PERSPECTIVES OF NOVICE TEACHERS ABOUT THE IMPACT OF BLENDED TEACHING ON LEARNING OF MATHEMATICS

By

Lukholo Raxangana

BEd., BEd. (Hons)

Dissertation submitted for the degree of

MASTER OF EDUCATION

in the

SCHOOL FOR MATHEMATICS, NATURAL SCIENCES, AND TECHNOLOGY EDUCATION

Faculty of Education

University of the Free State Bloemfontein

November 2022

Supervisor: Dr. K.G. Pule

DECLARATION

I, Lukholo Raxangana, student number 2017025269, solemnly declare that this dissertation, titled: "**Perspective of novice teachers about the impact of blended teaching on learning of mathematics**", is my original work and is being submitted for the first time. It is the result of my own efforts through the professional assistance and guidance of my recognized supervisor, Dr K.G. Pule and has not been submitted for degree purposes at any other university. All sources quoted in this study have been duly indicated and acknowledged.

Name of student: Lukholo Raxangana

Signature 

Date: 30 November 2022

DECLARATION ON PLAGIARISM

(i) I understand 'plagiarism' as the wrongful appropriation and stealing and publication of another author's thoughts, ideas, or expressions, discoveries and inventions and so on and representing them as one's own original work. This is the procedure of taking somebody else's work or ideas and passing them off as one's own.

(ii) I have, therefore, duly and appropriately acknowledged all references and confirmed to avoiding plagiarism as I define and understand it.

(iii) I have made use of the citation and referencing style as suggested by my supervisors.

(iv) I declare that this dissertation is my own, as it is about my own practice improvement, through action research methodology.

(v) No one is allowed to copy my work and present it as their own as the study is about me and the work that I do.

(vi) I am committed to uphold research and professional integrity in academia.

(vii) I am aware of the consequences of engaging in plagiarism as this is explained by the University of the Free State (UFS) intellectual Property (IP) Policy.

30 November 2022

Signature **Date**

"*It always seems impossible until it's done*"- Nelson Mandela

ACKNOWLEDGEMENT

I wish to thank the Almighty God for bestowing upon me courage, perseverance and wisdom to finish this outstanding work. My sincere gratitude, appreciation and acknowledgements are directed to the following individuals:

- My promoter, Dr. K.G. Pule, who has guided and walked with me until the final stage of this dissertation.
- Mrs. Zukiswa Ketiwe, the university librarian, for her unending assistance in finding relevant sources, articles and other information used in this study.
- All the teachers who agreed to offer me their valuable and precious time by participating in the interviews.
- My wife Zesongiwe Raxangana, my kids Bungcwele and Khazimla Raxangana for allowing me to use their family time.
- The language editor Dr A. K. Masha, for the commendable work.

EDITING CERTIFICATE

EDITING CERTIFICATE

TO WHOM IT MAY CONCERN

This certifies that the research document whose title appears below has been edited for proper English language, grammar, punctuation, spelling and overall style.

Level of document: Masters dissertation

Title: Perspectives of novice teachers about the impact of blended teaching on learning of mathematics

Author: Lukholo Raxangana

Date: November 2022

Signed

Dr Tonny Kambi Masha (PhD in Education; D. Admin: Public Administration)

PhD in Education; Doctor of Administration: Public Administration – Leadership Development, Mentoring and Training (Fort Hare); Master's in Administration: Public Administration (Fort Hare); Honours B.A. (Group Dynamics - NMMU); Honours B.A. (Social Sciences - WSU); B.A. (Education - WSU); Postgraduate Diploma in Education (UWC)

- **Cell:** International (+27 76 866 2388) Local (076 866 2388) Fax: 086-618-4409 E-Mail: akmasha@lantic.net
- **Postal address:** PostNet Suite 436, Private Bag X 9063, East London, 5200, Eastern Cape, South Africa

ABSTRACT

Teaching mathematics in the Fourth Industrial Revolution (4IR) era offers novice mathematics teachers daunting challenges. Despite using various aids in teaching the learning area, novice mathematic teachers still experience challenges during crises such as during the COVID-19 pandemic era. Such challenges could escalate and confirm the preconceived notion perceived by others that mathematics is a challenging learning area. This study sought to investigate the perspectives of novice teachers on the impact of blended teaching and learning mathematics in Sedibeng West District. The study involved eight novice teachers from four selected schools. Blended Teaching (BT) approaches for novice teachers are intended to ensure that they are effective in their teaching so that learners can gain a deeper insight into mathematics. The researcher adopted a case study design involving thematic analysis of responses from novice mathematics teachers. The researcher conducted semi-structured and focus group interviews due to the origination of discrete ethical defies that do not fully match those fostered by one-on-one discussions on collecting the data. This study was framed mainly within a Social Constructivist theory by Vygotsky (1978). The study used the Community of Inquiry (CoI) model as its analytical framework to analyse the data. It emerged from the study that there were various perspectives of novice teachers about the impact of blended teaching on learning mathematics. These included the impact of load-shedding, benefits of blended teaching, perceptions of novice teachers, and hindrances of BT. Novice teachers from the selected schools ascribed their perceptions of the challenges associated with blended teaching tools. The anticipated findings of this study will give curriculum designers, district directors, school management teams, and mathematics teachers a clear overview of how these perceptions could be addressed across the board. Thus, the recommendation was that the teacher development division could train novice teachers in the Department of Basic Education to bridge the gap between teacher training institutions of higher learning. Novice teachers should attend classes on time to avoid the misuse of internet connection so that they (novice teachers) can supervise the learning process when using the devices. The development of Data-free blended teaching tools should assist all learners regardless of their location during load shedding.

Keywords: Blended teaching, COVID, teachers, novice, and mathematics.

Contents

APPENDICES

List OF TABLES

LIST OF FIGURES

ACCRONYMS/ABBREVIATIONS

BT	Blended Teaching
BL	Blended Learning
RSA	Republic of South Africa
DBE	Department of Basic Education
UFS	University of the Free State
US	United States
BL	Blended Learning
SSVE	Shared Simple Virtual Environment
ICTs	Information and Computers Technologies
CAPS	Curriculum Assessment and Policy Statement
LMSs	Learning Management Systems
WP6	White Paper 6
CoI	Community of Inquiry
FLIP	Flexible Learning Intentional Professional
SWD	Sedibeng West District
4IR	Fourth Industrial Revolution
CAT	Computer Applications Technology
ATP	Annual Teaching Plan

CHAPTER ONE: INTRODUCTION AND BAKGROUND

1.1 Introduction and Background

Blended teaching (BT) is the amalgamation or blend of modes of web-based experience (technology) (e.g., self-paced education, live online schoolroom, streaming video, audio, cooperative learning, and text) to accomplish an educational goal (Cronje, 2020). It (BT) is more than enhancing novice teachers; it embodies the transformation of how they attempt teaching and learning (Mal & Adhya, 2020). Moreover, it is a complete rethinking and restructuring of the scholastic atmosphere and general learning experience. Mal and Adhya (2020) claim that BT is a logical construct approach that openly evaluates and incorporates the strong points of face-to-face and virtual learning to address meaningful educational objectives.

A 2018 study commissioned by the US Department of Education states that BT reduces in-class seat time for students (Becker et al., 2019). The study further highlights that schools must be well-resourced with technology and must have qualified staff for BT to succeed. However, Bates (2018) reveals that in the global South, high schools in countries such as the Republic of South Africa (RSA) face resource challenges, especially in public high schools. This study investigated the perspectives of novice teachers on the impact of BT in Sedibeng West District in the Gauteng Province of RSA.

The uniqueness of context in the RSA education system presents an interesting case of the achievement of feasibility in BT (van Deursen & van Dijk, 2019). Anderson, Keturah, and Dieckmann (2018) assert that socioeconomic factors, race, social class, gender, age, geographical area and educational background determine the level of the digital divide within the school setting. Baleni (2015) believes that the causal relationship between socioeconomic factors and learning impacts the BT approach's efficacy in RSA schools.

This study acknowledges that technological tools have become accessible to most public schools in Gauteng Province (RSA) through the government's provision of tablets to learners. The tablets are pre-loaded with past examination papers and mathematics applications for students to use at home. This kind of technology presents an opportunity to improve mathematics performance in Grade 12. Through these tablets, Al-Huneidi and Schreurs (2012) highlight that such tools allow teachers to use various means of BT to learn mathematics through social media and networks, such as YouTube, and WhatsApp, among others. Adopting

such online tools is already being (formally or informally) implemented in this Province's public schools.

Horn and Staker (2017) assert that a complete online learning experience for students comprises non-teaching factors, such as convenience, learner characteristics, and readiness. Convenience is an enormous non-quality factor for students as it allows flexibility and comfort in the study at the convenience of time (Artino, 2010). This learning approach has necessitated embracing online learning, especially during the Covid-19 pandemic. This flipped classroom pedagogical model addresses challenges posed by a teacher-centred approach.

A teacher-centred approach attempts to transfer information to students through one-sided downward communication where mostly passive listeners have to individually work without questioning the educator's knowledge (Mulryan-Kyne, 2010). The drawbacks of the traditional teaching approach (using chalkboard, chalk and duster) are the assumption that all learners have shared learning preferences. However, online teaching and learning centres use the learner perspective. Learner characteristics are made more visible in online learning through self-regulation, which positively impacts both receptiveness and readiness for learning.

Gwaltney (2017) asserts that the evolving pressures and possibilities of future teachers of the "millennial" generation have coerced the Department of Basic Education (DBE) to change dogmatic teaching strategies. Bates (2018) highlights similar sentiments that traditional face-to-face teaching methods quickly lose practicability in the 21st century. However, it is still Africa's preferred and most widely used teaching approach. It allows educators to teach and directly interact with learners (Anderson, 2016).

However, Hlathi (2021) states that face-to-face teaching has run its course and had its successes, but now it faces its prospective demise due to the COVID-19 pandemic and technological advancement. Despite Hlathi's accessions, Bates (2018) emphasises that online learning has educational disadvantages. Furthermore, Bates (2018) believes that online learning with mixed non-quality factors will make it difficult to discern the instructors' contextual roles in quality.

It is essential to note that most of the studies cited here have mainly presented the implementation of a flipped classroom without associating its effectiveness with traditional teaching. Previous research has also not considered vital indicators such as students' grades, reflection, teacher observation and peer observation (Nikoubakht & Kiamanesh, 2019).

Supporters of the BT approach (Liu & Long, 2014; Nikoubakht & Kiamanesh, 2019) contrast Anderson (2016) on the certainty of the implementation of this approach in RSA schools. The latter scholars contend that face-to-face learning is the fundamental cornerstone of teaching and learning, despite technological advances and demand for the use of e-learning. The previous studies highlight that there exists a puzzle between face-to-face and e-learning. Bates (2018) argues that BT should not be seen as a replacement for face-to-face learning in RSA but as an essential alternative.

Moreover, the DBE takes cognizance of the multiple areas of knowledge for collaborative learning in primary education to flourish. Thus, BT is positioned to allow for face-to-face and much broader contexts through online learning, which allows for self-exploration and online collaborative learning (Al-Huneidi & Schreurs, 2012). A more comprehensive repository of learning tools where learners can form meaning using different learning methods allows optimal learning.

However, since this study investigates BT, the priority is on teaching processes that position learners at the centre of a fruitful teaching and learning experience. Traditional teaching methods emphasize memorizing information and gaining new knowledge, while blended learning is more concerned with deliberate and active learners' inquisition about information. However, this is not to say that cognitive stimulation does not exist in face-to-face learning (Graham, 2019). Face-to-face learning is still relevant and applicable in the information age to inform and give clear direction to learning in a class.

Thus, the e-Education White paper details that 25,582 and less than 5% of these schools can afford internet connections for integrating the internet for teaching, learning, communication, and collaboration. The report states that all novice teachers have used extensive technological applications, mainly structured learning approaches. However, the White paper (2019) highlights that novice teachers lack proper guidance and support to infuse technology and face-to-face interchangeably effectively. Unfortunately, poor performance in grade 12 Mathematics continues unabated.

1.2 Research Problem

Blended Teaching (BT) incorporates face-to-face and online classroom learning to develop extensive skills and knowledge transferrable to the workplace (Lowe, 2019). Anderson (2016)

and Mpungose (2020) highlight that BT could solve some of the current teaching problems and address the educational backlog during Covid-19 challenges. However, this is far from the truth, as due to socioeconomic disparities and related issues, the dropout rate has seen an exponential escalation since 2020 (Manca, 2020). The ominous pressure is therefore put on novice teachers who happened to teach mathematics in Grade 12 to ensure blended teaching is a success.

Novice teachers are confronted with the unrealistic responsibilities of making BT a success, despite the lack of adequate resources from the DBE and unclear policy directives regarding blended teaching. Furthermore, Mavani (2016) maintains that the DBE's technology equipment, such as computers and tablets, is under-utilised due to many teachers not being sufficiently equipped to use this technology in the classroom effectively. Studies on BT exist but studies on the impact of BT by novice teachers on learning mathematics are limited. It is against the backdrop, this study investigated the impact of BT by novice teachers on learning mathematics, despite inadequate but essential hardware and software resources.

1.3 Research Question

Guided by the purpose statement provided above, the study investigated the research question below: *What are the selected novice teachers' perspectives on the impact of blended teaching on learning mathematics?*

1.3.1 Sub Research Questions

1. What are some of the challenges that novice mathematics teachers experience when executing blended teaching?
2. How do novice teachers perceive the influence of BT on learning mathematics?
3. What BT tools can selected novice teachers use to improve the learning experience in Mathematics?

1.4 Primary Aim

To probe selected novice teachers' perspectives on using the blended teaching approach in learning Mathematics.

1.5 Research Objectives

- To examine some challenges that novice mathematics teachers experience when executing blended teaching.
- To describe how selected novice teachers' perceive the influence of BT on learning mathematics.
- To ascertain which BT tools used by novice teachers could improve mathematics teaching and learning experience.

1.6 Research Methodology

1.6.1 Qualitative Research Method

Qualitative research encompasses gathering and analysing non-numerical data (e.g., text, video, or audio) to understand concepts, opinions, or practices (Bhandari, 2020). It (qualitative research) is an approach that allows the researcher to assess people's experiences by using a specific set of methods, such as in-depth interviews, focus group discussions, observations and life histories (Hennik et al., 2020). This study adopted a qualitative research approach aimed at understanding the participants' views, beliefs, and perceptions (Hennik et al., 2020). Cohen et al. (2019) assert that qualitative research focuses on the attitude toward understanding experiences and their interpretations by humans. The researcher focused on novice teachers' experiences using the BT approach in teaching and learning mathematics.

