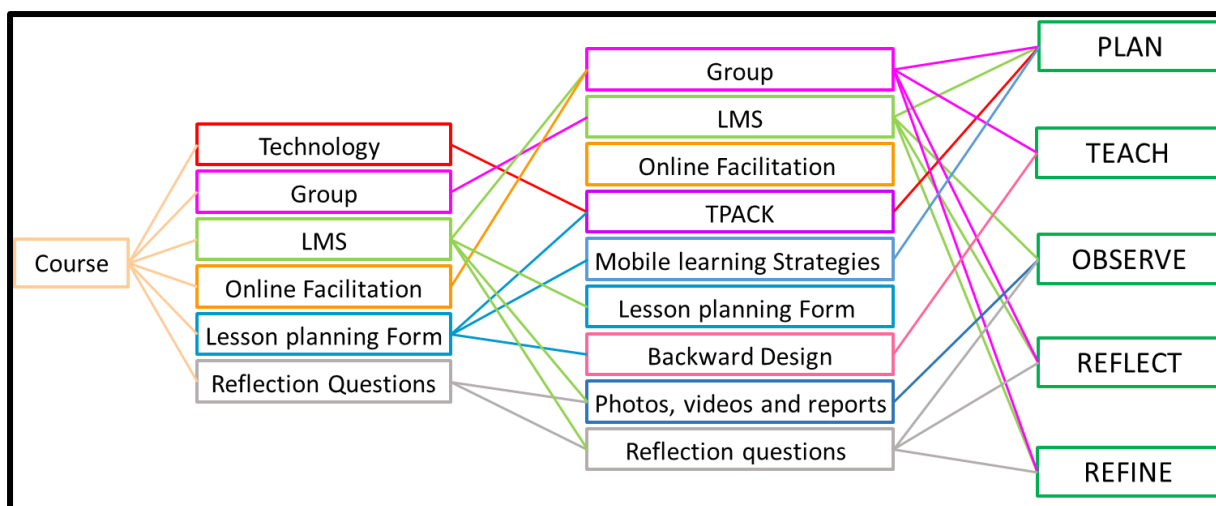
Figure 6. 5: Course impact

As can be seen in the figure above, the blended learning course, through the six aspects it introduced to the LS process, had an impact on all the phases of the LS process. It is for this reason that the blended learning course and the essentials that came with it should be considered an aspect of the LS process when attempting to support Isolated teachers in teaching with technology.

6.5. Conclusion

In this chapter, the aim was to link the challenges and aspects with each other to investigate the main research question and determine how LS should be adapted to a blended approach that supports isolated teachers in teaching with technology.

Through the discussions in Section 6.3, the links between the various aspects and the LS process is clear from the discussions in Chapter 5. This chapter has, however, now brought with it the link that exists between the challenges and the aspects. Therefore, it is now possible to consider how the challenges related to the LS phases.

Table 6.1 below indicates the challenges and their sub-challenges, with the LS phases to which they link. Further, Table 6.2 indicates whether the preceding discussions have shed any light on possible aspects that address some of these challenges. In some cases, as the table shows, this was not possible.

Table 6. 2: Challenges linking with Lesson Study cycle

Category	Challenge	Sub-challenge	Plan	Teach	Observe	Reflect	Refine	Possible solution discussed	No solution discussed
CA	CA1								
	CA2	CA21	X	X		X	X		X
		CA22	X			X	X		X
		CA23	X	X	X	X	X		X
CS	CS1		X						X
	CS2		X					X	
	CS3	CA31	X						X
		CA32	X		X	X	X		X
	CS4		X					X	
CE	CE1		X						X
CU	CU1		X						X
	CU2							X	
	CU3		X	X		X	X	X	
	CU4							X	
	CU5			X					X
CB	CB1		X	X	X	X	X		X
CG	CG1								
	CG2		X	X			X		X
CW	CW		X	X		X	X		X
CT	CT1		X	X		X	X	X	
	CT2		X	X				X	
CP	CP1		X	X	X	X	X	X	
	CP2		X	X	X	X	X		X
	CP3		X	X	X	X	X	X	
CV	CV1		X						X
CH	CH1		X						X
CI	CI1		X	X		X	X		X
CR	CR1		X					X	

Considering the information in this table, along with the preceding discussions in this chapter, one can now link the challenges, aspects and LS with each other. This is done in Figure 6.4 that follows.
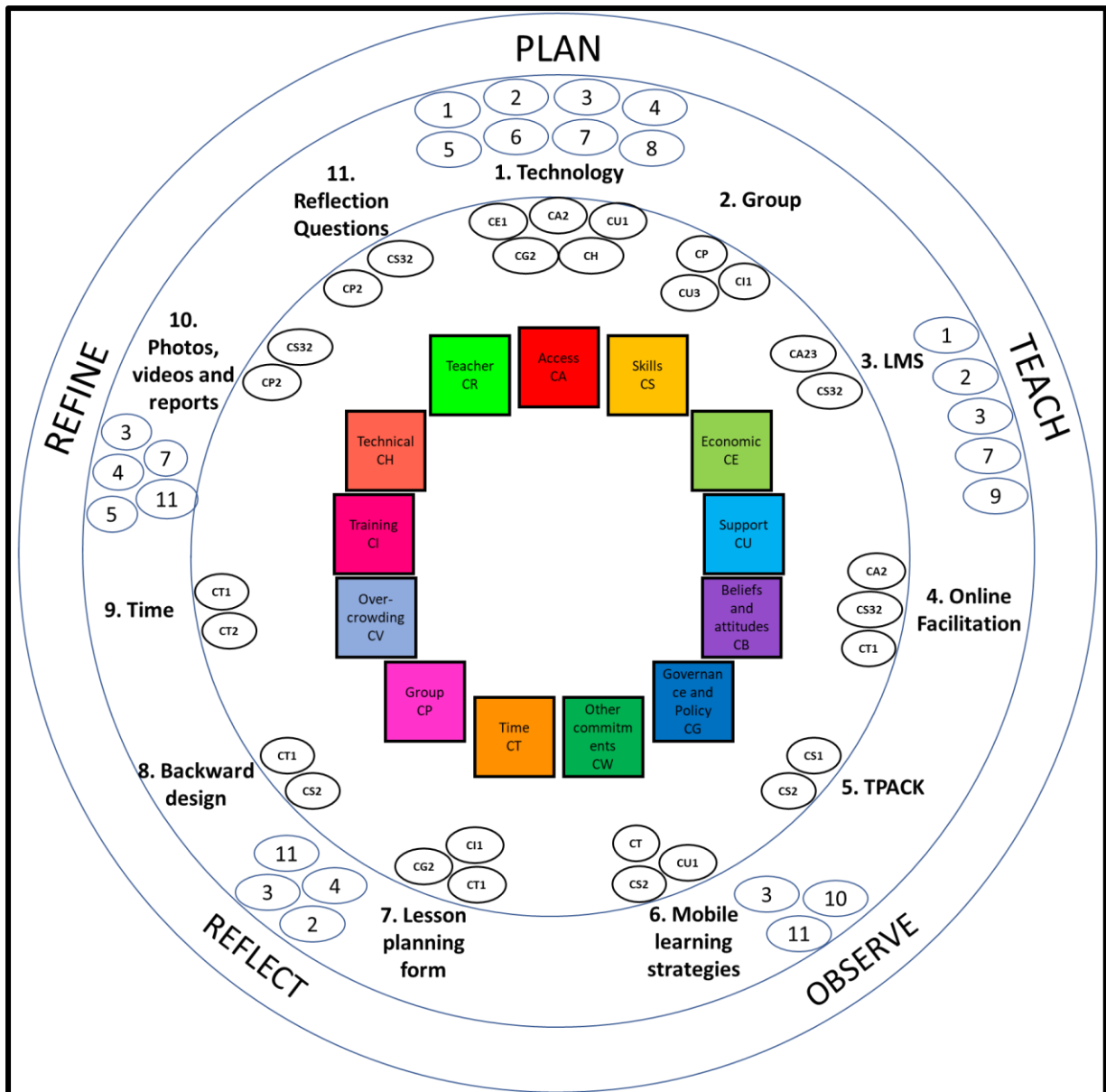
Figure 6. 6: Linking challenges, aspects and Lesson Study cycle

In the figure, the inner circle represents the challenges, the next circle represents the aspects and the outer circle the LS cycle. The codes from the challenges, as they were shown in Figure 6.4 are indicated next to the aspects that they influence. Further, the aspects (numbered from 1 to 11) are indicated next to the LS phase that they are attributive to. On the outside of this figure, one can see that the entire LS ecosystem resided within the blended learning course as discussed in Section 6.4.12. This will be explored further in the concluding remarks of Chapter 7.