This study was framed mainly within an interpretive paradigm that strengthened its nature as a qualitative study. Central to this paradigm is obtaining more profound insight into the subjective world of human experience (Cohen, et al., 2019).

1.6.2 Research Design

Research design is a coherent plan for obtaining answers to a set of questions to be tackled and completed through the gathering and analyses of relevant data (Yin, 2018). The design allowed researchers to improve on research techniques proper for the subject matter and set their studies up for accomplishment. The design of a study topic expounds the kind of research (experimental, survey, descriptive case study) it embodies in a particular research. This study

followed a case study design. Therefore, this approach in this research aided the study in gaining an in-depth understanding of how novice teachers understand and use a BT approach in learning Mathematics.

1.6.3 DATA COLLECTION

Since this study is qualitative, the researcher used focus groups and semi-structured interviews to collect data and to establish a protocol for recording information (Creswell, 2017). Thus, developing interview procedures. The researcher used a semi-structured, face-to-face interview guide that involved open-ended questions to prompt the participants' opinions on the integration and collaboration of BT in teaching mathematics. DeJonckheere and Vaughn, (2019) asserts that semi-structured, in-depth interviews are generally used in qualitative research and are the most common qualitative data source in a study. The researcher personally conducted interviews that lasted between 15 and 60 minutes and recorded, with the approval of the individual participant. The aim was to collect data from a purposively selected group of participants instead of a statistically represented sample of a broader population (O.Nyumba et al., 2018).

1.6.4 RESEARCH POPULATION

The research population is a comprehensive group of individuals, institutions, and objects, among other things, with common characteristics that interest a researcher (Creswell & Creswell, 2018). The typical features of the groups distinguish them from other individuals, institutions, and objects, among other things. In this study, the research population was all novice educators teaching mathematics at the Sedibeng West District.

1.6.5 PURPOSIVE SAMPLING

Purposive sampling is a technique in which the researcher relies on his decision when selecting members of a population to participate in the study (Saunders, Lewis & Thornhill, 2019). Purposive sampling enabled researchers to extract much information from the data collected. Thus, researchers could describe their findings' significant impact on the population. Purposive sample, also identified as judgmental, selective, or subjective sample, is a form of non-

probability sample in which the researcher depends on their decision when selecting members of the populace to partake in their research (Dejonckheere & Vaughn, 2019). The sampled participants for this study were eight (8) novice teachers at Sedibeng West District in Gauteng Province.

1.6.6 DATA ANALYSIS, INTERPRETATION, REPORTING AND QUALITY ASSURANCE

Data is analysed and reported either a quantitatively or qualitatively (Schunk, 2012). In qualitative studies, data analysis is the organisation and preparation of data, interpretation through the data, coding all data, and generating and representing the description and themes (Creswell & Creswell, 2018; Cohen et al., 2019). The researcher used thematic analysis in the study since most of the data collected was qualitative. Thematic analysis is the foundational method for qualitative analysis, as it provides core skills for conducting many forms of qualitative analysis (Nowell, Norris, White & Moules, 2017). Thematic analysis approach validated the responses from 8 selected participants in this investigated research study's content. This sample size is adequate for a qualitative study where a large amount of data is collected. This sample size ensured the right amount of data was collected, which did not overwhelm the data analysis process.

1.7 Value of The Study

This study strengthens the integration and collaboration among the role players of teacher development within the department. The provincial government departments may benefit from this study by seeing the need for resourcing, human resources, infrastructure, and materials and support services.

1.8 Ethical Considerations

The researcher applied to the University of the Free State (UFS) ethical clearance and the study complied with all the ethical clearance prescripts. The study was then granted the ethical clearance number UFS-HSD2022/0035/22 and ethical clearance was granted (see attached Appendix A).

1.9 Chapters Outline

Chapter 1: Introduction and background of the study: This chapter highlights the international, national literature as the background to the study. Furthermore, problem statement, research questions, methodology are also highlighted.

Chapter 2: Literature review: The chapter reviews literature that guides this study. The literature that guides this study seeks to answer the research questions that emanate from the main research question of the study.

Chapter 3: Theoretical framework: This chapter focuses on the theoretical framework informing the study. The theoretical framework focuses on constructivism.

Chapter 4: Research methodology and design: This chapter presents research methods, design, data analysis, target population, the sample of the study, and trustworthiness, the second section discusses research methods and techniques used for data collection and the third section discusses ethical considerations.

Chapter 5: Data analysis and discussions: This chapter outlines the findings of the study. Presentations and analysis are based on the raw data (results) from the field study and compared with all sections of the study, specifically the literature review chapter, to ensure comparative viability, topicality, and relevance. The chapter analyses and reviews the findings with particular reference to the research objectives and questions.

Chapter Six: Findings and conclusions: The findings of the study, recommendations and conclusion are discussed in this study.

1.10 Summary

Blended Teaching (BT) is crucial for novice teachers in teaching of mathematics at both macro and micro level. In this chapter, a general overview of the study is outlined. This includes the background, problem statement, research questions, purpose and objectives of the research, methodology, value of the study and ethical considerations. In addition, this chapter touched on literatures' large scale, thus, the effects of the flipped classroom to promote constructivism and active and personalised learning in class need further investigation. The chapter that follows presents the study's literature review.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Background information set the tone for this study in the previous chapter. This chapter discusses the relevant literature guiding the study. The literature sought to answer the following research questions: What are some of the challenges that novice mathematics teachers experience when executing blended teaching?, How do novice teachers perceive the influence of BT on learning mathematics? and What BT tools can novice teachers use to improve the learning experience in Mathematics? Thus, this chapter provides an account of the literature reviewed on the perspectives of novice teachers about the impact of blended teaching on the learning of mathematics.

2.2 Background of the South African Education System

2.2.1 Application Of The South African Education System

Since 1994, South Africa's education system has experienced significant modifications. Recently, there has been a growing desire for schools to provide equitable opportunities for all students. (Murungi, 2015, p. 3168) Attest that inclusive education presumes that all education of children can think regardless of having access to a meaningful curriculum and outcomes. Implications are that instructors (novice teachers) must study and implement various teaching approaches (blended teaching) and abilities to satisfy their learners' demands.

However, the DBE (2018) reveals that RSA learners struggle in mathematics due to their poor background. Hlathi (2021) further highlights concerns over the performance of the 2020 matric class in mathematics. Further, RSA saw a decline from 54.6% in 2019 to 53.8% in 2020. Mathematics has always been a significant concern, as problem-solving in formal assessment has hovered around 30 % in the last ten years (DBE, 2018). Hence, it is essential to naturally question whether accessible and cheap technologies can contribute to addressing the poor quality of the teaching and learning of Mathematics (Padayachee, Boshof, Olivier & Harding, 2011).

Thus, South Africa's approach to inclusive education White Paper 6 (WP 6) seeks to explain a South African model of inclusion that accommodates resource limitations (Murungi, 2015). Moreover, there is country-provided education. Furthermore, (Murungi, 2015) asserts that WP

6, inclusive education, accepts all learners with learning needs, respects diversity in learning spaces and conditions, and acknowledges that all learners can learn if given support. The inclusive classroom with blended teaching might enable and provide independent individual and cooperative group work.

Flipped classrooms, mobile devices via ubiquitous Wi-Fi, e-mentoring programs, tutorials, assistance for multilingualism, and learning analytics are all examples of innovative blended learning practices used in South African schools (Bertrand, 2018). Blended learning has become the standard at many schools. Because the usage of blended learning apps varies extremely context-specific within each school, it is hard to offer an entire list of all applications (Barrie, 2015).

In terms of institutional growth, access to resources, discipline, group belonging, and individual motivation, it is imperative to emphasize the contextuality of new technologies. The list of possible methodology implementation in the classroom:

- Taking a test online (Google form test) is an excellent technique to evaluate learner proficiency. Furthermore, the automated marking, monitoring, and reporting scores simplify the complications of managing big groups of students (Lester, 2020). However, ensuring that the questions asked measure higher-order thinking skills is essential. It is also an approach that necessitates using a learning management system (LMS) with a quiz tool or a specialized computer-based testing application.

- High school libraries can collaborate to load resource pages published. Thus, this could lead learners to internet resources that go further into specific themes. As a result, they are less reliant on conventional single sources of knowledge, such as textbooks. Many open educational tools, such as animations, movies, and other media, are also available to help them expand their knowledge.
- Introducing online mentors or coaches is a terrific approach to enhancing the learning experience. Outside the classroom, online mentoring and coaching give support and direction to students.
- Underestimation of email messaging, although it is one of the most effective methods to extend the learning experience (Lester, 2020). The utilization of distribution lists,

task management, attachments, and scheduling features offers learners a comprehensive platform for interacting with educators.

Table 2.1: Examples of Blended Learning Systems

CATEGORY	BLENDED TEACHING TOOL	USE
Cloud storage	Drop Box Google Drive	Host course content and share files
Social media tools and networks	Schoology – social network for learning Facebook, WhatsApp, and Twitter	Group Discussions, Uploading information, reflection
Video and audio creation	VoiceThread, Show the researcher PowerPoint, animated slideshows, Edu creation, Flicker.	Produce instructional videos and podcasts. Record a presentation, voice, and audio Record a whiteboard Record a slideshow
Existing video platforms	YouTube Education TED Khan Academy Academic Earth	Provide videos on a large variety of topics
Collaborations	Google docs, Skype, Zoom, MindMeister	Work together to create and edit documents. Communicate online Share files Live chat feature.
Video and web conferencing	Blackboard Collaborate, Skype Pal Bee, Scribbler, Twiddle, Big Marker	Bring human resources into the class discussions.

Source: Adopted from Zinovieva et al. (2021)

The results of blended learning research and various uses of BL tools question the usage of these blended learning tools to promote success among low-performing South African grade 12 learners. Specifically, to address the key factors that influence learner success, arising. This study cannot cover all of the indicated success characteristics; thus, it concentrated on a select handful and accommodated within the teaching and learning environment of accounting education in a developing nation.

Underperformance frequently indicates the detrimental impact of educational deficiencies rather than a learner's capacity to thrive in higher education, especially in South Africa, which has a history of uneven schooling. As a result, this paper focuses on the success elements that educators and learners in developing nations consider crucial. In research on distance learning for Accounting Honours students by Chaves (2019), the students ranked the following characteristics in importance: timely and regular test preparation, logical thinking, consistent effort, and promising examination approaches.

Low-class attendance, a lack of accounting expertise, insufficient time, and a lack of English education as the vital contributing variables that contribute to poor student performance, according to Zhu, Struyven, and Blieck (2017) in similar research on learner performance factors. Another difficulty for higher education is that employer expectations have shifted significantly over time, and students do not always live up to them. Employers want learners to have problem-solving abilities, real-world business experience, and fundamental skills, according to Kavanagh and Drennan (2008).

Polyacskó (2009) also discovered that language proficiency, the capacity to apply information in practice, and individual drive are the abilities that many learners lack. Furthermore, their drive and devotion appear dubious, affecting their attitude toward their employment. Polyacskó (2009) mentioned the relationship between motivation and mood. The chapter that follows is on this study's theoretical framework.

2.3 The Concept of Blended Teaching – Learning in Operation

Blended Teaching (BT) is a new phenomenon that has seen its rise in being adopted even by the most underprivileged states in sub-Saharan Africa (Bates, 2018). The global pandemic outbreak has further escalated the suggestion of new approaches such as (BT) of content delivery (teaching and learning processes) and implementation (Cahapay, 2020). This implementation benefits educators and learners through its minimal physical interaction. The portrayed (BT) is a teaching approach that combines teaching space (classroom) and blended practice (Cahapay, 2020), whereas BT is a teaching and learning approach that amalgamates web-based teaching and face-to-face classroom collaborations (Sahni, 2019). Similarly, Garrison and Kanuka (2014) define blended teaching as a collaboration of traditional face-to-face learning with virtual (online) experiences.

Moreover, the use of BT tools (mobile technologies) such as smartphones and tablets, in teaching and learning mathematics, is escalating interest among scholars and practitioners (Borba et al., 2017). Thus, Borba et al. (2017) contend that the attributes of mobile devices (portability, availability, access to the Internet), including their broad recognition among the youth and others, have made portable devices capable of growing the limits of mathematics instruction and learning beyond the four walls of the teaching space (classroom).

Furthermore, the BT approach allows learners time to introspect and self-study to take responsibility for their studies. However, the pronunciation of BT is in developed nations such as the United States (US) and the European Union (EU) where learner resources are abundant in public or private schools. Thus, Sweden, Singapore and Norway have transcended the US in Mathematics and Sciences primarily because of their transformed education system (Deschacht & Goeman, 2015).

Blended teaching has seen East European countries taking quantum leaps in developing their economies because they have effectively adopted BT. Bates (2018) claims there is no recognisable move from traditional face-to-face teaching and learning towards BT in the Sub-Sahara.

Furthermore, Garrison and Kanuka (2014) distinguish blended learning from that enhanced classroom or fully online learning experiences; although they recognized that the boundaries between these concepts are unclear. In this study, blended teaching-learning is the collaboration of face–to–face teaching with online teaching tools (such as smartboards, projectors, WhatsApp platforms, online broadcasting classes, et cetera) by selected novice teachers in the learning of mathematics.

Thus, the teaching strategy (BT) comprises two components viz: face-to-face learning and electronic learning (e-learning) (Graham, 2016). However, there is a minimal face-to-face interaction due to content delivery (discussions) that are predominantly virtual (Smith et al., 2015). Hence, there is a suggestion that the amount of online delivered content should be between 30 to 70 % in the blended learning approach (Smith et al., 2015). Moreover, there are several different methods for calculating the needed amount of face-to-face and online teaching and learning.

For inclusion in a meta-analysis of blended learning, Deschacht and Goeman (2015) suggested allocating 50% of total course time to face-to-face learning. Moreover, Garrison and Kanuka (2014) acknowledged the incredible complexity of blended learning since no two blended learning designs are identical. They suggested that blended learning should be face-to-face, and online learning should be integrated and done so thoughtfully. However, it is often unclear what these benefits are; for example, Zacharis (2015) proposed that blended learning could support learning beyond the classroom.