7.   Chapter 7: Final conclusions

7.1.   Introduction

In this chapter, the conclusion of the study will be discussed. This will be done by referring to the final illustrations made in terms of the sub research questions as well as the main research question. Thereafter, the research focus will be placed on the shortcomings, limitations, benefits and way forward of this study. Lastly, the study will be concluded in Section 7.9. This is summarised in Figure 7.1 below.
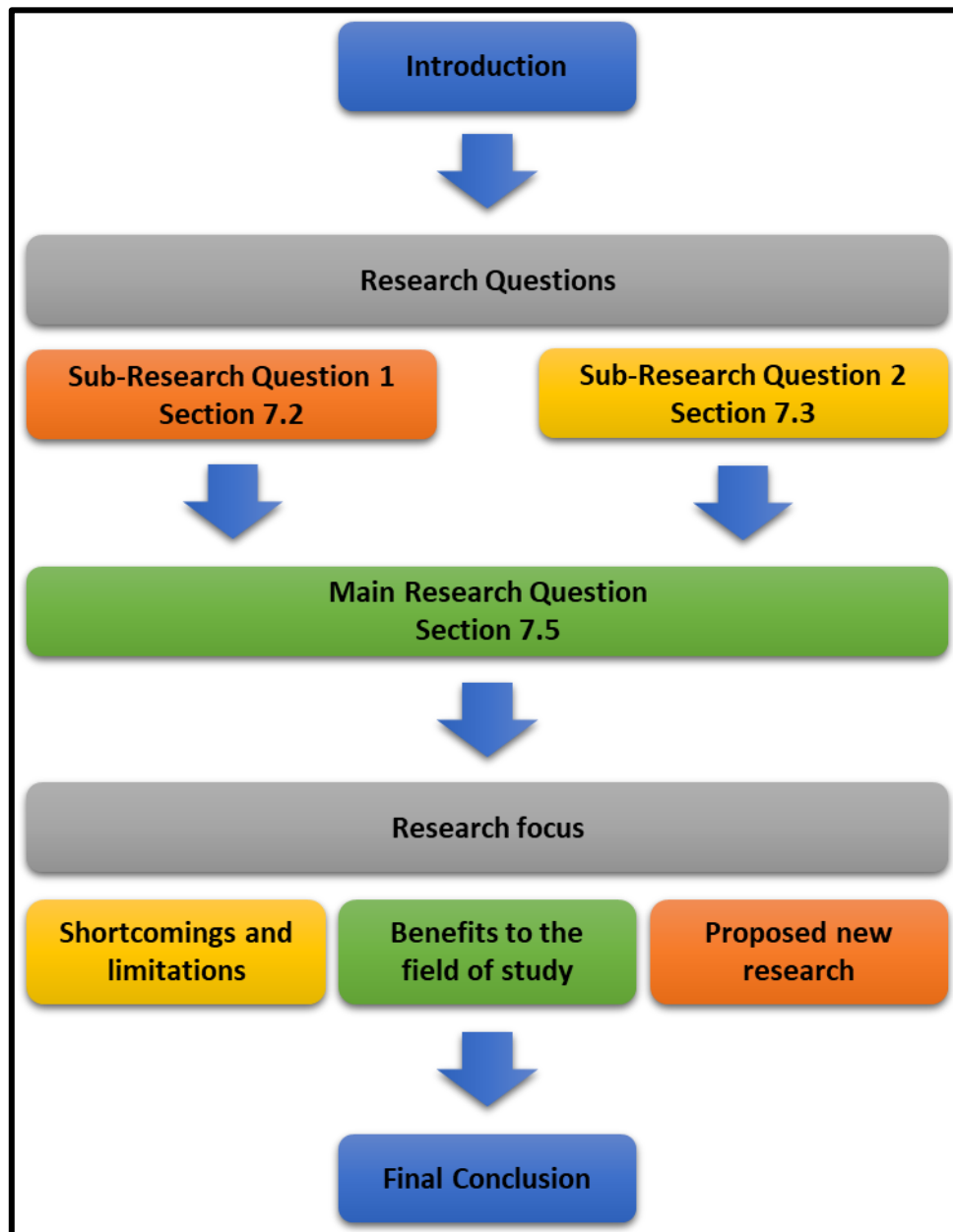
Figure 7. 1: Chapter 7 - Outline

7.2. Sub-research question 1

Figure 7.2 is an illustration of the final division of challenges raised in Chapter 6. Note the four categories, contextual challenges, support and management challenges, teacher related challenges and course challenges.
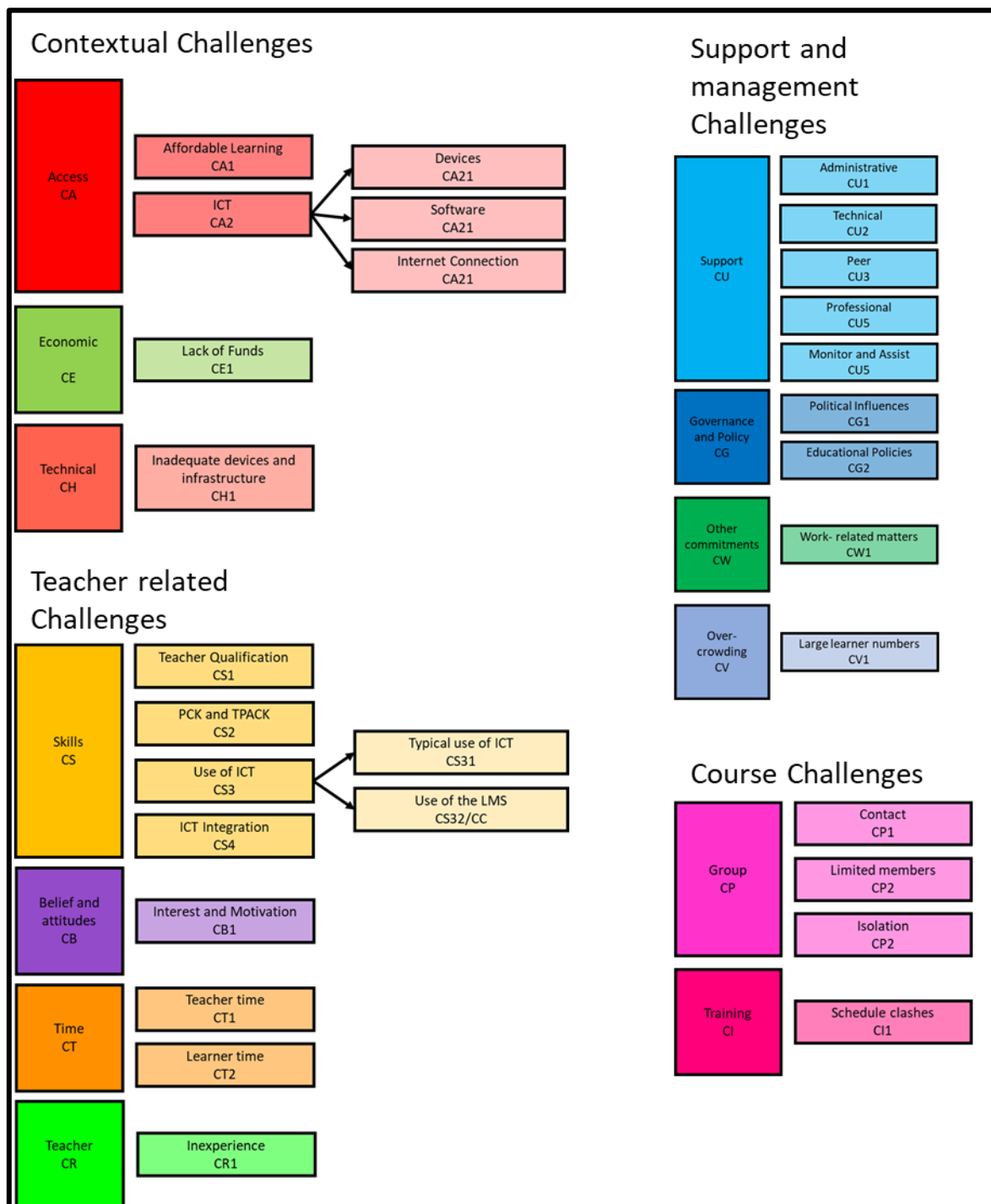
Figure 7. 2: Sub-research question 1- Illustrated

7.3. Sub research question 2

Figure 7.3 depicts the links between the various aspects discussed in Chapter 6, as well as how the aspects link to the LS process.
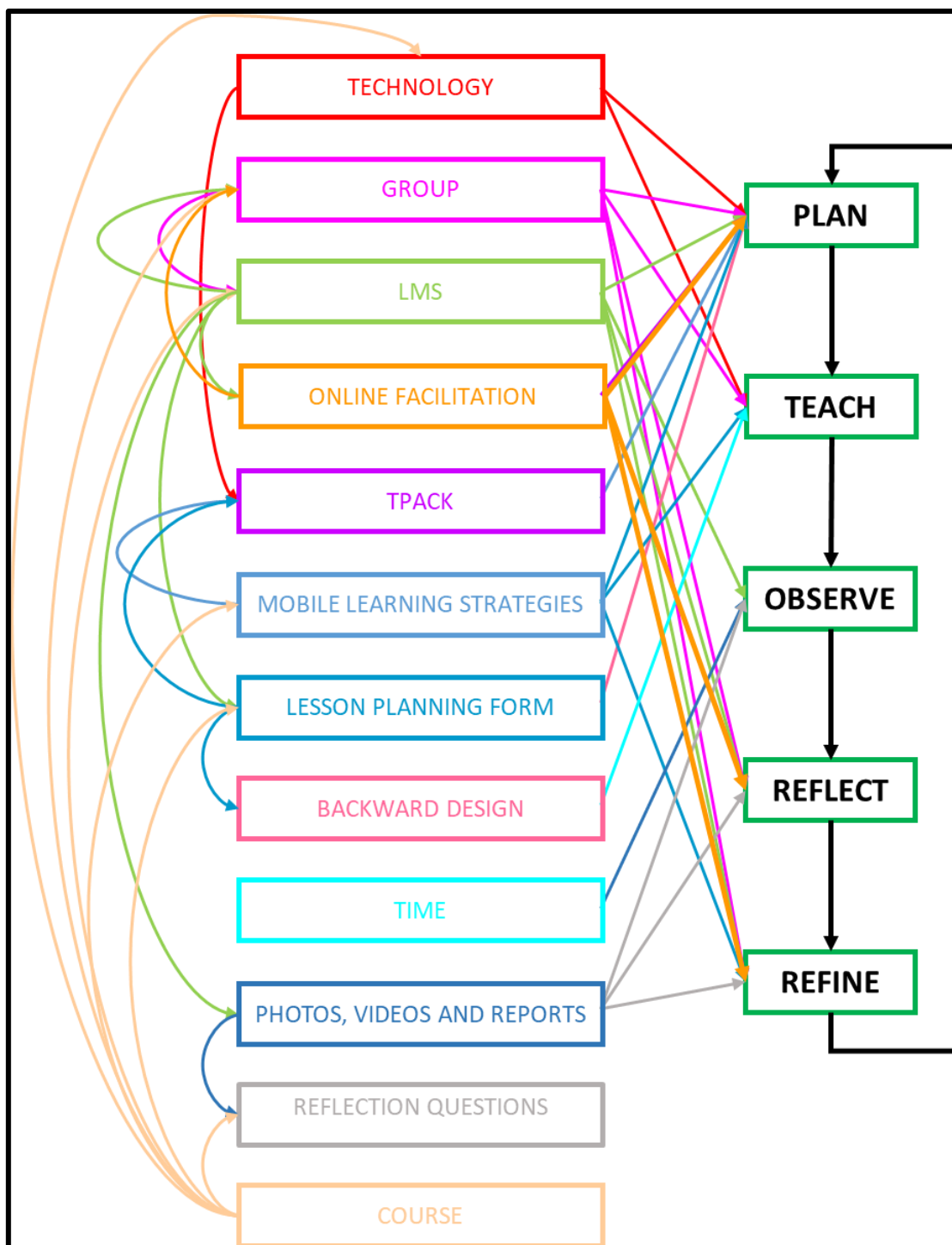
Figure 7. 3: Sub-research question 2 - Illustrated

7.4.   Main research question

When adapting LS to a blended approach, one should take note of the challenges and include the 11 aspects in a blended environment. Figure 7.4 depicts the adaptation mentioned above. At the centre of this figure, one can see the four challenge categories (also explained in Section 7.2) within the green challenges circle. Surrounding this are the 11 essential aspects that need to be included in the LS process when adapting the process for a blended approach. Note the arrows that indicate the dual impact that the challenges and aspects have on each other. The red circle indicates the cyclic flow of the LS process in its five stages. Again, note the dual impact between the LS process (requiring certain aspects) and the aspects (impacting on the process). All of this is depicted in a blended environment.
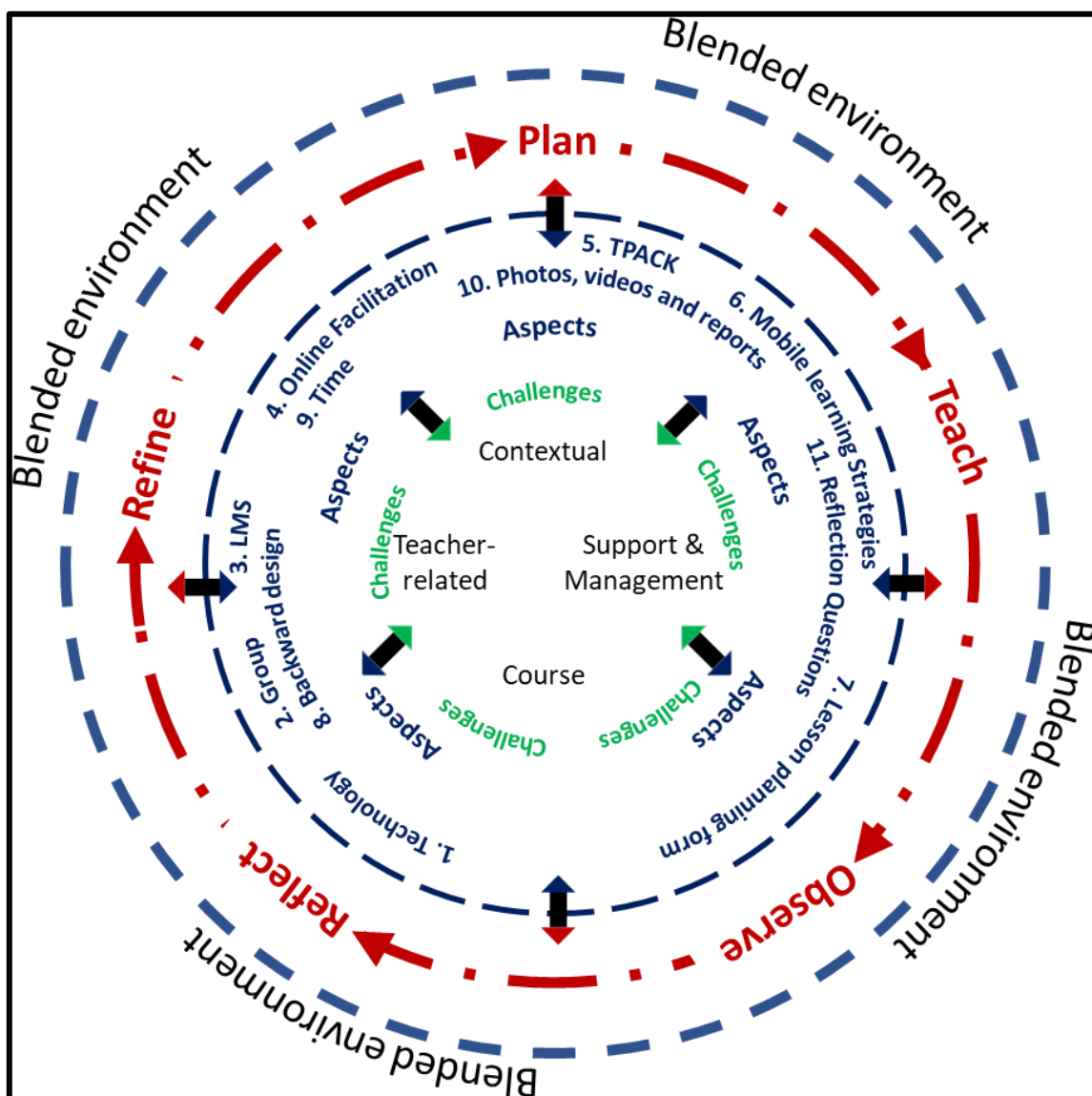
Figure 7. 4: A blended approach to Lesson Study