Therefore, since learners and teachers have limited time in the classroom, online classes may continue to complement classroom shortfalls through discussion boards and other media. Watson (2018) updated institutions' blended learning definitions, which generally required about 50% of compulsory online teaching. Diep, Zhu, Struyven, and Blieck (2017) investigated two blended learning models, one with 25% face-to-face instruction and the other with 50% online instruction. In addition, there are more particular examples in the literature. Similarly (Tan & Hew, 2016) provide an example to prepare students for face-to-face activities. These include the flipped classroom approach, where learners can access e-learning materials such as video lectures at home so that in-class face-to-face time is used for discussions on the subject and for carrying out student-centered group work.

2.4 Blended Learning

The literature review indicates that scholars have a deficit of accord in defining the concept of blended learning as it has discrete interpretations by researchers (Sahni, 2019). However, Garrison and Kanuka (2014) define blended learning as the reflective incorporation of classroom face–to–face learning integration of classroom face-to-face learning capabilities with online capabilities. Similarly, the most often used definition of blended learning combines previously separate teaching and learning approaches. The teaching strategy comprises two components: 1) traditional face-to-face learning; and 2) electronic learning (e-learning) (Graham, 2016). Thus, Blended learning (BL) is a broad concept that intertwines various facets, such as delivery media, which combines face-to-face and online instruction (Graham, 2016).

Moreover, students' desire to learn might be internal or external. Similarly, according to Garrison and Vaughan (2018), intrinsic motivation comes from inside, i.e., pupils who want to study because they desire to do so. In contrast, extrinsic motivation refers to external elements

that encourage students to learn without relying on the instructor (Garrison et al., 2018). According to Graham (2019), there are three forms of instruction: mass instruction, customised instruction, and group instruction. The number of pupils determines the three categories, and each group requires a distinct delivery approach (Niekerk & Webb, 2016).

Thus, the practical nature of the Shared Simple Virtual Environment (SSVE) on the other hand, necessitates involving the students and making teaching and learning an interactive process between the teacher and the students. As a result, the teacher is responsible for selecting the most appropriate teaching technique or approaches to fulfil the needs of the pupils. In an ideal world, various teaching approaches should be used in each class so all students can participate (Tan & Hew , 2016).

Moreover, the most crucial factor here is to establish an in-class climate that encourages students to engage, voice their ideas without fear of being judged, ask questions, and practice what has been taught before without fear of failing (Driscoll, 2017). Hence, it is astonishing how many missed genuine learning opportunities and events because students fear judgment if they seek further information.

Graham (2016) argues that although the first two places resonate with the fascination with the inspiration of media and learning methods, these positions describe BL so broadly that they would similarly include all learning systems. However, this definition could be interpreted quite broadly by the combination of different styles in education that blends some aspects of face-to-face or computer-mediated instructional modes. Blended learning means other things to different people who demonstrate the untapped potential of blended learning, as alluded to by (Driscoll, 2012). Contrary, Oliver and Trigwell (2015) argue that there is ambiguity in the definition of blended learning, which makes it problematic to adopt a standard definition for scholars.

Many universities or schools have adopted a fused learning management system. They postulate whether such teaching and learning contexts could be labelled as blended learning as it has become the conventional education of our time. Diep, Zhu, Struyven and Blieck (2017) aver that in another research, it transpired that amongst 612 modules delivered on campus were modules categorised as blended learning courses. The blended learning courses are organised (based on their minimal usage) as blended learning management systems (Diep et al., 2017).

Depending on the success criteria that help them, blended teaching and learning innovations evolve differently in different settings.

In this study, the link between BT and BL is phenomenal such that the perceptions of selected novice teachers could be implemented as they (selected novice teachers) use BT tools when teaching mathematics learners in the classroom – thus creating an environment that is user friendly in this Fourth Industrial Revolution Era.

2.5 The Concept of Synchronous and Asynchronous Blended Teaching – Learning

The synchronous conception of blended learning emphasises real-time teaching and learning that includes on-campus and online learners. In synchronous learning, remote students participate in face-to-face sessions using synchronous technologies such as web and video conferencing (Cross, 2016). This approach uses various techniques to aid problem-solving, learner engagement, debates and collaboration (Canning, 2020). This conceptualization entails unpredictable amounts of technological complexities such as the invitation of learners to participate in pre-scheduled classes via Zoom and Skype, all of which are accessible through laptops (Cunningham, 2014).

Blended teaching is a perception that comprises outlining instruction acquiring method, incorporating both face-to-face teaching and teaching advocated by Information and Computers Technology (ICT). It integrates direct teaching, indirect teaching, collaborative instruction and individualised technology-assisted learning (Lalima & Dangwal, 2017). Thus, the teaching methods used by selected novice teachers, embrace both the online and the face-to-face interaction in a collaborative manner.

However, asynchronous learning is an option for learners to take part in learning at their preferred times (Chirinda et al., 2021). This participation uses neither conversation boards for asynchronous learning nor digital tools such as WhatsApp. Gómez et al. (2021) aver that asynchronous learning platforms were prevalent in a JIMplus study conducted in Germany. Thus, the prevalence of asynchronous learning has been confirmed by a survey of 171 German mathematics teachers, which resulted in 42% of students who had an in-person interaction with their mathematics teachers for less than one month, once or never (Gómez Chova et al., 2021).

2.6 The Challenges of Executing Blended Teaching Approaches to Learning Mathematics

The Covid-19 pandemic was declared a national disaster by the President of the Republic of South Africa on 11 March 2020. Hence, the South African government, led by the Minister of Basic Education, emphasised rescuing the school year. Teachers were encouraged to employ blended teaching approaches to save the academic year (Chirinda et al., 2021). Similarly, Basilaia and Kvavadze (2020) and Taha, Abdalla, Wadi and Khalafalla (2020) aver that online learning in a Covid-19 pandemic could be an alternative solution. Thus, this could anticipate that blended teaching in mathematics learning might be the solution for remote teaching.

However, Chirinda et al. (2021) assert that teachers had to experience the new normal for the first time as the resources, knowledge, or support were insufficient. Furthermore, this unprecedented situation resulted in teachers adapting their teaching, thus changing their teaching methods. Irfan et al. (2020) affirm that implementing online learning has its benefits and challenges. The drawback is that it has a potential for plagiarism behaviour and internet signal strength, including devices that support it (Arkorful & Abaidoo; 2015; Irfan, 2015; Irfan et al., 2020). Thus this could confirm the notion that the load shedding we have that results in poor network signal could negatively impact blended teaching in mathematics learning.

Furthermore, the growth that took place in the 21st Century is a hindrance for novice teachers as content instructors, especially in executing learning by incorporating technology (Yustina et al., 2020). In CoSN 2020, shifting the school system to a remote knowledge acquisition environment is not just a technological obstruction. Instead, this is a didactic and instructional hindrance (Yustina et al., 2020). Technology is a means of provision. Moreover, Yustina et al. (2020) assert that the challenged novice teachers require invention and adaptiveness in the sense of adjusting to the demands of the development of mathematics, science, and technology. This follows the goal of learning invention to maximize creative skills.

Furthermore, the growth that took place in the 21st Century is a hindrance for novice teachers as content instructors, especially in executing learning by incorporating technology (Yustina et al., 2020). In CoSN 2020, shifting the school system to a remote knowledge acquisition

environment is not just a technological obstruction. Instead, this is a didactic and instructional hindrance (Yustina et al., 2020). Technology is a means of provision. Moreover, Yustina et al. (2020) assert that the challenged novice teachers require invention and adaptiveness in the sense of adjusting to the demands of the development of mathematics, science, and technology. This follows the goal of learning invention to maximize creative skills.

2.7 Implementation of BT Approaches to Learning Mathematics

A teaching and learning experience that is guided by a novice teacher, that takes place in the virtual space (over the Internet), is one where all learners contribute in the understanding at the same time, and where the understanding comprises two-way interaction between learner and learner or learner and novice teacher (Wu & You, 2022). Contrary to that, teachers would like their pupils actively participate in the learning process (van Niekerk & Webb, 2016).

van Niekerk and Webb (2016) aver that controlling learners' conduct on the other hand, is a top priority. One advantage is that behavioural issues are usually easier to manage in this setting. Another advantage is that because the instructor oversees everything in the classroom, it is unusual for students to miss a topic (Staker & Horn , 2012). Despite its benefits, the teacher-centred method has several drawbacks. Most significantly, youngsters cannot reap the social benefits in other ways.

2.8 Impactful Learning of Mathematics

2.8.1 Factors That Influence Student Success

Al-Ani (2013) posits a favourable association between learner accomplishment and learning motivation when adopting blended learning - following the educator's notes and undertaking additional reading. Blended learning methodologies help them retain a good attitude toward their study. Students are more inspired and encouraged to study, according to Malinina (2013), when web-related technology allows them to personalise their studies (for example, students can learn at their speed, whenever and wherever they choose). In addition to the aforementioned, Activities that are more relevant to the actual world, according to Malinina (2013), provide additional motivation for pupils to study.

2.8.2 Building Partnership Among the Tiers of The Education System

Efforts in blended teaching and learning, or even to get started using technology, should be integrated across the levels of the education system. Teachers and school leaders should be trained to leverage technology effectively to help students learn (Diep, et al., 2017). Contrary, as some case studies demonstrate, one innovative educator at a school can spark significant change.

However, to scale, schools will need more people and centralized support structures to guide the effort (Kuhn, 1962). Still, this will require supporting those early-stage innovators who tend to operate in a siloed manner. One of the most significant challenges to effectively implementing blended learning is teachers feeling isolated in their efforts. Instructors generally prefer to use the "chalk and talk" technique and, most importantly, do not take advantage of the technology and equipment available.

2.8.3 Adopt Public – Private School Twinning Collaboration

The DBE's reduced expenditures could link regional or national initiatives (Kane & Alavi, 2017). Many budgetary challenges affect schools nationwide regarding boosting technology use and digital learning. Deschacht and Goeman (2015) believe schools might help one other in light of these common issues, mainly through cross-school and cross-sector (public and private) cooperation.

For example, Hatfield Christian School, a private school in Gauteng, developed an online curriculum eight years ago and has since worked with over 50 underprivileged public schools around South Africa to assist them in implementing their digital courses (Headmaster, 2018). Hatfield works with each school for three years to facilitate a seamless transition and to track kids' progress over time (Headmaster, 2018). There is no charge for public schools for this collaboration in digital learning integration. Partnerships like this have the potential to provide schools with economies of scale as they begin to integrate digital, CAPS-aligned learning into their models.

2.8.4 Set the Right Metrics and Measurement to Drive Innovation Forward

A crucial first step in any technology-based or blended-learning program is determining the appropriate Key Performance Indicators (Graham, 2016). Given the prevailing perspectives

from educators to get to the unknown of whether technology is delivering the desired benefits, schools should start implementing interim success measures that assess a program's effectiveness regularly. For example, at the Future Nation private school network in Gauteng, the leadership built a feedback channel for instructors to review how technology functions for them and their pupils (Driscoll, 2017).

The school as a community is creating a network of practice that is constantly measuring the success of the blended learning program and tweaking the model in circumstances where it is not succeeding by inviting teachers to participate in critiquing and deciding which digital learning programs work best and why. It is important to note that these indicators will likely change based on the specific problems a school or instructor is attempting to tackle using technology.

Interim measurements may include reports of improved student engagement or time on the task at one school combating behaviour difficulties. At another school attempting to transform adult perspectives, these metrics might include educator or parent satisfaction.

2.9 Benefits Derived from Blended Learning

2.9.1 It Increased Engagement Efficacy Between Learners And Educators

The higher education business benefits greatly if its growing presence in the electronic world is fully realized (Deschacht & Goeman, 2015; Graham, 2019). Through collaboration, virtual communities, instant messaging, and blogging, the transformation of learning focus on increasing the degree of interaction between human and technology-based assistance. The goal of learning transformation is to make higher education more valuable daily.

The fundamental goal of blended learning is to incorporate delivery experiences that give the most efficient and practical training and open communication for teaching and learning. The blended learning method promotes a connection between teacher and student that strikes a balance between a steady coherent impact and unlimited access to knowledge on the Internet (Garrison & Kanuka , 2014). When researchers understand blended learning well, the next natural step is to see how successful it is for the recipients.

Furthermore, Garrison and Kanuka (2014) aver that Blended learning's key purpose is to inculcate a teaching experience that affords the most efficient and effective teaching and

effective in creating open communique for teaching and learning. The blended learning approach encourages communication between instructor and learners that balances stable, cohesive influence and limitless access to information on the Internet (Naaj et al., 2012; Garrison & Kanuka, 2004). As researchers understand the definition of blended learning, the following logical chronology is to determine the effectiveness of blended learning for the recipients.

2.9.2 Ease of Use And Student Satisfaction

The blended learning benefits represented might differ depending on the institutional environment and the conceptual frameworks utilized. Blended learning, for example, offers learners access to flexible learning settings and allows them to voice their ideas, build learning communities, use a range of learning techniques, and repeat and reinforce learning (Angrist, 2019).

Students who need to enhance an essential ability like reading or numeracy. Teachers not providing them enrolled program's curriculum can use adaptive learning programs to study and practice independently and at speed until they reach the requisite standard. Adaptive learning systems and platforms, with their robust feedback loops, may be employed in diverse learning settings to provide more personalization.

According to Gedik et al. (2012), interaction with learners in big classrooms is a benefit of blended learning for lecturers. LMSs could help lecturers better manage their teaching environments by collecting assignments and automatically marking quizzes. Thus, providing immediate feedback, using an integrated grading system, tracking progress, and setting up early intervention warning systems to reduce student dropout risk.

Time management, increased workload, cultural and psychological obstacles, such as familial and job obligations, and, probably most crucially and plainly, technological impediments are some of the critical problems blended learning brings students, according to Gedik et al. (2012). It is plausible to argue that similar issues might apply to educators' blended learning experiences.

Almusharraf and Khahro (2020) contend that blended teaching tools are crucial in increasing and making the environment conducive for online education, thus inspiring analytical thinking in cooperative interaction with learners. Whereas Wang (2003) discovered that student satisfaction and blended learning determine the amount of enjoyment and effectiveness of the student's educational experiences in any higher education institution. Sher (2009) studied students' satisfaction levels with various components of e-learning courses and discovered that students with greater levels of satisfaction had significantly higher levels of learning than those with low levels of satisfaction.