7.5. Conclusion: Main research question

LS done through a blended approach is a viable solution to support isolated teachers in teaching with technology.

In the adaptation of LS seen through this research, support was given to participants in the LS through group interactions and online facilitation. Although this support is not uncommon and is also present in more traditional LS approaches, the difference lies in the fact that the facilitation took place online.

This online approach meant that teachers do not have to be near each other or travel long distances to partake in the LS process. The study shows that teachers can have access to others online through mediums like learning management systems or other systems that have similar characteristics.

An important consideration is that there should be something that drives the initiative for LS to be implemented as a blended approach. This drive could be in the form of private institutions using LS as a professional development opportunity for teachers as was the case in this study. It could also be an initiative from government or as part of other larger-scale initiatives. This could be, for example, administrated through subject advisors.

The drive should, however, have an initial face-to-face session where teachers can be trained and get to know those who they will be working with in person. This should be followed by a supported online session. The online support should take into consideration aspects like groups, learning management system, online facilitation, lesson planning forms and the reflection questions.

A lesson planning form, like the one used in this adaptation of LS, is seen as a way to support coherent planning processes for teachers who are isolated from each other. They get acquainted with this form during the face-to-face session and decide how they will approach the use of the form during the online collaboration. When teaching with technology, as was the case in this study, this lesson planning form can be used to facilitate the TPACK aspect. If teaching is to be done with or without technology, this form should still facilitate the backward design process to assure the implementation of PCK. The form can also be adapted to contain other subject specific content that is needed rather than teaching with technology. This will assure that subject-specific elements can be facilitated due to the design of the form.

The facilitators in this adapted LS approach should be experts that can assist teachers in their endeavour as collaborative practitioners. These experts need not be people from a higher education institution, as was the case in this study. They could also be subject knowledge experts in the different school subject that the adapted LS aims to address. Further, in the case where teaching with technology is important, these facilitators can be ICT integration experts. It is important that these facilitators should have a strong online presence in the online facilitation of this LS format.

The teachers who participate in the LS should also understand their role as online facilitators of the LS approach. This speaks to the community of practice where all the participants are equals in supporting others. It was seen from the approach followed in this study that the groups should be kept small (3- 5 participants), but that these groups should be monitored to ensure that all members continue to participate. The larger group of participants should also not be too big. In the case of this intervention, the ratio of facilitators to participants was more or less one facilitator to six groups (24 people).

Time should be considered when implementing this LS approach on a large scale. Teacher time as discussed in the challenges should be carefully considered by all involved to allow teachers to make the most of their collaboration with others without being overloaded by other commitments. The schedule of such an approach should also be kept flexible and generic to allow the interaction of teachers not to interfere with the schools' internal schedules.

The ability for these teachers to send each other photos, videos and reports of their lesson presentations was a viable way for the observation phase of the LS to be conducted. This allowed for asynchronous lesson observation that could be safeguarded on the online platform for teachers to refer to again and again.

Reflective practice can be a guided process and should be kept positive. It is the researcher's opinion that the use of positive reflection questions made the difference in convincing participants to reflect on their practice individually and as a group. The use of the guided reflection also provided a way for the participants to put together a collaborative reflection with ease.

7.6. Shortcomings and limitations

Shortcomings and limitations included participants, the course programme, the use of the learning management system and the LS process followed.

Two shortcomings were noticed in terms of the participants. Firstly, some participants in the blended learning course were not teachers. As discussed in Chapter 1, participants who were not teachers were school administrators, principals, and strategic planners. This meant that these individuals could not participate fully in the course and therefore, could not support and collaborate with others on an optimal level. In groups where this was the case, data collection was difficult as there was not a lot of interaction.

The course programme also contributed to some shortcomings and limitations. The course programme was planned in such a way that teachers could attend the face-to-face session at a time that most schools could operate without these teachers. This meant that the first LS cycle, in some cases occurred while schools had examinations to complete and others had school holidays. This led to a less meaningful participation, and in some cases, a lack of participation in the first LS cycle. This also had an impact on the data that was available in the study as some teachers did not teach their lesson but rather worked on the tasks in a theoretical way. This was, however not the case for the second LS cycle followed in the blended learning course.

It was observed that participants who were uncomfortable with the use of the LMS reverted to also work through the WhatsApp messenger application. This resulted in the researcher not having access to the conversations and interactions of the participants to include this in the data collection.

7.7. Benefits to the field of study

This study has two contributions to make to the field of computer integrated education. This includes a practical and a theoretical contribution.

7.7.1. Practical contribution

The most significant contribution that this study makes is the practical contribution of applying LS in an online format. The significance of this study, therefore, lies in the fact that LS was adapted from a very traditional practice into a blended approach. The innovation lies in the fact that the adaptation aims to acknowledge the challenges faced by teachers while being a way for teachers to overcome some of these

challenges. The combination of the Technology Integration Planning (TIP) model and the LS process is unique to this study. The participants in this study are representative of all the provinces in South Africa and Botswana. This indicated that LS in a blended approach could be applied on a large scale despite the distance between the participants.

7.7.2. Theoretical contribution

Through the combination of the challenges and aspects investigated in this study with the LS process, Figure 7.4 delivers the theoretical essence of the study in the form of a framework. This framework illustrated in Figure 7.4 can provide a starting point for any follow-up applications of blended LS or research to be done in this regard. The significance lies in the fact that this framework combined the ideas of the TIP model and the LS process and provides the necessary delineations needed for these trusted frameworks to function in a blended environment.

7.8. Proposed new research

It would be interesting to see the application of this blended approach to LS in a setting where it is not administered by an academic institution to continue the trajectory of this research. This could be done, for example, if the Department of Basic Education would implement this form of LS on a national or provincial level.

Further, this adaptation of LS could be administered in different sections of the educational realm where the aspects included in this adaptation could be questioned and remodelled to suit new niches.

7.9. Final conclusions

It was apparent from the completion of the course that something special happened in the way the course was presented, and the teachers participated in the Lesson Study cycles. It is uplifting to see that there are so many eager individuals who want to develop themselves and their teaching practice by taking part in an intervention like this. It is also encouraging to see companies who engage in projects where technology is made available for education. The fact that this company saw the need for professional development for the teacher using their technology is eye-opening and exceptional.

The insight that was gained into the challenges is invaluable. Not only in the fact that there is new light on the challenges faced in the South African context, but that there are solutions to many of these challenges.

This study has presented a possible adaptation that can be made to LS to facilitate it in a blended environment. This adaptation can be a powerful tool for teacher collaboration. It can also be a tool for teacher development that can address some of the challenges and expectations that teachers experience in their everyday life.

Conducting this study gave the researcher an insight into the possibilities that recent technological development brought to Education. This is in regard to the fact that technology, especially mobile technology, has become more accessible to the average classroom. Further, these developments have led to the possibility to have teachers collaborate in an endeavour like this regardless of where they are in the country and maybe even in the world.

REFERENCES

Afshari, M., Bakar, K. A., Luan, W. S., Samah, B. A., & Fooi, F. S. (2014). Factors affecting teachers' use of information and communication technology. *International Journal of Instruction, 2*(1), 77-104.

Ahmad, S. A., Abubakar, Y., & Dabo, J. I. (2013). Information and Communication Technology acceptance for teaching and learning among secondary school Teachers in Nigeria. *Asian Journal of management sciences and Education, 2*(1), 69-79.

Alshwaikh, J., & Adler, J. (2017). Researchers and teachers as learners in Lesson Study. *SAARMSTE Book of Long Papers*, 1-13.

American Society for Training and Development. (1988). Basics of instructional systems development (Info-line : practical guidelines for training and development professionals). Alexandria, VA: American Society for Training and Development.

Ang'ondi, E. K. (2013, July). Teachers Attitudes and perceptions on the use of ICT in teaching and learning as observed by ICT champions. In Proc. 10th IFIP World Conference on Computers in Education, Torun.

Benedict, A. E., Park, Y., Brownell, M. T., Lauterbach, A. A., & Kiely, M. T. (2013). Using lesson study to align elementary literacy instruction within the RTI framework. *Teaching Exceptional Children, 45*(5), 22-30.

Bloom, B. S., & Anderson, L. W. (2014). *A taxonomy for learning, teaching, and assessing : a revision of Bloom's*. Harlow: Pearson.

Botha, A. I., & Herselman, M. (2015). Supporting teacher professional development to use tablets in resource constrained schools: a case study of Cofimvaba schools, Eastern Cape Province, South Africa. *Systemics, cybernetics and informatics, 13*(5), 20-27.

Brooks, R., te Riele, K., & Maguire, M. (2014). *Ethics and Education Research*. London: SAGE Publications Ltd. Retrieved from http://methods.sagepub.com/book/ethics-and-education-research. doi:10.4135/9781473909762

Cakir, R., & Yildirim, S. (2013). ICT teachers' professional growth viewed in terms of perceptions about teaching and competencies. *Journal of Information Technology Education: Innovations in Practice, 12(1), 221-237*.

Callaghan, R. (2018). Developing mobile teaching practice: A collaborative exploration process. *Technology, Knowledge and Learning, 23*(2), 331-350. doi:10.1007/s10758-017-9319-y

Chong, J. S. Y., Han, S. H., Abdullah, N. A., Chong, M. S. F., Widjaja, W., & Shahrill, M. (2017). Utilizing Lesson Study in Improving Year 12 Students' Learning and Performance in Mathematics. *Mathematics Education Trends and Research, (1)1*, 24-31. doi:10.5899/2017/metr-00095

Christmas, J. (2014). Challenges with creating professional development workshops for Japanese elementary school teachers. *The Language Teacher, 38*(6), 3-9.

Clayton, N., & Abbass, H., (2019). *Machine teaching in hierarchical genetic reinforcement learning: Curriculum design of reward functions for swarm shepherding.* Paper presented at the IEEE Congress on Evolutionary Computation (CEC) Wellington, New Zealand doi:10.1109/CEC.2019.8790157

Corbetta, P. (2003). *Social Research: Theory, Methods and Techniques.* London: SAGE Publications, Ltd. Retrieved from https://methods.sagepub.com/book/social-research-theory-methods-and-techniques. doi:10.4135/9781849209922

Creswell, J. W. (2007). *Qualitative inquiry & research design : Choosing among five approaches* (2nd ed.). Thousand Oaks: Sage Publications.

De Clercq, F. (2013). Professionalism in South African education: The challenges of developing teacher professional knowledge, practice, identity and voice. *Journal of Education, 57*(1), 1-24.

Desta, D., Chalchisa, D., & Lemma, G. (2013). School-based continuous teacher professional development in Addis Ababa: An investigation of practices, opportunities and challenges. *Journal of International Cooperation in Education, 15*(3), 77-94.

Dick, B. (2014). Transferability. In D. Coghlan & M. Brydon-Miller (Eds.), *The SAGE Encyclopedia of Action Research.* London.

Dick, W., & Carey, L. (1978). *The systematic design of instruction.* Glenview, Ill.: Scott, Foresman.

Elkaseh, A. M., Wong, K. W., & Fung, C. C. (2015). The acceptance of e-learning as a tool for teaching and learning in Libyan higher education. *International Journal of Information Technology, 3*(4), 1-11.

Elliott, J. C. (2017). The Evolution from Traditional to Online Professional Development: A Review. *Journal of Digital Learning in Teacher Education, 33*(3), 114-125.

Estes, L. A., McDuffie, A. R., & Tate, C. (2014). Lesson planning with the common core. *Mathematics Teacher, 108*(3), 206-211.

Fetterman, D. M. (2005). Emic Perspective. In S. Mathison (Ed.), *Encyclopedia of Evaluation.* Thousand Oaks, CA: SAGE Publications.

Fitzpatrick, J. L. (2005). Informed Consent. In S. Mathison (Ed.), *Encyclopedia of Evaluation.* Thousand Oaks, CA: SAGE Publications.

Fox, N. J. (2008). Induction. In L. M. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods.* Thousand Oaks, CA: SAGE Publications.

Fürstenberg, U., & Kletzenbauer, P. (2015). Language-sensitive CLIL teaching in higher education: Approaches to successful lesson planning. *ELTWorldOnline. com. Special Issue on CLIL.*

Grandy, G. (2010). Instrumental Case Study. In A. J. Mills, G. Durepos, & E. Wiebe (Eds.), *Encyclopedia of Case Study Research* (Vol 1, pp. 473-476). Thousand Oaks, CA: SAGE Publications

Grant, M. M. (2019). Difficulties in defining mobile learning: analysis, design characteristics, and implications. *Educational Technology Research and Development : A bi-monthly publication of the Association for Educational Communications & Technology, 67*(2), 361-388. doi:10.1007/s11423-018-09641-4

Gudmundsdottir, S., & Shulman, L. (1987). Pedagogical Content Knowledge in Social Studies. *Scandinavian Journal of Educational Research, 31*(2), 59-70. doi:10.1080/0031383870310201

Hammett, R. F., & Phillips, P. (2014). Teaching with digital technologies in university and school contexts: Research and professional development using TPACK. *The Morning Watch: Educational and Social Analysis, 42*(1-2), 1-9.

Hammonds, L., Matherson, L. H., Wilson, E. K., & Wright, V. H. (2013). Gateway tools: Five tools to allow teachers to overcome barriers to technology integration. *Delta Kappa Gamma Bulletin, 80*(1), 36-40.