Owston, York, and Murtha (2013) investigated the mix of face-to-face and online learning settings used to provide blended learning to understand better the processes of student satisfaction with blended learning and its consequences. According to their findings, students gain more temporal and spatial flexibility during classes, broader and easier access to materials utilized in the learning process, and a better level of autonomy to control their learning process.

2.9.3 Fosters Strong Learning Interactions

Furthermore, participating in face-to-face interactive activities helps students to engage with their peers and create close links (such as friendships), fostering and creating strong learning interactions outside of the classroom (Callopy & Arnold, 2009). As a result, Wu et al. (2009) think that three crucial factors influence student learning satisfaction: (1) perceived ease of use, (2) perceived value, and (3) learning environment. They also suggested that a blended learning system provides an environment conducive to social contact and that the teacher encourages good interaction publicity.

Defining what "perceived ease of use" means in this context is essential. The phrase perceived ease of use, as defined by Wu and Liu (2013), relates to the degree to which students believe that participating in blended learning saves time and effort. In the context of blended learning, Joo, Lim, and Kim (2011) defined perceived ease of use as the degree to which a person feels that utilizing a specific interface and content delivery will be simple. Several studies have examined the impact of perceived utility and satisfaction on undergraduate students' intentions to use Internet-based learning tools, according to Sahin and Shelley (2008). There is proof that users who consider reusing e-learning tools are those who believe the products are beneficial and straightforward to use.

These people have increased their usage of the e-learning tool and have a favourable outlook on the intervention (Joo et al. 2011). Thus, this suggests that distance education teachers should highlight students' preparedness to employ a range of learning tools as well as raise knowledge of the advantages of online learning. As a result, research demonstrates that well-designed and properly implemented online learning environments are required to satisfy students' requirements and expectations (Sahin & Shelley, 2008). Furthermore, Wu and Liu (2013) discovered that perceived ease of use links to student happiness.

2.9.4 Pursuit of Personal Learner Growth

Borstorff and Lowe (2007) observed that e-learning allows students at higher education institutions to get their education while pursuing their objectives and maintaining their professions to assess the impact of perceived value on student happiness. Students can attain personal and professional goals without attending classes or adhering to a strict schedule.

A study by Entmer et al. (2008) discovered that when instructors play an essential role in increasing students' motivation, students' perceived value of their online learning conversation rose, prompting them to participate actively and engage. In their exciting analysis of students' perceived value, Entmer et al. (2008) identify that online discussions increase when students perceive content as relevant, engaging, and enjoyable.

2.9.5 Increased Learner Happiness

The happiness of learners within and without school sets a trajectory for the learner's life. Learning should go beyond increasing learner performance; it should also promote contentment. Student happiness and the learning environment Extending education, such as life-long learning and learning-on-demand paradigms, has become increasingly significant as worldwide collaboration in education has expanded. For the expanded education landscape, a flexible blended learning environment is becoming more needed (Wei & Chen, 2008).

Laumakis, Graham, and Dziuban (2019) allude that there is a growing amount of literature on the factors contributing to the classroom atmosphere and learning effectiveness. The challenges include individual educators' perceptions, which emerged in recent years, focusing on the crucial role educators play in developing a classroom atmosphere with the effectiveness of learning. Students are more supportive of new and provisionally-registered teachers in open

learning settings. Because seasoned professionals are to their left and right in the classroom, more experienced colleagues can monitor, assist, and applaud instructors' success. Continuing low-level mentoring can be easily implemented (Osborned, 2013).

Similarly, Sher (2009) believes that a positive learning environment promotes shared learning experiences, fosters student community, and promotes cooperation. Thus, Walker and Fraser (2005) concur with this view, mentioning that although classroom learning environments could improve learner outcomes, education stakeholders and scholars should initially develop a model to measure the learning environment before effecting changes that could enhance the effectiveness of the education system. Trust and collaboration between learners, according to Tennyson (2010), fosters and stimulates a good learning atmosphere that facilitates the interchange of ideas, views, information, and other resources (Norton, 2015)

2.9.6 INCREASED STUDENT AND EDUCATOR SATISFACTION

According to Sher (2009), student-instructor interaction relates to the instructor's delivery of knowledge, encouragement, and feedback to students. According to Chyung (2018), interaction in an online or face-to-face course investigated learning for various reasons, including the vitality of a discussion, students' willingness to share ideas, participation in collaborative activities, and group projects, all of which contribute to productive learning environments.

Concurrent or intermittent delivery of instruction and communication between instructors and students is carried out (Her Wu et al., 2008). Educators who encourage learners to participate actively in class discussions; offer comments on learners' work and tell them of their progress regularly; and treat them as people who are more satisfied (Sher, 2009). Learners believe that interactions with educators are essential in an educational setting, according to Chaves (2019), as they are experts.

2.10 The Impact of Methods in Blended Teaching – Learning

2.10.1 LEARNER-CENTRED

BT has been an effective tool for teaching and learning (Ahmadi, 2018). Furthermore, Ahmadi (2018) attests that this is a crucial section of the novice teachers' profession through which they could use technology to enable learners' learning. This technology integration, such as the BT approach, could facilitate the entire learning process. However, increasing evidence demonstrates the efficiency of this active – learning symbolized by using the BT approaches

(Persky & McLaughlin, 2017). Generally, Persky & McLaughlin (2017) aver that this evidence suggests that the use of sound–designed BT approaches activate active learning that could foster higher–order thinking skills, collaborative skills, and self–awareness among learners. Thus, using the BT approach has changed the methods from novice teachers-centered to the learner – centered (Persky & McLaughlin, 2017).

2.10.2 PERSONALISED EDUCATION

Personalized education takes the student-centred approach to a new level by reacting to each learner's unique needs, skills, and shortcomings as feasible. Individualized education tailors learning to the student (Ginns & Reeva, 2017). Moreover, one-on-one tutoring or high-tech, responsive learning tools transpire. Personalized education is a very effective method of learning that can result in remarkable learning outcomes. Finally, a personalized education strategy may incorporate cooperative learning for a balanced combination of social and customized learning.

Today, many experts believe incorporating more learner-centred learning practices into the classroom can boost learning (Moate & Cox, 2015). Using a teacher-centred approach deprives pupils of essential skills and learning opportunities. However, for some specific topics and learning objectives, there may still be room for teacher-centred learning (Laumakis, et al., 2019). However, teacher-centred learning should not be a teacher's sole approach in the teachers' toolkit. The bottom line is that each instructor must discover a teaching style compatible with their personality. A motivated teacher who is confident in their abilities is an excellent teacher.

2.10.3 DIGITAL CLASSROOM

Blended learning in a digital classroom emphasizes using online technology. "blended learning" refers to using digital technologies in the classroom. Much of this research is carried out in K-12 schools Council of European Union, (2019), although there are also such papers from higher education settings. One research used a tablet computer, and earbuds students got when they entered the classroom to access multimedia lectures (Watson, 2018). Another

research looked at a curriculum designed for schools and included online and print resources (Staker & Horn , 2012).

2.11 Summary of Chapter 2

There are various perceptions of novice teachers about blended teaching on learning of mathematics. This chapter discussed this study's key concepts and also gave an overview of literature guiding the study. The following chapter is the overview of the theoretical framework.

CHAPTER THREE: THEORETICAL FRAMEOWRK

3.1 Introduction

The previous chapter discussed the relevant literature guiding the study. The literature sought to answer the following research questions. The chapter provided an account of the literature reviewed on the perspectives of novice teachers about the impact of blended teaching on the learning of mathematics. This chapter discusses the theory that underpins the study. The use of conceptual framework such as Community of Inquiry (CoI) aided in the analysis of the data that transpired from the study. Furthermore, conceptualised framework is discussed.

3.2 Social Constructivist Approach

According to Walliman (2018:74), although the meaning of theory is rather imprecise in research, "it refers to a statement that makes claim about a phenomenon." It (theory) is "a generalised and generalisable statement which describes, explains, predicts and helps to select, classify and organise ideas, process and concepts. It helps to explain, clarify and articulate the heart of the issue" (Cohen et al, 2018). However, according to Muhajirah (2020) the development of Constructivism is associated with the Cognitive learning theory. Kostruktivism proceeds from the principle (belief) that knowledge is a method of training that continually develop and change (Muhajirah, 2020). Theory helps in formulating and finding causal relationships (Patten & Newhart, 2018) using rigorous criteria so that it aligns with logic and empirical evidence (Patten & Newhart, 2018); it helps in understanding what, how, and why observed phenomena and regularities occur (Cohen et al., 2018). Theory helps in predicting and in guiding direction of research; thereby having a firm theoretical base strengthens research as it identifies assumptions and enables the researcher to evaluate and to critique those (Cohen et al., 2018). Characteristically, a theory is important in explaining a relationship between two or more actions or things using rigorous criteria so that it aligns with logic and empirical evidence (Patten & Newhart, 2018).

The above definition makes theories to be an organised body of concepts and principles intended to explain a particular phenomenon (Leedy & Ormond, 2021), making factual the reality that theories are speculative road maps for how things work (Blanchard & Thacker, 2013). This study is underpinned by the Social Constructivist Theory by Lev Vygotsky (1978).

This study further adapted the CoI Model by Garrison et al. (2000) as an analytical framework. This theory has been influential in developing working curricula for mathematics and other learning areas (Vygotsky's, 1978). Furthermore, Social Constructivism underscores the importance of human interaction in learning enhanced by technology through BT beyond the classroom environment (Gwaltney, 2017).

Moreover, Muhajirah (2020) instruction (education) is always an outcome of the reasoning construction of reality through one's exercises. Thus, knowledge is not inevitable or stable but rather a method of developing to be known (Muhajirah, 2020). The principle of constructivism theory is that students must discover and alter detailed knowledge into other situations, and if required, that knowledge becomes their own. For this reason, the educator's job description is to enable the progression by:

1. Making knowledge acquisition (learning) significant and applicable for students;
2. Permit students to research and put into practice their ideas;
3. Teachers are making students mindful of their approaches to acquiring knowledge.

The acquisition of student knowledge begins with the adoption of new. According to (Muhajirah, 2020), the characteristics of constructivist learning are:

1) Offering knowledge acquisition (learning) skills by combining the experience that students have in such a way that is knowledge acquisition (learning) through the process of knowledge development;

2) Offering different replacement learning practices, not all do the same task; for example, a problem can be solved in different ways;

3) Incorporating learning with authentic and appropriate situations comprising distinct experiences, for example, to apprehend a concept through the authenticity of everyday life;

4) Incorporating learning to enable social transmission that is the manifestation of cooperation and interaction of an individual with others or with the atmosphere, for example, interaction and collaboration between students, teachers, and students;

5) Employing different media with the inclusion of oral and written communication so that learning becomes more active; thus

6) Emotionally and social involvement of students so that it becomes exciting and students want to learn.

Following scientific ideas, knowledge is not transferred from teacher to student, except with students' activeness to reason; the teacher's role is to help provide facilities and situations. Hence, the construction process of students runs smoothly. Blended Teaching tools will foster this learning as novice teachers will facilitate the teaching process so that it becomes clear to the recipients of the lesson.

Duffy and Cunningham (1996) substantiate that constructivist approaches use technologies that significantly impact teaching. Thus, Mal and Adhya (2020) aver that a corresponding association emerges between BT and Constructivism—the execution of each one advancing the other. Thus, Constructivism is an instruction affirming that learning takes place in settings, while BT refers to the strategies and conditions that involve learners. To apprehend the perspective of BT in enhancing the teaching-learning procedure trying to incorporate technology in the schoolroom needs to be researched within the perspective of a constructivist framework. Constructivist approaches embrace collaborative and concerted learning strategies involving analytical and meditative reasoning (Nanjappa & Grant, 2003).

3.3 Constructivism and Conversation Theory in Blended Teaching and Learning

The flipped learning confirms the notion and the methodologies used to achieve it (Eppard & Rochdi, 2017). Moreover, the broad examining of using it (flipped learning) and neither have the theory that underpins could elaborate and substantiate the distinguished success of this approach. Eppard and Rochdi (2017) contend that this chapter aims to deal with this gap in the literature. Thus, by showing how learning theories link flipped learning and the operationalized components of these theories. Thus, demonstrating learning theories' connection with BT approaches in mathematics learning.

One of the most substantial critiques of Blended teaching is that it places the burden of knowledge creation on the instructor rather than the student. Addressing this gap through Constructivism theory may be implemented in a Blended teaching environment, which promotes student engagement and focuses on the learner's ability to create new knowledge based on prior experience (Graham, 2016). Thus, this assimilation should be done in such an approach that blended teaching should not emerge as a diverse mixture of separated traditions.

However, preferably, it should be a productive blend as the paramount of both worlds (Mal & Adhya, 2020).

Mal and Adhya (2020) maintain that the main prerequisite is that both approaches (assimilation & mixture of separated traditions) should supplement each other in the primarily feasible way, both in learning and technical terms. The qualities of a blended teaching environment allow it to adapt, assist, and encourage using Constructivism and Conversation theories in the learning process. Blended teaching might be similar to flipped learning, as learning will not be restricted within the classroom, i.e., it will take place in the comfort of learners, with novice teachers being the mentors of learners. Similarly, Yousufi (2020) avers that flipped classroom triggers the constructivist model.