Hennink, M., & Kaiser, B. (2008). Saturation in Qualitative Research. In P. Atkinson, S. Delamont, A. Cernat, J. Sakshaug, & R. Williams (Eds.), *The SAGE Encyclopedia of Qualitative Research Methods.*Thousand Oaks, CA: SAGE Publications. doi: 10.4135/9781526421036822322

Herselman, M., Botha, A., Mayindi, D., & Reid, E (2018). *Influences of the Ecological Systems Theory Influencing Technological Use in Rural Schools in South Africa: A Case Study.* Paper presented International Conference on Advances in Big Data, Computing and Data Communication Systems (icABCD), Durban.

Herselman, M., Botha, A. I., Dlamini, S., Marais, M., & Mahwai, N. (2019). *Findings from a mobile tablet project implementation in rural South Africa.* Paper presented at the 15th International Conference on Mobile Learning, Utrecht.

Hogan, S. O. (2008). Voluntary Participation. In P. Lavrakas (Ed.), *Encyclopedia of Survey Research Methods.* Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412963947

Hooks, M. (2015). Pinterest: A tool for lesson planning. *Mathematics Teacher, 108*(6), 466-468.

Hossain, M. A., Salam, M. A., Shilpi, F., & Officer, A. D. (2016). Readiness and challenges of using Information and Communications Technology (ICT) in higher education of Bangladesh. *Online Journal of New Horizons Education, 6*(1), 123-132.

Hubbard, J. D. (2015). Teachers Collaborate Using Lesson Study: Implications for Early Childhood Social Studies Students. *Social Studies Research & Practice, 10*(3), 1-17.

Jensen, D. (2008a). Confirmability. In L. M. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods* (Vol 1). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412963909

Jensen, D. (2008b). Dependability. In L. M. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods* (Vol 1, pp. 208-209). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412963909

Jensen, D. (2008c). Transferability. In L. M. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods* (Vol 1). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412963909

Jesson, J., Matheson, L., & Lacey, F. M. (2011). *Doing your literature Review : traditional and systematic techniques*. Los Angeles, CA: SAGE.

Jones, L., Stall, G., & Yarbrough, D. (2013). The importance of professional learning communities for school improvement. *Creative Education*, 4(5), 357-361. doi:10.4236/ce.2013.45052

Juhler, M., & Håland, B. (2016). The impact of lesson study and content representation on student-teachers' science teaching. *Lesson Study i en nordisk kontekst*, 195-213.

Kadroon, T., & Inprasitha, M. (2013). Professional development of mathematics teachers with Lesson Study and open Approach: The process for changing teachers values about teaching mathematics. *Psychology, 4*(2), 101-105. doi: 10.4236/psyc

Kaiser, K. (2012). Protecting Confidentiality. In J. F. Gubrium, J. A. Holstein, A. B. Marvasti, & K. D. McKinney (Eds.), *The SAGE Handbook of Interview Research: The Complexity of the Craft* (pp. 457-464). Thousand Oaks, CA: SAGE Publications, Inc.

Kamau, L. M. (2014). The future of ICT in Kenyan schools from a historical perspective: a review of the literature. *Journal of Education & Human Development, 3*(1), 105-118.

Kennedy, J. (2008). Anonymity. In P. Lavrakas (Ed.), *Encyclopedia of Survey Research Methods* (pp. 27-28). Thousand Oaks, CA: SAGE Publications, Inc.

Kiragu, J. W., King'oina, J. O., & Migosi, J. A. (2013). School-Based Management Prospects and Challenges: A Case of Public Secondary Schools in Murang'a South District, Kenya. *International Journal of Asian Social Science, 3*(5), 1166-1179.

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary issues in technology and teacher education, 9*(1), 60-70.

Koehler, M. J., Mishra, P., & Cain, W. (2013). What Is Technological Pedagogical Content Knowledge (TPACK)? *Journal of Education, 193*(3), 13-19.

Koh, J. H. L., Chai, C. S., & Tsai, C.C. (2014). Demographic factors, TPACK constructs, and teachers' perceptions of constructivist-oriented TPACK. *Journal of Educational Technology & Society, 17*(1), 185-196.

Koh, J. H. L., & Divaharan, S. (2013). Towards a TPACK-fostering ICT instructional process for teachers: Lessons from the implementation of interactive whiteboard instruction. *Australasian Journal of Educational Technology, 29*(2), 233-247.

Kolb, D. A. (1984). *Experiential learning : experience as the source of learning and development.* Upper Saddle River, NJ: Prentice-Hall.

Krulatz, A. (2014). Teaching Norwegian to beginners: Six principles to guide lesson planning. *Journal of the National Council of Less Commonly Taught Languages, 15(1)*, 1-14.

Kushner, S. (2005). Confidentiality. In S. Mathison (Ed.), *Encyclopedia of Evaluation.* Thousand Oaks, CA: SAGE Publications, Inc.

Lazar, J., Feng, J. H., & Hochheiser, H. (2010). Case Studies In *Research methods in human-computer interaction* (pp. 143-176). Chichester, West Sussex: Wiley.

Lepkowski, J. M. (2008). Population. In P. Lavrakas (Ed.), *Encyclopedia of Survey Research Methods.* Thousand Oaks, CA: SAGE Publications, Inc.

Lewis, C., & Perry, R. (2017). Lesson study to scale up research-based knowledge: A randomized, controlled trial of fractions learning. *Journal for Research in Mathematics Education, 48*(3), 261-299.

Lim, D., You, J., Kim, J., & Hwang, J. (2019). Optimizing instructional design methods in higher education. In *Instructional design for adult and continuing higher education* (pp. 73-100). Information Science Reference. doi:10.4018/978-1-5225-4975-8.ch005

Lucenario, J. L. S., Yangco, R. T., Punzalan, A. E., & Espinosa, A. A. (2016). Pedagogical Content Knowledge-Guided Lesson Study: Effects on Teacher Competence and Students' Achievement in Chemistry. *Education Research International, 2016*(1), 1-9. doi:10.1155/2016/6068930

MacQuarrie, C. (2010). Holistic Designs. In A. J. Mills, G. Durepos, & E. Wiebe (Eds.), *Encyclopedia of Case Study Research.* Thousand Oaks, CA: SAGE Publications, Inc.

Mandoga, E., Matswetu, V., & Mhishi, M. (2013). Challenges and opportunities in harnessing computer technology for teaching and learning: A case of five schools in Makoni East district. *International Journal of Humanities and Social Science, 3*(1), 105-112.

Maree, K. (2016). Planning a research proposal In K. Maree (Ed.), *First steps in research* (2nd ed.) pp. 26-47. Pretoria: Van Schaik.

Mathison, S. (2005a). Ontology. In S. Mathison (Ed.), *Encyclopedia of Evaluation*. Thousand Oaks, CA: SAGE Publications, Inc.

Mathison, S. (2005b). Trustworthiness. In S. Mathison (Ed.), *Encyclopedia of Evaluation*. Thousand Oaks, CA: SAGE Publications, Inc.

Mathumbu, D., Rauscher, W., & Braun, M. (2014). Knowledge and cognitive process dimensions of Technology teachers' lesson objectives. *South African Journal of Education, 34*(3), 1-8.

McGinn, M. K. (2010). Credibility. In A. J. Mills, E. Wiebe, & G. Durepos (Eds.), *Encyclopedia of Case Study Research* (Vol 1). Thousand Oaks, CA: SAGE Publications, Inc.

McKechnie, L. E. F. (2008). Structured Observation. In L. M. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods* (Vol. 1). Thousand Oaks, CA: SAGE Publications. doi:10.4135/9781412963909

Mee, L., & Oyao, S. G. (2013). Establishing Learning Communities among Science Teachers through Lesson Study. *Journal of Science and Mathematic Education in South Eas Asia, 36*(1), 1-22.