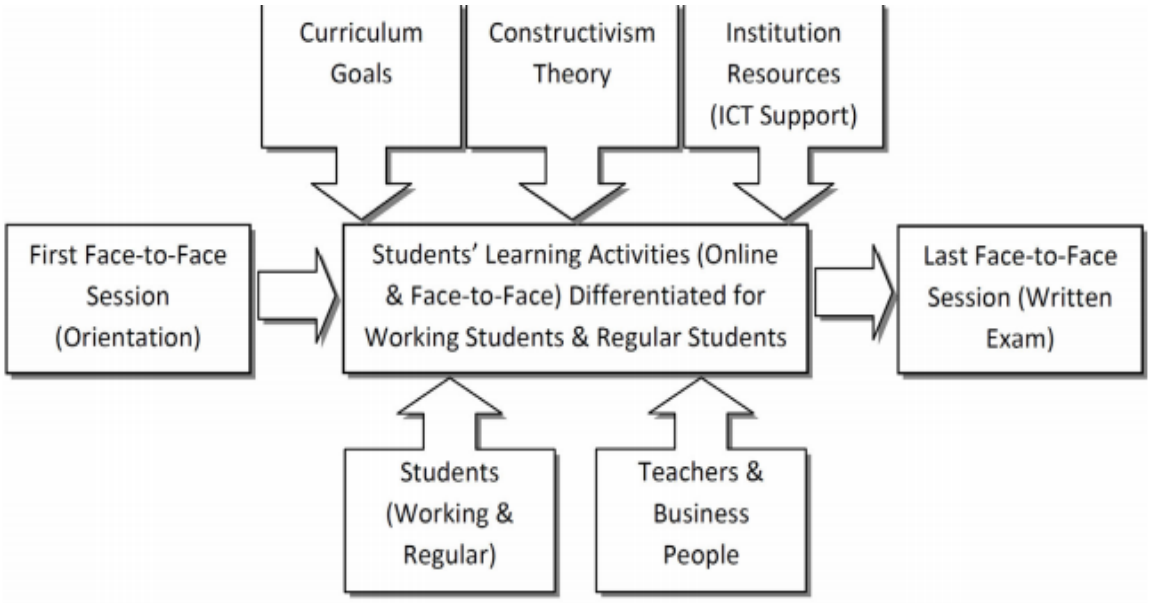
Blended learning aims to lay out the most efficient and practical teaching experience by combining delivery modalities (Kumar, 2012). Learners and teachers work together to improve the quality of learning and teaching; the ultimate aim of blended learning is to provide realistic, practical opportunities for learners and teachers to make learning independent, practical, sustainable, and ever-growing (Graham, 2005).

3.4 Constructivism-Based Blended Learning Model

Figure 2.1 above highlights constructivism characteristics with related BT activities and ICT support tools. The constructivists created knowledge through social negotiation, cooperation, and experience. At all times, the instructor analyses students and serves as a coach, mentor, or guide, providing feedback to students and correcting any miscommunication between students at an early stage. The proposed Constructivism BT model consists of various face-to-face classrooms and online learning activities (Chyung, 2018).

The teaching process starts with a face-to-face lecture to overview the course and discusses the most significant knowledge taught. Table 2.1 depicts the proposed teaching process, which consists of seven significant phases in which various scenarios could be applied (Deschacht & Goeman, 2015). During these phases, students construct knowledge through various learning activities linked to continuous evaluation.

Figure 3. 1: Constructivist-based blended learning



Source: adapted from Al-Huneidi and Schreurs (2012)

3.5 Applying Constructivist Perspectives

Mal and Adhya (2020) contend that Constructivism depicts a way of acquiring knowledge in which novice teachers cooperate meditatively to create new perceptions. Thus, this is precisely in the perspective of collaborative inquiry grounded in their knowledge (Mal & Adhya, 2020). Moreover, Mal and Adhya (2020) advocate that central to this cooperation is the advancement of communicative ability that facilitates learners to participate in open and critical conversation with both the novice teacher and capable peers.

On the one hand, constructivist teaching gives outstanding significance to improving novice teachers' ideas (Mal & Adhya, 2020). In constructivist teaching, inspired novice teachers use their problem-solving techniques. Thus, they are expected not to embrace others' reasoning but to enhance their own.

Anderson (2016) and Mpungose (2020) aver that learners learn better through facilitation, collaboration, interaction, communication, and knowledge construction. Hence, in developing countries like South Africa, BT seems to be a suitable strategy to augment the teaching-learning procedure in mathematics. Furthermore, during the collaboration with peers and novice teachers, the pupil's insightful thinking increasingly develops more abstract and vigorous

(Clements & Battista, 1990). The responsibility of the constructivist novice teacher is to direct and support pupils' creativity of doable concepts rather than conveying ascertained techniques of task achievement. The constructivist novice teacher drives learners' attention, thus unremarkably commanding their knowledge acquisition (Bruner, 1986).

Constructivism is a guideline asserting that understanding occurs in perspectives and that learners construct much of what they learn – comprehend as a meaning of their capabilities in the situation (Schunk, 2012) and perceptions within profound contexts and collaborations (Oliver, 2002). According to Jonassen et al. (1999), BT denotes the constructs and atmosphere that involve learners. Hence, the application of Constructivism and technology is on the invention of the teaching atmosphere. These environments make engaging and content-relevant capabilities by utilising ICTs and BT resources to reinforce unique teaching objectives and knowledge comprehension (Young, 2003).

The moves towards constructivism in mathematics education have been pushed by the development of comprehensive connectivity through ICTs (Wims & Lawler, 2007), allowing learners to communicate universally and, most significantly, access world knowledge resources. Thus, given the admission to broader foundations of knowledge, research recommends that combined learning is the most effective means of facilitating instruction and learning (Phillips et al., 2007). Hence, Constructivism is acquiring a foothold in mathematics education worldwide because teaching and learning can now simply be commenced as a cooperative activity (Bondarouk, 2006).

3.6 Conversation Theory and Blended Learning

The growing use of technology-mediated learning leads to increased research needs for information systems (Alavi and Leidner, 2001). Authors such as Bonk and Kim (2005) focus on the technological significance and explore several technology-driven possibilities. The emphasis by Salmon (2002) and Laurillard (2002) alludes to educational philosophy as a basis for applying higher education information technology. Gordon Pask and Bernard Scott advocated for the Conversation Theory, which is the basis for the Conversational Framework (Scott, 2001). The basis of Conversation Theory attests to the following assumptions (Scott, 2001):

- humans are learning systems;

- motivation should concentrate on learned material and why;
- if one can teach something back, it is remembered; and
- the particular conceptions and misconceptions that participants have of the topic in question can be broadly classified following Aristotle and others.

Cross (2016) highlights that the conversation theory focuses on awareness, evaluation, and Reflection about an event beyond the concept of "learning by doing." In addition, the beliefs, values, needs, and individual objectives should link to this experience (Garrison & Kanuka, 2014). The suggestion is that all learners are responsible for their education and hence "self-organized learners," At times, people are pushed by others, i.e., "other-organized" learners. The more learners manage their learning, the more they can organize and enhance their learning capacity (Garrison & Kanuka, 2014).

The Conversational Framework represents the teacher-student communication process for developing students' knowledge. Thus, using conversation as the basis for teaching and learning, the teacher-learner relationship becomes more trusting and transparent to both parties. The conversation theory views social systems as symbolic, linguistic systems where reactions depend on a unique understanding of another person's behaviour and the meaning of conversation (Driscoll, 2017).

The conversational framework is a suitable base considered the theoretical base for blended learning. However, (Graham, 2019) believes that it depends mainly on the desire and capacity of learners and educators to participate in the discourse. In practice, mixed learning lowers face-to-face contact time, reducing possibilities for face-to-face dialog between teachers and learners (Cunning, 2014). It is, therefore, vital to stimulate dialogue through various channels and to be an intrinsic component of mixed theory or practice of learning.

Thus, not all higher education institutions are in a position to invest substantial sums in developing electronic teaching and learning materials (Driscoll, 2017). The opportunity to utilize self-reflection and a conversation with students is a feasible alternative for a massive number of schools. In its simplest form, blended learning involves applying IT Cruciality for the information system community to conduct research.

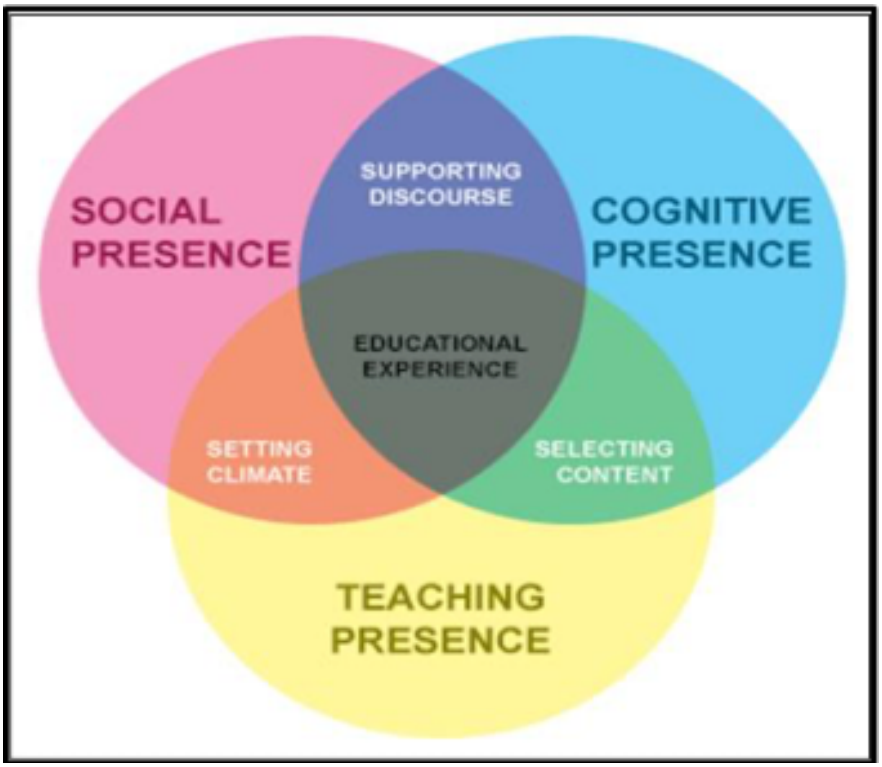
The conversational framework (1993) is a pedagogical basis that combines learning mode and curriculum design (Watson, 2018). This built framework confirms the notion of conversation theory. The framework bases its dialog on facilitating the learning process. Various online

media can adapt for use in school facilitates conversational teaching and learning. Affordable media such as Whatsapp, Youtube, and others are cheap and feasible conversational frameworks infusing blended learning.

3.7 Implementation of the Community of Inquiry (COI) Model

Wu and Jung (2022) endorse that synchronous, and asynchronous approaches optimize online learning and teaching experiences. Furthermore, Garrison (2022) concludes that the learner's presence is vital in turning to practical aspects of the Community of Inquiry (COI) model, which also guides this study. The researcher demonstrated the COI model below.

Figure 3. 2: Community of Inquiry (CoI) framework



Source: Garrison, Anderson and Archer (2000)

In their analysis, Garrison et al. (2010) determine indicators and the correlation of those indicators with the three core elements, as shown in Table 3.1 below.

Table 3.1: Community of inquiry essential elements

Elements	Categories	Examples of Indicators
Cognitive Presence	Triggering event Exploration Integration Resolution	Sense of puzzlement Information exchange Connecting ideas Apply new ideas
Social Presence	Emotional expression Open communication Group cohesion	Emotions Risk–free expression Encouraging Collaboration
Teaching presence	Instructional management Building understanding Direct instruction	Defining and initiating discussion topics Sharing personal meaning Focusing discussion

Source: Adapted from Garrison et al. (2010)

3.7.1 COGNITIVE PRESENCE

Cognitive presence is an intentional cyclical movement over a four-phase progression from understanding a matter or hindrance to promoting events, investigation, incorporation, and resolution (Padilla & Kreider, 2018). However, Kilis and Yildirim (2018) condone that cognitive presence is the most stimulating to research and develop in virtual lecture series between the three sections of the community of inquiry framework. Furthermore, due to the practical investigation cycle in which learners progress purposefully from comprehending the obstruction to exploration, integration, and application. Thus, in cognitive presence, learners can construct interpretation through self-reflection and interaction with others (Padilla & Kreider, 2018).

Padilla and Kreider (2018) affirm that one of the applications of the COI within the cognitive Presence is the theory of "profound and significant" learning, which obliges critical

understanding and accurate knowledge of the information. Moreover, this kind of learning, as opposed to “surface” learning, permits complex order handling and memorizing material. Some research papers have proposed that the superiority of interaction and engagement among partakers (learners) within a lesson stimulates deep knowledge (Padilla & Kreider, 2018).

3.7.2 Social Presence

Earlier research papers contends that in order to corroborate a community of inquiry, social presence was crucial (Garrison et al., 2000) as it impacts studying due to social interaction (Kilis & Yildirim, 2018). Akyol (2009) avowed that social presence envisages the perceptions of cognitive presence. Moreover, social presence is established in virtual learning situations with the assistance of different methods and enhanced course design (Kilis & Yildirim, 2018). Similarly, Rourke et al.’s (2007) study acknowledged social presence sustaining cognitive presence through its capacity to instigate, sustain, and support critical thinking in a community of virtual learners. A recent study by Gordon (2016) insists on social presence in an undergraduate writing course by trying to employ Facebook, one of the social networking services.

3.7.3 Teaching Presence

Teaching presence is the underpinning of initiating a virtual community of inquiry (Kilis & Yildirim, 2018). The facilitation element of teaching presence correlates with metacognition. This obligation is to execute and reinforce shared metacognition (Garrison, 2022). Mainly those verify that emphasize personal acquaintance, monitoring, evaluating, directive manners, and domain-general frames” (Zepeda, Hlutkowsky, Partika & Nokes-Malach, 2019). Moreover, they affirm that novice teachers in classrooms with high-growth scores on a abstract learning assessment used more metacognitive talk than novice teachers with low-growth scores. Thus, these results support the argument that metacognitive talk ("discourse" in CoI terminology) concerning the inquiry process and task goals have enormous value. Moreover, pragmatically comprehending and endorsing shared metacognition in a classroom.

3.8 The Community of Inquiry Model

The COI framework provides a dynamic model of a blended teaching approach, which engulf face-to-face and online reshaped educational experience based on the subsets in the diagram in

figure 3. COI can be used to empower novice teachers to integrate technologies into the curriculum to assist student learning.

Furthermore, the COI postulates a theoretical framework contributing to the complexity of virtual learning (Padilla & Kreider, 2018). Garrison, Anderson, and Archer (2010) highlight how the COI model accepts that learning takes place within the "community" through the collaboration of 3 main elements, cognitive, Social, and teaching presence, with cognitive Presence being the most basic to attainment in the learning of mathematics.

Thus, the COI model was acquired initially to address novice teachers' online learning in a course where an argument board/forum was the primary means of communication.