Mehdipour, Y., & Zerehkafi, H. (2013). Mobile learning for education: Benefits and challenges. *International Journal of Computational Engineering Research, 3*(6), 93-101.

Melia, K. (2010). Recognizing quality in qualitative research. In Bourgeault, I., Dingwall, R., & De Vries, R. (Ed.), *The SAGE handbook of qualitative methods in health research*, pp. 559-574. London: SAGE Publications Ltd doi: 10.4135/9781446268247

Mingaine, L. (2013a). Challenges in the implementation of ICT in Public secondary schools in Kenya. *International Journal of Social Science and Education, 4(1)*, 224-238.

Mingaine, L. (2013b). Skill challenges in adoption and use of ICT in public secondary schools, Kenya. *International Journal of Humanities and Social Science, 3*(13), 61-72.

Morgan, D. L., & Morgan, R. K. (2009a). *Single-Case Research Methods for the Behavioral and Health Sciences* Thousand Oaks, CA: SAGE Publications, Inc. doi:10.4135/9781483329697

Morris, M. (2005). Ethics. In S Mathison (Ed.), *Encyclopedia of Evaluation*. Thousand Oaks, CA: SAGE Publications.

Morrison, G. R., Ross, S. M., & Kemp, J. E. (2004). *Designing effective instruction* (4th ed.). Hoboken, NJ: J. Wiley & Sons.

Naresh, N. (2013). Traverses through the landscape of reflective thinking: Teachers' actions in the context of lesson study. *Fields Mathematics Education Journal, 1*(1), 21-42.

Ndongfack, M. N. (2015). Mastery of active and shared learning processes for techno-pedagogy (MASLEPT): A model for teacher professional development on technology integration. *Creative Education, 6*(1), 32-45.

Nieuwenhuis, J. (2016a). Analysing qualitative data In K. Maree (Ed.), *First steps in research* (2nd ed.) pp. 26-47. Pretoria: Van Schaik.

Nieuwenhuis, J. (2016b). Introducing qualitative research In K. Maree (Ed.), *First steps in research* (2nd ed.) pp. 26-47. Pretoria: Van Schaik.

Nieuwenhuis, J. (2016c). Qualitative research designs and data-gathering techiniques In K. Maree (Ed.), *First steps in research* (2nd ed.) pp. 26-47. Pretoria: Van Schaik.

Nkula, K., & Krauss, K. E. (2014). The integration of ICTs in marginalized schools in South Africa: Considerations for understanding the perceptions of in-service teachers and the role of training*. In International Development Informatics Association (IDIA) conference*, 3-5.

Ogden, R. (2008a). Anonymity. In L. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods* (Vol. 1). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412963909

Ogden, R. (2008b). Pseudonym. In L. Given (Ed.), *The SAGE Encyclopedia of Qualitative Research Methods* (Vol. 1). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412963909

Osang, F. B., Ngole, J., & Tsuma, C. (2013). Prospects and Challenges of Mobile Learning Implementation in Nigeria. Case Study National Open University of Nigeria NOUN. In I*nternational Conference on ICT for Africa*, pp 1-13.

Parsons, S. (2018). Informed Consent. In B. Frey (Ed.), *The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation*. Thousand Oaks, CA: SAGE Publications.

Pella, S. (2015). Pedagogical reasoning and action: Affordances of practice-based teacher professional development. *Teacher Education Quarterly, 42*(3), 81-101.

Phua, V. C. (2004). Convenience Sample. In M. S. Lewis-Beck, A. Bryman, & T. F. Liao (Eds.), *The SAGE Encyclopedia of Social Science Research Methods*. Thousand Oaks, CA: Sage Publications, Inc. doi: 10.4135/9781412950589

Posthuma, A. B. (2012). *The nature of mathematics teachers' reflective practice.* University of Pretoria, Pretoria.

Qasem, A. A. A., & Viswanathappa, G. (2016). Teacher Perceptions towards ICT Integration: Professional Development through Blended Learning. *Journal of Information Technology Education: Research, 15*(1), 561-575.

Ravhuhali, F., Kutame, A. P., Mutshaeni, H. N., Mokhele, M. L., & Maluleke, M. (2017). Professional Development as a Tool for Promoting Quality Teaching and Learning: Teachers' Perspectives. *International Journal of Educational Sciences*, 16(1-3), 114-122.

Roblyer, M. D., & Doering, A. H. (2014). *Integrating educational technology into teaching* (6th ed.). Harlow, England: Pearson.

Saeed, M. M., & Samani, A. T. (2014). The role of E-learning in facing the challenges of the century. *International Journal of Engineering Science and Innovative Technology (IJESIT), 3*(2), 189-194.

Salkind, N. J. (2010). Convenience Sampling In N. J. salkind (Ed.), *Encyclopedia of Research Design*. Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412961288

Saunders, M. N. K., Lewis, P., & Thornhill, A. (2016). *Research methods for business students* (7th. ed.). Harlow, Essex, England: Pearson Education Limited.

Scholz, R. W., & Tietje, O. (2011). Types of Case Studies. In *Embedded Case Study Methods* (pp. 9-14). Thousand Oaks, CA: SAGE Publications, Inc. doi:10.4135/9781412984027

Schraudner, M. (2014). The online teacher's assistant: using automated correction programs to supplement learning and lesson planning. *CELE Journal, 22*(1), 124-136.

Serra, F. A. R. (2015). Constructing a literature review. *Revista Ibero-Americana De Estratégia*, 14(3), 01-05. doi:10.5585/ijsm.v14i3.2271

Seyyedrezae, S. H. (2014). The application of chaos/complexity theory in classroom teaching, task design and lesson planning. *Journal of Language Sciences & Linguistics, 2*(2), 27-32.

Shapiro, G. M. (2008). Sample. In P. Lavrakas (Ed.), *Encyclopedia of Survey Research Methods*. Thousand Oaks, CA: SAGE Publications, Inc.

Shúilleabháin, A. N. (2013). Lesson Study in a Community of Practice: A model of in-school Professional Development. *Trinity Education Papers, 2*(1), 22-40.

Simons, H. (2012). Evolution of the Concept of Case Study Research In *Case Study Research in Practice*. London: SAGE Publications, Ltd. doi:10.4135/9781446268322

Souza, L. d., Lopes, C. E., & Pfannkuch, M. (2015). Collaborative professional development for statistics teaching: a case study of two middle-school mathematics teachers. *Statistics Education Research Journal, 14*(1), 112-134.

Stigler, J. W., & Hiebert, J. (2009). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York, NY: *Simon and Schuster.*

Streb, C. K. (2010). Exploratory Case Study. In A. J. Mills, G. Durepos, & E. Wiebe (Eds.), *Encyclopedia of Case Study Research* (Vol 1). Thousand Oaks, CA: SAGE Publications, Inc.

Su, W. M., Osisek, P. J., & Starnes, B. (2004). Applying the Revised Bloom's Taxonomy to a medical-surgical nursing lesson. *Nurse educator, 29*(3), 116-120.

Sudejamnong, A., Robsouk, K., Loipha, S., & Inprasitha, M. (2014). Development of Teachers' Mathematical Knowledge for Teaching by Using the Innovation of Lesson Study and Open Approach. *Sociology Mind, 4*(4), 317-327.

Sun, Z., Liu, R., Luo, L., Wu, M., & Shi, C. (2017). Exploring collaborative learning effect in blended learning environments. *Journal of Computer Assisted Learning, 33*(6), 575-587. doi:10.1111/jcal.12201

Susanto, H. A., & Murwaningsih, U. (2015). Improving students' activity in mathematics communication trough metacognitive learning approach based on lesson study. *International Journal of Education and Research, 3*(2), 169-180.