Furthermore, this study adopted the following Community of Inquiry (CoI) model (see figure 3), which resonates with the research as its analytical framework tool, which complements the theory by Vygotsky (1978). The CoI model divides teaching into viz:

1. **Teaching presence**: everything else the novice teacher does – instructing the subject, providing lectures, creating rehearsal opportunities.
2. **Cognitive Presence**: Opportunities provided by novice teachers for learner interaction with the material in robust, thought-provoking ways.
3. **Social presence**: building a learning community incorporates student–to–student interactions.

The essential attention of the revealed metacognition paradigm is the responsibility of novice teachers to take the role and capability for supervising and accomplishing learning in a community of inquiry (Garrison, 2022). Moreover, there is a highlight that the teaching presence forms communal metacognition. This hypothesis includes planning, facilitation, and direct instruction and its similarity to operationalized cognitive presence.

Garrison (2022) avers that the fundamental dynamic of a CoI is critical thinking focused on creating personal meaning and shared understanding. Thus, the cognitive presence theory operationalized through the Practical Inquiry model reflects this dynamic and that of a practical educational experience (Garrison, 2022). However, Garrison (2018) substantiates that separating the responsibilities of teachers and learners violates the framework's integrity.

3.9 Conceptualised Approaches

3.9.1 CONSTRUCTIVIST APPROACH

Many of the teaching approaches and practices are learner-centred or constructivist. Simply said, it shifts the emphasis from the instructor to the pupils. Learners in this technique may sit in small groups, visit areas, and move freely across the classroom. Learners take a more active role in their instruction and may even help pick the things they study (Jones & Chen, 2018). To minimize behavioural issues in learner-centred classrooms, instructors must lay many foundations. Typically, it entails developing in learners a feeling of responsibility.

Furthermore, learners must gain intrinsic motivation. Although difficult to accomplish, these traits of responsibility and intrinsic drive create self-confidence and a lifetime love of learning in pupils. Teachers may find it challenging to grasp or perfect the student-centered approach. However, the effects and outcomes could favour the strategy when used successfully.

3.9.2 PROJECT-BASED LEARNING

Project-based learning is a relatively contemporary teaching style that falls under the student-centered approach. Students execute projects in project-based learning, as the term implies. These are large, meaty projects in which students learn, investigate, think critically, assess, analyze, make decisions, cooperate, and more (Chyung, 2018). Another fundamental tenet of the initiative is that students have a choice. Typically, established projects amid open-ended questions like "How can we make our school greener?" or "How was our city planned in the past, and how may it be planned in the future?"

Furthermore, another significant aspect of initiatives is that they are real-life situations by nature. The initiatives should not only be educational but also have a social influence. Students might, for example, create a radio program that the entire school can listen to (Bertrand, 2018). They might also submit a letter to the local council and attend a meeting to voice their concerns. All learning takes place under the supervision of the teacher. A teacher may give scaffolding and smaller bite-sized assignments in between projects to strengthen abilities such as how to research, solve division problems, write a letter, and so on.

Project-based learning provides numerous relevant skills beyond graduation that are effective teaching techniques.

3.9.3 INQUIRY-BASED LEARNING

The essence of inquiry-based learning is that students are constantly probing questions to gain understanding. The instructor supports pupils in developing this technique's critical thinking and problem-solving abilities. The instructor assists learners in thinking through their processes, teaches them viable ways, and encourages them to attempt different techniques in order for them to gain these abilities (Norton, 2015). Students are encouraged to fail as part of the process to improve their performance in the following activities.

In addition, students learn to seek solutions to questions instead of duplicating the responses taught. As a result, pupils have excellent research abilities. Furthermore, youngsters learn how to pick which questions to respond to and which ones to ask (Kane & Alavi, 2017). This method is also student-centered because it necessitates active engagement from students. The teacher directs and instructs, but students also help determine study topics.

3.9.4 FLIPPED CLASSROOM LEARNING

Homework is highly deliberate in this intriguing method of learning. Homework prepares for the following session rather than "additional" practice. In this strategy, students may view a video or listen to a lecture about the topic and ideas covered in the following class. Lower levels of thinking in Bloom's Taxonomy, such as remembering and comprehending, are thus assigned to homework (Graham, 2019). Then, in the classroom, students engage in higher-order thinking and learning skills such as analysing, evaluating and producing.

The notion is that students should spend more time in class focused on these higher levels of thinking and learning. As a result, the teacher effectively guides the activity—the acronym (Flipped classroom) was the researcher used mainly in the study. FLIP stands for the four pillars of this form of learning: flexible environment, learning culture shift, intentional content and professional instructor. The second pillar relates to a cultural shift from a more passive approach to an approach in which students are active players. As a result, this form of instruction is also student-centred.

3.9.5 COOPERATIVE LEARNING

Cooperative learning necessitates a significant amount of group effort. However, this necessitates a significant amount of organization and intervention. Thus, the instructor's side

maximizes learning effectiveness. "Think-pair-share" is one of the most often utilized cooperative learning methodologies (Kuhn, 1962). Discussions in small groups or couples and a "jigsaw" method can also be successful. Students in the jigsaw model are divided into small groups and read or learn from a certain point of view.

Then, one group member forms a new group and brings their understanding to that group (Tan & Hew , 2016). Cooperative learning, in essence, holds that social interactions can promote learning. Furthermore, the technique simulates real-world work circumstances in which teamwork and cooperation are necessary. There is strong evidence that this student-cantered approach is a successful teaching style. The chapter that follows is on this study's research methodology.

3.10 Summary of Chapter 3

This chapter's focus was on this study's theoretical framework and analytical framework that guided the study. Grounding the study with theory is like giving lens to your study. This study's key concepts were also discussed. The chapter that follows presents this study's research methodology.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.1 Introduction

The previous chapter dealt with this study's theoretical framework. This chapter outlines the study's research methodology. The researcher approached this chapter by using research steps, as explained hereunder.

4.2 Research Steps

Academic disciplines often follow a set of traditional steps in the course of executing a research project (Matshaphalala, 2017). When these steps are executed in a linear order (Bartley & Hashemi, 2022) by adopting a systematic and logical approach (Sharp, et al., 2016), it is possible to increase one's understanding of the world around us (Fouché & Delport, 2018). Out of the several research steps by various authors (e.g., Babbie & Mouton, 2018; Bartley & Hashemi, 2022; Denzin & Lincoln, 2018; Gaudet & Robert, 2018; Hoftsee, 2018; Johnson & Christensen, 2020; Mcnabb 2018; Polit & Beck, 2020; Zikmund, et al., 2019), this study adopted the research steps by Johnson and Christensen (2020). These are listed and elaborated hereunder:

4.2.1 Step 1: Select a Research Topic

Perspectives of novice teachers about the impact of blended teaching on learning of mathematics.

4.2.2 Step 2: Determine Research Questions

- What are some of the challenges that novice mathematics teachers experience when executing blended teaching?
- How do novice teachers perceive the influence of BT on learning mathematics?
- What BT tools can novice teachers use to improve the learning experience in mathematics?

4.2.3 STEP 3: DESIGN THE STUDY

Definitions of research design are rather ambiguous and, accordingly, several terms are used to define research design across research (Fouché, Delport & De Vos, 2018). Seeing that *"there are numerous types of research designs that are appropriate for different types of research projects"* (Wallliman, 2018:6), the research designs of this study followed a revelation made by O'Sullivan, Rassel, Berner and Taliaferro, (2017:28) that the term 'research design' has two meanings – *"a general and a specific meaning."*

1. **General meaning of research design:** the general meaning of research design refers to plan of the study's methodology. The design should indicate the purpose of the study and demonstrate that the plan will answer the research question(s) and is consistent with the study's purpose. Frequently, research designs are described as blueprints for the final research product.
2. **Specific meaning of research design**: The specific meaning of research design refers to the type of study. Common types of studies are cross-sectional studies, time-series studies, case studies and experiments. These types of studies or designs dictate when and how often collect the data and how much control an investigator will exert over the research environment.

Under the specific research design, this study engaged an interactive (Maree, 2022), case study research design (Bertram & Christiansen, 2021; Henning, 2022; Johnson & Christensen, 2020; Leedy & Ormond, 2021).

This study also engaged a general research design. The general meaning of research design refers to plan of the study's methodology. The design should indicate the purpose of the study and demonstrate that the plan will answer the research question(s) and is consistent with the study's purpose. Frequently, research designs are described as blueprints for the final research product (Nardi, 2018). In terms of general meaning, several authors (Creswell & Plano Clark, 2018; Eller, Gerber & Robinson, 2018; Ferreira, 2018; Kumar, 2018; Li, Lipping & Khan, 2018; Nardi, 2018; Wild & Diggines, 2015; Zikmund, Babin, Carr & Griffin, 2019) have defined research design which rolls down to the following:

> *A research design refers to a framework (Li et al., 2018; Maree, 2020; Zikmund et al., 2019; Wild & Diggines, 2015), a road map (guide) (Kumar, 2019; Li et al., 2018) or a plan (Bougie & Selkaran, 2020; Ferreira, 2018; Li, Liping & Khan, 2018; Nardi, 2018; Nieuwenhuis, 2020; Wild & Diggines, 2015; Saunders et al., 2019c; Seabi, 2018;*

Zikmund et al., 2019) or strategy (Bougie & Selkaran, 2020; Nieuwenhuis, 2020) that researchers utilise to accomplish a research study, starting with the identification of a problem (Ferreira (2018) and theories (Ferrira, 2018; Nardi, 2018) and progressing through to planning, implementation and analysis (Ferrira, 2018; Li et al., 2018; Nardi, 2018). Here, the process by which data gathering methods are structured and defined (Eller et al., 2018; Nardi, 2018) through data collection, data analysis, data interpretation (Creswell & Plano Clark, 2018; Ferreira, 2018; Li et al., 2018; Nardi, 2018; Nieuwenhuis, 2020; Zikmund et al., 2019) and data reporting (Creswell & Plano Clark, 2018; Ferreira, 2018; Nardi, 2018). This plan provides a structure that informs researchers as to which instruments the study will be based on (Ferrira, 2018), research approaches (Li et al., 2018), sampling design (Li et al., 2018; Nardi, 2018), research sites (Ferreira, 2018) and ethics (Saunders et al., 2019c).

Therefore, a generic research design is a roadmap that researchers decide to follow through during the research journey to find answers to research questions as validly, objectively, accurately and economically as possible (Nieuwenhuis, 2022), with the aim of providing credible results (Ferreira, 2018). In this study, the researcher defines a generic research design as a strategy used by researchers to execute a research study from the planning phase to the execution phase (research process) through planning, implementation and analysis in order to answer the study's research questions validly, objectively and accurately. The plan needs to take into account data collection, data analysis and data interpretation strategies.

Thus, this case study comprised of novice teachers (see the ethics form in Appendix D) in the Sedibeng West District. Moreover, the use of the case study design in this research allowed the researcher to determine novice teachers' perceptions of the use of blended teaching in the learning of mathematics. Thus, this research design is a coherent plan for obtaining answers to a set of questions to be tackled and completed through the gathering and analyses of relevant data (Yin, 2018). Furthermore, the how or why questions are the rationale for a case study conducted by the researcher (Yin, 2018). Moreover, this design allowed the scholar to hone in on research methodology that is suitable for the topic and set his study up for success.

Qualitative research paradigms, also known as constructivist/social constructivist, interpretive (Bless, Higson-Smith & Sithole,), naturalistic (Denzin & Lincoln, 2018), post-positive or post-modern perspective (Li, Lipping & Khan, 2018), are based on describing a phenomenon in a, holistic, contextually and deep comprehensive manner (Bless et al., 2020) and is the general label applied to a collection of methods used to obtain information about lived experiences (Chase, 2018). Lived experiences refer to trying to understand events from the viewpoints of people who were part of the events and to understand their experiences, instead of imposing

another persons' viewpoint (Nardi, 2018). The goal is to understand the viewpoint of those involved, as opposed to a quantitative method in which predetermined categories and a more structured scientific approach are involved (Dane, 2018).

Accordingly, a qualitative method has been chosen for this study because it is defined by the nature of its object of research which is based on subjective relationships (Gaudet & Robert, 2018), it uncovers the significance and seriousness of human behaviour, it looks at the deep meaning of actions (Cohen et al., 2019) to understand the experiences of those involved (Creswell & Plano Clark, 2018), it follows an inquiry approach in which the researcher enters real-world settings to observe, interact and understand what emerges in a naturalistic way, it collects data subjectively (Salkind, 2019) and, as such, relies primarily on different methods of collecting information such as focus groups discussions (Li et al., 2018), interviews (Li et al., 2018), field notes (Nardi, 2018), observations, conversations, photographs, recordings, and memos to the self (Denzin & Lincoln, 2018) whereby the researcher's stance is an engaged one, reflexive and value-laden. This qualitative research used purposive sampling of rich information for in-depth study to document diversity and looks for themes and patterns across case studies (Dane, 2018), using an inductive analysis (Patton, 2015).

This study is a qualitative study that was used to gather in-depth details on a specific topic (Rahi, 2017). The aim of this approach is to accomplish an understanding of the views, beliefs and perceptions of the participants (Hennik, Hutter & Bailey, 2020). Thus, the researcher used the inductive approach of reasoning as there are various views and perceptions of novice teachers about the impact of blended teaching in the learning of mathematics.

The qualitative research approach is suitable for this study, as it helped gain a deeper insight into the knowledge of the strategies to strengthen the usage of the BT approach in the Gauteng Province through the perceptions and experiences of novice educators. This approach provided sound scientific understanding on the qualitative data on BT in schools. This research design used a case study in Sedibeng West District, where novice teachers provided qualitative data to answer the research questions. The researcher adopted an intrinsic case study due to vested personal and professional interests. As a Mathematics teacher, the researcher seeks to contribute to the development of Mathematics in public schools.

4.2.4 PARADIGM: A research paradigm represents a particular worldview that defines for the researchers who hold this view, what is acceptable to research and how this should be done (Bertram & Christiansen, 2020). Research paradigms are a set of presupposition or beliefs that

are concerned with fundamental aspects of reality which give rise to a worldview (Maree, 2022). This implies that paradigms serve as the lens or organising principles by which reality is interpreted (Nieuwenhuis, 2022).

The main aim of a researcher in the interpretivist tradition is to gain a deeper and more empathic understanding of aspects of social life and human behaviour. In contrast to the positivistic tradition, interpretivist researchers want to gain an in-depth understanding of a phenomenon and how people make sense of and give meaning to their daily experiences. They do not aim to predict and control outcomes (Davis, 2021).