Sweeney-Burt, N. (2014). Implementing digital storytelling as a technology integration approach with primary school children. *Irish Journal of Academic Practice, 3*(1), 1-25.

Takahashi, A. (2014). Implementing lesson study in North American schools and school districts*. 22-32. Retrieved from *http://hrd. apec. org/images/a/ae/51.2. pdf*

Teele, S., Maynard, D. F., & Marcoulides, G. A. (2015). The Lesson Study Process—An Effective Intervention to Reduce the Achievement Gap. *US-China Education Review, 5*(4), 229-243.

Tondeur, J., Forkosh-Baruch, A., Prestridge, S., Albion, P., & Edirisinghe, S. (2016). Responding to Challenges in Teacher Professional Development for ICT-Integration in Education. *Educational Technology & Society, 19*(3), 110-120.

Uhrmacher, P. B., Conrad, B. M., & Moroye, C. M. (2013). Finding the balance between process and product through perceptual lesson planning. *Teachers College Record, 115*(7), 1-27.

Vehovar, V., Toepoel, V., & Steinmetz, S. (2016). The SAGE Handbook of Survey Methodology. In. 55 City Road, London: SAGE Publications Ltd. Retrieved from https://methods.sagepub.com/book/the-sage-handbook-of-survey-methodology. doi:10.4135/9781473957893

Vogt, W. P. (2005). Accidental Sample. In W. P. Vogt (Ed.), *Dictionary of Statistics & Methodology* (3 ed.). Thousand Oaks, CA: SAGE Publications.

Wake, G., Foster, C., & Swan, M. (2013). *A theoretical lens on lesson study: Professional learning across boundaries.* Paper presented at the Proceedings of the 37th Conference of the International Group for the Psychology of Mathematics Education, 369-376.

Wiggins, G. P., & McTighe, J. (2005). *Understanding by design* (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development.

Willig, C. (2014). Interpretation and Analysis, In U. Flick (Ed.), *The SAGE Handbook of Qualitative Data Analysis*. London: SAGE Publications Ltd. doi:10.4135/9781446282243

Willis, J. (2007). Interpretive and Critical Approaches. In J. Willis (Ed.), Foundations of Qualitative Research. Thousand Oaks, CA: SAGE Publications, Inc. doi:10.4135/9781452230108

Wilson, K. B., & Boateng, K. A. (2014). Integrating ICTs into the teaching process: Issues in pedagogical practices in teacher education. *International Journal of Computing Academic Research, 3*(4), 96-103.

Woodwell, D. (2014). *Research Foundations: How Do We Know What We Know?*. London: SAGE Publications, Ltd. doi:10.4135/9781506374734

Xiao, H. (2010). Single-Case Designs. In A. J. Mills, G. Durepos, & E. Wiebe (Eds.), *Encyclopedia of Case Study Research* (Vol 1). Thousand Oaks, CA: SAGE Publications, Inc.

Xiaofeng, W., Qi, W., & Ling, C. (2015). *A Case Study of Online-based Collaborative Lesson Planning.* Paper presented at the Proceedings of the Eighth International Conference on E-Learning in the Workplace (ICELW 2015), Kaleidoscope Learning, 1-6.

Yin, R. K. (2014). *Case study research : design and methods* (5th ed.). Los Angeles: SAGE.

Zhou, G., Xu, J., & Martinovic, D. (2017). Developing Pre-service Teachers' Capacity in Teaching Science with Technology through Microteaching Lesson Study Approach. *Eurasia Journal of Mathematics, Science & Technology Education, 13*(1), 85-103. doi: 10.12973/eurasia.2017.00605a

APPENDIX A: Consent letter

FACULTY OF EDUCATION

LETTER OF CONSENT: PARTICIPANTS

Mobile technologies in teaching and learning: Mobile learning course

A group of lecturers at the Faculty of Education at the University of Pretoria, in collaboration with other researchers, are investigating different aspects of the incorporation of mobile devices to promote innovation in teaching and learning. We request that you participate in this research where we shall explore challenges, developments, implementations and impact of mobile education in the South African context.   The specific aspect investigated in this part of the research is the development of a mobile learning course.

We would like to involve you, the participant in this course, in this research through *your feedback on and experiences of the core elements of the course.* This information will be incorporated into the improvements of the course design and will also be used to inform the mobile learning research field about the developments in mobile curricula.

Should you agree to participate, please read the following and sign the letter of consent;

- I consent that data can be collected from course activities and reflections on the activities.
- I authorise the researchers to use this data.

I acknowledge that:

- o I have been informed that participation is voluntary and I am free to withdraw from the project at any time without explanation or prejudice and to withdraw any unprocessed data previously supplied.
- o I have been informed that the confidentiality of the information I provide will be safeguarded.
- o I will be referred to by pseudonym or code name in any publications arising from the research.
- o My results in the module/course in which I am enrolled will not be influenced in any way because of my participation in this study.

We look forward to learning with you!

The e-Learning Group

PERMISSION FOR RESEARCH

I, _____, hereby give my consent to participate in the study. I am assured of anonymity and know that I can withdraw if I do not wish to participate any more.

Signature: _____   Date: _____

Researcher: _____   Date: _____

APPENDIX B: Survey Questions

1. Which technology interventions are in your school? The company's intervention? Other interventions?

2. How did you access the LMS? Which devices did you use (Computer, laptop, tablet, smart phone)? Where did you access it - at work, in an internet cafe, with free Wi-Fi, at home with your own data?

3. How did you experience the online collaboration during the post-course section of the course?

4. How often did you access The LMS to collaborate with your group members?

5. What did you do when accessing the LMS?   (Reading other's posts only, reading and replying, posting comments, submit material, download material etc.)

6. How did you experience the online facilitation process?

7. How did you experience the process of lesson planning - first plan a lesson with others, then teach the lesson, then refine and submit a final lesson plan?

8. Which challenges did you experience during the online lesson planning process?

9. How did you experience the use of the lesson planning form for the planning and refinement of the lessons?

10. Which challenges did you experience during the teaching of the lessons planned?

11. How (if at all) did the online, applied section of the course give you a different understanding of the concepts discussed during the face-to-face part of the course?

12. Which resources/information would you have wanted discussed/included/have access to before the online section of the course started?

13. What worked well for you during the course - from the first day we met face-to-face till the end of the online collaboration and last submissions?

14. Which section/topic/experience of the course did you find most valuable?

15. How did the course impact on your teaching practice?

16. How will the course impact your future teaching practice?

17. Please share suggestions for future courses with us.

APPENDIX C: Lesson planning form

E-LEARNING FOR THE 21ST CENTURY FACILITATOR

OUTCOME	ASSESSMENT	TEACHING

Technology needed

Symbols	Time	Content	Technology	
				COMPANY TECHNOLOGY

APPENDIX D: Lesson planning form symbols

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
▬	Direct teaching	🌍	Real-world example
↔	Pair	🌐	Internet search
✛	Small Groups	📹	Watch a video
✳	Whole Class discussion	?	Teacher asks questions
✎	Quiz	i	Teacher provides information
	Summary	Q. A.	Question and Answer

APPENDIX E: Observation Schedule

Task ___			
Group		Topic	
Subject		Grade	

Backward design

OUTCOME	ASSESSMENT	TEACHING	ALIGNED?
- - - - - - - - -	- - - - - - - - -	- - - - - - - - -	
- - - - - - - - -	- - - - - - - - -	- - - - - - - - -	
- - - - - - - - -	- - - - - - - - -	- - - - - - - - -	
- - - - - - - - -	- - - - - - - - -	- - - - - - - - -	
COMMENTS ON ALIGNMENT.			

TPACK

COULD THEY CHOOSE TECHNOLOGY TO SUPPORT "P" AND "C"?	Y	N
COMMENTS		

WERE THEY ABLE TO APPLY M-LEARNING STRATEGIES?	Y	N
COMMENTS		