One of the reasons for using interpretivism is that it is based on qualitative studies which depend heavily on information from educators through interviews. An interpretivist philosophy seeks solutions from the real world where knowledge is influenced by people as participants within a specified context (Saunders et al., 2019). Researchers who use the interpretative paradigm want to get human perception of the social phenomenon and to describe and interpret the experiences of participants (Ḥusaynī & Rajabī, 2022).

Since this study is located within the qualitative research that is interpretive, inductive (Gunawan, Nababan, Syukri & Burdah, 2022), it relied heavily on multiple realities whereby different types of information was provided by participants (Adil, Nagu, Rustam & Winarsih, 2022; Edelen & Skukauskaitė, 2022; Menon, Suresh & Raghu Raman, 2022). Its interpretive methodologies center on the creation of meaning of the practices of the participants (Menon, et al., 2022) in their natural settings (de Villiers, La Torre & Botes, 2022).

The researcher used interpretivism and depended heavily on information from the study participants through interviews (du Plooy-Cillers, 2019). By using an inductive approach to social reality (Oosthuizen, et al., 2020) and by advancing the view that there is no absolute truth (Linake & Maphosa, 2022), the researcher used use an interpretative approach to get human perception of the social phenomenon of teaching using BL (Hennink, et al., 2020; Ḥusaynī & Rajabī, 2022; Wolhuter, 2022).

Interpretivism allows space for the researcher as well as research subjects to bring into the research process their own interpretations, values and frames of reference. The exact measurements and quantitative methods of positivists are eschewed and the possibilities of universal laws are denied. Rather than explanation and prediction, interpretivism strives for understanding (Wolhuter, 2022). Interpretivism is informed by a relativist philosophy, which

advances the view that there is no absolute truth. Knowledge and truth are ever-changing and should be viewed from the subjective experiences of an individual, considering the context. The post-positivist research paradigm is informed by a critical realist philosophy, which opposes forms of empiricism and a cause and effect understanding of reality (Linake & Maphosa, 2022).

Qualitative research is generally appropriate when a researcher's primary purpose is to explore, describe, or explain (Leavy, 2017). Thus, the researcher's intention, in this paradigm, is to interpret the meanings others have about the world so as to generate or to inductively develop a theory or pattern of meaning (Saunders, Lewis, Thornhill & Bristow, 2019). Saunders et al. (2019) inform us that the purpose of interpretivist research is to create new, richer understanding and interpretations of social words and context. Thus, interpretivists often address the process of interaction among individuals and focus on specific contexts in which people live and work in order to understand the settings of the participants. The methods for generating data used in this paradigm include open interviewing, unstructured observation, idiographic descriptions and qualitative data analysis (Saunders et al., 2019).

In choosing interpretive research, the researcher in this study took into account foundational characteristics and advantages of interpretive research as explained by Tshabangu (2015). As far as foundational characteristics of interpretive research are concerned:

(i) In interpretive research, knowledge does not exist out there, separate from the human consciousness;
(ii) Human beings as participants in a research activity are capable of examining their own experiences and accurately describing them;
(iii) The interpretivist seeks to reach the depth of participants' perceptions and their lived world, through a multicultural conversation;
(iv) Interpretivist methods such as interviews allow for deep descriptions of participants' social worlds, with sufficient details so as to convey exact meanings;
(v) Data or facts never speak for themselves. Therefore, they require interpretation in order to be seen as meaningful;
(vi) The researcher is seen as key instrument. The researcher can never assume a value-neutral position and is always an integral factor in the phenomena being studied;

(vii) The research findings aim at describing multiple realities; establishing meanings; understanding of phenomena; social constructions; contextual relevance to studying phenomena;

(viii) Research studies often involve a small number of participants or cases in depth, who are purposively sampled because of specific characteristics that are of interest to the researcher; and

(ix) The research report often use narrative data (i.e. text) which is typically collected over a period of time from observations, interviews, analysis of documents and artefacts.

4.2.5 STEP 4: COLLECT DATA

4.2.5.1 POPULATION: In research, the word population is used to mean the total number of people, groups or organisations that could be included in a study (Bertram & Christiansen, 2021). This group of elements or cases, whether individuals, objects, or events, must possess the characteristics the researcher aims to investigate (Leedy & Ormrod, 2021; Morgan & Sklar, 2018; Nardi, 2018) and conform to specific criteria (Johnson & Christensen, 2020).

Pascoe (2019) informs us that once researchers have set the population parameters and have defined their population appropriately, there is need to distinguish between the target population and the accessible population. Pascoe (2019) defines the target population as everyone or everything that falls within the population parameters, whereas the accessible population refers only to the section of the population that we can actually include in our study. The population in this study was all teachers in the four purposively selected schools in Sedibeng West District of the Gauteng Province

4.2.5.2 SAMPLING: Sampling has been defined differently by several authors (Babbie & Mouton, 2018; Brynard, Hanekom & Brynard, 2022; Johnson & Christensen, 2020; Kumar, 2020; Van Wyk, 2015; Wild & Diggins, 2015). A sample is a subset of the population that is selected because although it is much smaller than the actual population (Mooi, Sarstedt & Mooi-Reci, 2018; Morgan & Sklar, 2018; Nardi, 2018).

According to Patten and Newhart (2018), it is usually impractical to study an entire population, so researchers draw a sample, study it, and infer that what is true of the sample is probably also true of the population. This is because an inference to a population is only as good as the

method used to draw the sample (Patten & Newhart, 2018). In this study, sampling was used to select a small group with a view to determining the characteristics of a large group or a population (Mooi et al., 2018). Thus, purposive sampling (also known as judgment, selective sampling) was used, and is defined as a sampling technique in which the researcher relies on their own judgment when selecting members of a population to participate in the study (Saunders, et al., 2019). Purposive sampling enabled the researcher to extract a lot of information from the data collected thus allowing the information to describe the major impact his findings had on the population. Elements of the research sample involved in the study were the actual inclusion in the research population (Chambliss & Schutt, 2012). In this study, a sample of 8 participants was purposively selected from four selected schools in Sedibeng West District of the Gauteng Province. This was because the focus groups are between 6 and 8 selected participants.

4.2.5.3 DATA COLLECTION: There are various data collection methods in qualitative research, including interviews (individual or group) (Hennik, et al., 2020). The everyday use of focus group discussion is a qualitative attempt to gain an in-depth perception of social issues (O.Nyumba, Wilson, Derrick & Mukherjee, 2018). Using a focus group in the study provided insightful results that uncovered personal attitudes and beliefs that other research methods cannot replicate.

Since this study is qualitative, semi-structured and focus group interviews were used to collect data, as well as establishing a protocol for recording information (Creswell, 2014). Interview procedures were also developed. The researcher made use of a semi-structured, face-to-face interview guide that involved open-ended questions. Face-to-face interviews permitted the research scholar to command the line of questioning (Creswell, 2017). On the Contrary, Creswell, (2017) alludes that the availability of the researcher might bias the replies from participants.

However, the use of face–to–face interviews prompted the participants' opinions on the integration and collaboration of BT in the teaching of Mathematics. Dejonckheere and Vaughn (2019) assert that semi-structured, in-depth interviews are generally used in qualitative research and are the most common qualitative data source in a study. Similarly, Maree (2016) contended that semi-structured interviews are normally utilized in research to substantiate data transpiring from other information sources. Moreover, Maree (2016), stressed that extra questioning and explanation is being probed in some open questions interviews.

Thus, researcher should be attentive to the participants' answers so that they could discover lines of inquiry that might require follow-up questioning. The researcher administered the interviews personally and each interview lasted between 15 and 60 minutes and were recorded, with the approval of the individual participant.

As the researcher, I became attentive to the responses given by participants so that it became easy to distinguish new developing links. The inquests that were precisely appropriate to the experience being studied, and investigated and explored. There were a variety of methods of data collection in qualitative research, including interviews (individual or group) (Hennik et al., 2020).

The study sought to ascertain the views of novice teachers on BT and therefore, semi-structured interviews seemed appropriate to meet the objectives of the study. The advantage of this technique is that the interviewer has prepared questions beforehand to help guide the conversation and keep respondents on topic. The two-way communication during a semi-structured interview allowed for open-ended responses from participants for more in-depth information.

The efficacy of BT at school could be understood only from a detailed perspective where research participants were allowed to give their views, as well as encouraging two-way communication. Thus, this research instrument enabled the researcher to answer questions one and two of the research questions.

Focus group discussions were most commonly used as a qualitative attempt to gain an in-depth perception of social issues (Nyumba, Wilson, Derrick & Mukherjee, 2018). Similarly, Waterfield and Sim (2019) aver that focus groups could be defined as a category of cluster symposium about a certain topic being guided by the competent cluster mediator (moderator). Whereas, Maree, (2016) avers that the focus group strategy has its basis in the hypothesis that group collaboration will yield in broadening the variety of answers from participants. Thus, activating detailed information that may be forgotten about the participants' experience and freeing shyness that may otherwise hinder them (participants) from divulging data (Maree, 2016). Hence, the use of a focus group in the study has provided insightful results which uncovered personal attitudes and beliefs that other research methods cannot replicate thus answering research question three. The following table was adopted in this study.

Table 4.1: Strengths of focus groups versus in – depth interviews

	Appropriate for	Strength of method
Focus groups	Identifying group norms	Elicits information on a range of norms and opinions in a short time
	Eliciting opinions about group norms	Group dynamic stimulates conversation, reactions
	Discovering variety within a population	
Interviews	Eliciting individual experiences, opinions, feelings	Elicits in-depth responses, with nuances and contradictions
		Gets at interpretive perspective, i.e., the connections and relationships a person sees between particular events, phenomena, and beliefs

Source: Macqueen et al. (2005)

The planned data generation is expected to unfold in three interlinked phases:

Phase 1: Pilot study

The first phase lesson that was a pilot in cycle one has been a pilot done by individual novice teachers teaching mathematics in their schools but not taking part in the study. The pilot aimed to verify the data collection tools whether worked. This piloted lesson has been audio recorded. The audio recording at this stage was also part of a pilot that enabled the researcher to determine the effectiveness of the recordings before the actual implementation of the teaching. The scholar, analysed the recorded audio with the novice teacher so as to give clarity to any hindrances that could have arouse in the pilot. Some questions were paraphrased after the pilot was conducted.

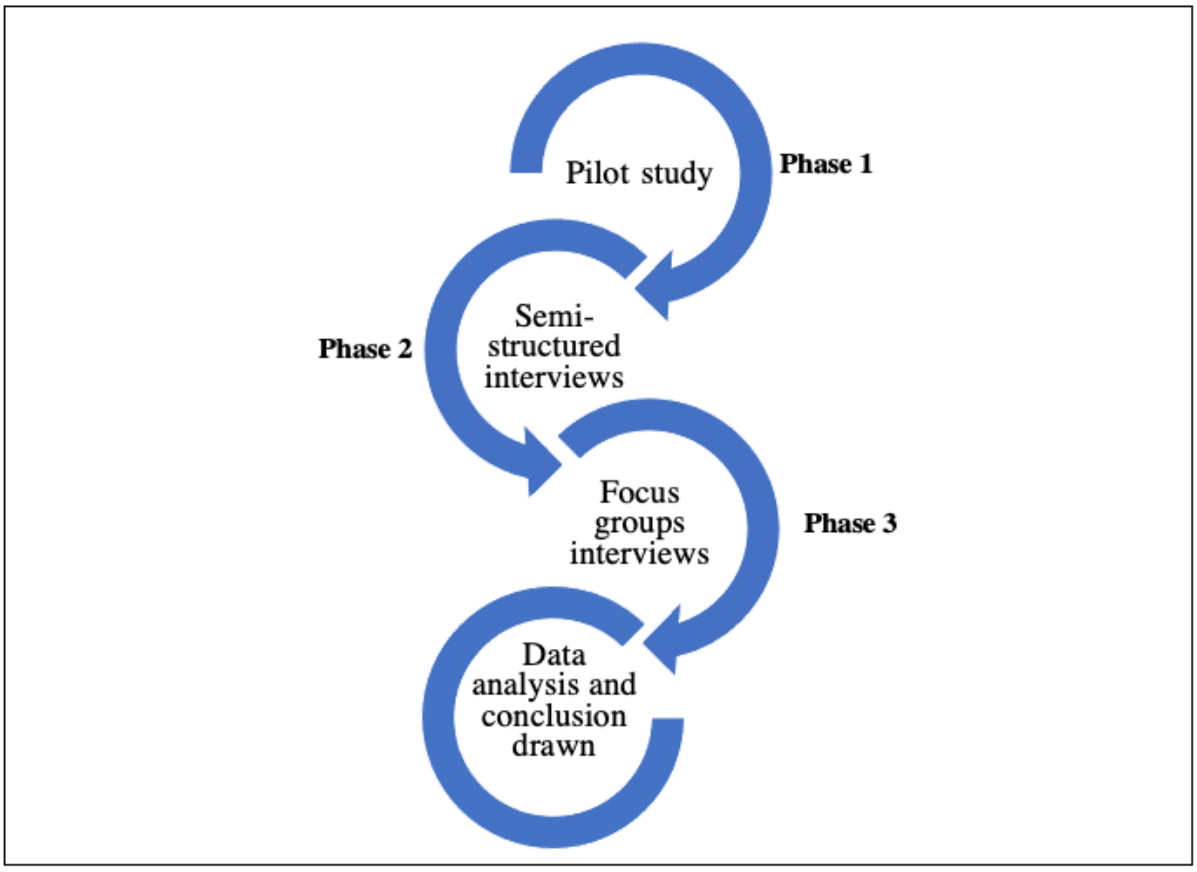
Phase 2 Semi-structured interviews

Semi-structured interviews were conducted with novice teachers teaching in the Sedibeng West District in the Gauteng Province of the Republic of South Africa. All the novice teachers were interviewed by the same semi-structured interview instrument in the selected schools. The data collected has assisted me (the researcher) to answer questions, 1, 2.

Phase 3 Focus groups interviews

The researcher utilized a minimum of eight novice teachers in the selected schools and the focus group interviews were conducted with the eight novice teachers in the selected schools. A total number of novice teachers (n = 8) in the selected secondary schools were interviewed but two were unavailable for the focus group discussion. The fieldwork was completed with the analysis of the semi-structured and focus group interviews. Thus, the data collected assisted the scholar to answer question 3.

Figure 4.2: Qualitative research design model to be adopted in the study



Source: Prepared by the researcher

4.2.4.4 TRUSTWORTHINESS: The researcher further uncovered patterns emanating from the research data analysis, and interpreted data from written notes and observational documents which made it an essential tool for a reliable study (Dejonckheere & Vaughn, 2019). For the statistics to be acknowledged as trustworthy, the research exhibited that the data analysis is performed in a detailed, reliable, and in-depth routine through recording, systematising, and disclosing the methodology of analysis. To ensure its credibility and validity, the study used specific procedures in the line of questioning, and in the data-gathering sessions, the study utilised previous research.

(A) RIGOUR

This research used credibility and triangulation as measures of trustworthiness in this study. Criteria for determining the reliability of the data along with other things is confirming credibility (DeJonckheere & Vaughn, 2019). Furthermore, credibility and triangulation is used as asserted by these researchers. Nowell et al., (2017) aver that the credibility of a research is controlled when a scholar is challenged with the experience that is recognised. Thus, the researcher, in the findings ended up having 6 participants for the focus group interview instead of 8 participants which could make the data to be richer.

Numerous data sources benefit a study to acquire an inclusive knowledge of the phenomena (De Jonckheere & Vaughn, 2019), thus credibility and methodological triangulation is used in the study. Cell phone audio recordings are used for ensuring the reliability and credibility of the data apprehended. In addition, qualitative scholars look for participants involvement in the data collection and develop connection and credibility with the participants in the study. Where there is a need, I used virtual or WhatsApp meetings, depending on the agreed arrangement with my participants.

4.2.4.5 LIMITATIONS AND DELIMITATIONS OF THE STUDY: Ultimately, every study has challenges, limitations, and shortcomings (Brutus, 2019; Eze, Masha & Seeletso, 2022; Lumadi, 2022). This study was conducted in four public secondary schools in Sedibeng West District. The study focused on novice teachers in these schools. The study was limited to the Sedibeng West District novice teachers because there was no prior research of this nature that had been conducted in this area regarding the perception of novice teachers about the impact of blended teaching on the learning of mathematics. Stakeholders such as facilitators (subject advisors), Departmental Heads and learners could have provided some valuable information but were

excluded, they could have added quality, validity, and reliability to the study. Crucially, because of the logistical limitations of this study, not all mathematics novice teachers were present when I had focus groups interviews. A total of 6 novice teachers were present, thus, certain individuals (2 novice teachers) who may have made important contributions did not take part. The map below is indicating the Sedibeng West District, with its local municipality, major towns and high school areas.

Figure 4. 2: Sedibeng West District Map

Map: Adopted from www.municipalities.co.za

4.2.4.6 ETHICAL CONSIDERATIONS: The University of the Free State (UFS), just like any other university, has its own guidelines to research ethics from the research ethics committee (Durdella, 2019; Elias & Theron, 2018; Gaudet & Robert, 2018). Since this project involved working with humans, the researcher obtained ethical approval before the research began (Devlin, 2018; Nardi, 2018; Salkind, 2019). Accordingly, the first ethical issue to be considered by the researcher was to complete the necessary research ethics clearance application forms, which led to the issuance of an ethical clearance certificate. The researcher sought permission and ethical clearance from the correctional facilities whose respondents were part of this research project (Creswell, 2017).

Hereunder are some ethical principles that relate to data collection in terms of maintenance of objectivity, right to withdraw, maintenance of informed consent, participants' right to privacy, avoidance of harm, and respondents' right to confidentiality and anonymity (Louw, 2021).

(A) INFORMED CONSENT: The researchers secured informed consent from respondents (Bertram & Christiansen, 2021) by getting respondents to sign an informed consent form. As a key

principle of research ethics, respondents were given much-needed information to decide whether or not they wished to participate in the study (Bryman, 2016). Respondents were informed by the researcher that they had the right to terminate their participation in the study at any time without penalty (Neuman, 2014).

(B) PRINCIPLE OF BENEFICENCE: Through the principle of beneficence (Polit & Beck, 2020), the researcher ensured that the study is of benefit to respondents (Patten & Newhart, 2018).

(C) PRINCIPLE OF NON-MALEFICENCE: Through the principle of non-maleficence, the researcher did not harm the respondents physically or otherwise (Carter, 2018).

(D) CONFIDENTIALITY AND ANONYMITY: This is part of the principle of non-maleficence which required the researcher to assure respondents of their confidentiality and anonymity (Devlin, 2018). The researcher ensured that she would keep the respondents' identities a secret with regard to their participation in the research study (Saunders & Lewis, 2018). This principle guaranteed the confidentiality of the data and the privacy of respondents with regard to their participation in the research study (Ferreira, 2018) by not availing their details to anyone (Sotuku & Duku, 2015).

4.2.5 STEP 5: ANALYSE DATA

The researcher analysed and interpreted data through thematic analysis which involved the following steps (Creswell & Creswell, 2018):

- Organising and preparing data for analysis;
- Reading through the data;
- Coding all of the data; and
- Representing the description and themes.

Thematic analysis is an approach that identifies, analyses, describes, and reports themes that originate within a set of data (Nowell, Norris, White & Moules, 2017). The data collected was organized using folders of semi-structured interview findings, focus groups interviews data, field notes, and audio recordings. Data was sorted and arranged according to its mutual elements. Data collected from semi-structured interviews and focus group interviews was transcribed since transcriptions give significant detail and the interviews' verbatim record that is accurate (Cohen et al., 2019). The transcription assisted the researcher to listen repeatedly to

the audio recordings and re-reading the responses of the participants to understand the perceptions of novice teachers about the impact of blended teaching.

Creswell and Creswell (2018) opine that analysing and interpreting data through thematic analysis involves the following steps: organizing and preparing data for analysis; reading through the data; coding all of the data, and generating and representing the description and themes (Dejonckheere & Vaughn, 2019). Thematic analysis of data from 8 participants validated the content sought to be investigated by the research study. This sample size was adequate for a qualitative study where a large amount of data is collected. This sample size ensured that the right amount of data are collected which do not overwhelm the data analysis process. Thematic data analysis went through the following process:

- Instant sorting out and audio recording of statistics (significant facts, date/time details, reflections).
- Commencement of data analysis soon after collection.
- Reduction of data to meaningful information.
- Identification of meaningful patterns and themes.

This process was supported by analytical tools. The researcher further uncovered patterns emanating from the research analysis software and interpreted data from written notes and observational documents, which made it an essential tool for a reliable study (Dejonckheere & Vaughn, 2019). Moreover, to confirm data trustworthiness, the study showed data analysis in an accurate, constant, and comprehensive manner through recording, systematizing, and divulging the analysis methods. In ensuring its credibility and validity, the study used specific procedures in the line of questioning, and in the data-gathering sessions, the study utilized previous research.

4.2.6 STEP 6: GENERATE FINDINGS

Reporting the research process and findings is a very important aspect of the research. As this is the only way in which the entire project will be communicated to other role players, this task should not be underestimated. The researcher bore in mind that the dissemination of information might determine the impact of the research results. The researcher had to develop a narrative and relevant mechanisms for dissemination to appropriate audiences that accurately reflect the core findings or themes of the research.

4.2.7 STEP 7: WRITE A RESEARCH REPORT

The main purpose of any research report is to present a clear explanation of what has been done in the different stages of the study process (Bougie & Selkaran, 2020). Once the data was analyzed and the findings assessed for validity, the researcher was ready to write the final report.

4.3 Summary of Chapter 4

This chapter was on this study's research design and methodology. The research questions were presented. The chapter further described the procedures such as sampling and population, the semi-structured interviews, and focus groups interviews as data collection instruments, data analysis, trustworthiness, and rigor outlined. The researcher also presented the ethics and maintained them throughout the study. The chapter that follows presents this study's findings

CHAPTER FIVE: DATA ANALYSIS AND DISCUSSIONS

5.1 Introduction

The previous chapter was on this study's research design and methodology. This chapter presents this study's results. The results presented include perceptions and views of novice teachers affected by the decisions discussed in this study. The researcher presented data analysis with its interpretations —the data from semi-structured interviews with eight novice mathematics teachers and six focus group interviews. Two novice teachers could not proceed to focus groups due to valid reasons but consent was given to proceed with the data collected from semi-structured interviews. This chapter aims to respond to the research questions and corresponding objectives.

What are the novice teachers' perspectives on the impact of blended teaching on learning mathematics?

1. To examine some challenges that novice mathematics teachers experience when executing blended teaching.
2. To describe how teachers can use personal teaching experiences in implementing blended teaching approaches to learning mathematics.
3. To ascertain which BT tools used by novice teachers could improve mathematics teaching and learning experience.

5.2 The Research Results

The basis of qualitative phase findings is a distinctly philosophical approach, which perceives individuals with or their world as interconnected and essentially having no existence without the other. The researcher viewed the social reality as unique; thus, the researcher understood novice teachers' perceptions of the impact of blended teaching with a focus on the events in which the participants were involved. The researcher did not only look at what the participants did. He also observed how they felt and thought about an idea. Thus, the researcher attempted to get a deeper understanding of their reality. Qualitative results were outlined as a narrative report to get a sense of the participants' social reality versed by the participants.

The data presented and analysed was about novice teachers' perception of the impact of blended teaching on mathematics learning. Attainment of the resolution of specific issues covered by the researcher is vital.

The researcher collected data through semi-structured and focus group interviews with the novice teachers of the selected schools in the Sedibeng West District. The data outlined is under the themes emanating from the data interpretation and analysis process. The researcher sought to seek participants' (novice teachers) perceptions about the impact of blended teaching on mathematics learning. The section below outlines data collected through focus group interviews. The details about the date, composition, and venue are in table 5.1 below.

Table 5.1: Schedule of focus group interviews

Location	Date	Time	Composition	No.	Experience
Sebokeng	23.06.2022	16:00-17:00	Novice teachers of selected schools	8	1-3 years

Source: Prepared by the researcher

Participants recruited were among the novice teachers in the selected schools in Sedibeng West District. The focus group comprised novice teachers whose experience ranged from 0 to 3 years. As Guest, Namey, and Chen (2020) alluded, data saturation navigated this study – thus in the session with novice teachers, reaching data saturation.

The session lasted from around 15 minutes to 60 minutes and was conducted mainly in English. The researcher conducted focus groups in June 2022 and concluded before the mid-year examinations, as portrayed in Table 1.1 above. The location with the dates is the reference for the same focus group.

The researcher used provisionally approved questions. The objective is to implore perceptions, views, and opinions about the impact of blended teaching tools on mathematics learning. The scholar advanced the process by asking questions at a particular time. The researcher categorized data generated from the respondents based on what transpired during the data interpretation and analysis. The presentation of words from respondents was portrayed verbatim and presented in italics. On average most respondents responded with similar perceptions in the semi-structured and focus group interviews, with the results outlined below.

In response to the three research objectives stated above, these findings are outlined and discussed below.

5.3 Challenges that Novice Teachers Experience When Executing Blended Teaching

The section below outlines the challenges novice teachers experience when executing blended teaching. These challenges were identified by novice teaching during semi-structured and focus group interviews.

5.3.1 LOAD SHEDDING

The participants responded as follows to this challenge.

> **Teacher 3***:* "*…Since these boosters are the ones feeding the WIFI, they are electric-powered, so if there is load-shedding; there will be no connectivity; it does affect….*"
>
> **Teacher 2**: "*…it is a hindrance in that I will find out that in most cases, when I have already planned to teach the lesson, and suddenly the power is off already, my plans will not be able to proceed….*"

The extracts mentioned above indicate that load-shedding is the hindrance experienced by novice teachers in executing blended teaching in mathematics. According to Teacher 3, the WIFI network is electric-powered. During load shedding, there is poor signal and connectivity. Electricity is significant in the signal and connection. In agreement with Teacher 2, indicates that load shedding is the problem that discards the novice teachers teaching plans. The researcher concurs with Teacher 2 as the schools installed with Blended Teaching tools such as smartboards have small boards to accommodate the traditional way of teaching when the load shedding is in effect. Furthermore, this distorts plans as according to this teacher, "*suddenly the power is off already, my plans will not be able to proceed*."

The above extracts concur with the encouragements from senior government officials about approaches to be in place to save the academic year, as asserted by Chirinda et al. (2021) (see 2.6). The Minister encouraged novice teachers to exercise their teaching skills to learners in the comfort of their homes to keep track of the Annual Teaching Plan (ATP). Electricity contributes to good network signals, so communication with web-based tools is clear. This communication makes it efficient to implement BT. However, in saving the academic year during Covid - 19, hindrances encountered by the novice teachers to do this exercise effectively

and efficiently. Loadshedding was one of the challenges contributing to this effective implementation of blended teaching.

The disruption of the teaching plan is also problematic according to Teachers 1 and Teacher 6.

> **Teacher 1**: "*it is a very hindrance, and it is very challenging sometimes; I will do a topic that needs copies. If I want to project a payslip, I cannot write a payslip on the board. Load-shedding is a severe challenge. Sometimes when learners watch a live video, the presenter needs to respond immediately during the presentation*".
>
> **Teacher 6:** *"Load shedding can hinder teaching and learning to be specifically blended teaching and learning on mathematics because, as a teacher, we are used to blend teaching, we plan our lessons around that. Now I must consider an alternative; I can use the textbook*"

According to Teacher 1, load-shedding disrupts their teaching plan as sometimes specific topics require them to use blended teaching tools. In addition, the presenters do not respond immediately to the questions that learners could have as he indicates that "*sometimes when learners watch a live video, the presenter does not respond immediately to the questions during the presentation*." In agreement with *teacher 6, "I must now consider an alternative; I can use the textbook*". During load shedding, they should consider alternatives to be on track with syllabi coverage (Annual Teaching Plan). This violates the notion presented and discussed by Constructivist Approach (see 3.9.1). This violation might be because of load shedding since instructors (novice teachers) plans are disturbed.

5.3.2 LEARNER DISCIPLINE

> **Teacher 1** "*…blended teaching tools are making learners noisy when they do not understand a particular concept as they resort to asking their fellow friends. "Learners tend to be disciplined for a limited period, remember, because during the process, they cannot ask questions to the smartboard, so if they have a question, then they tend to ask their friends, which disturbs the class and lose discipline during that period…"*.
>
> **Teacher 2**: "*The issue of on-time submission was a problem during the lockdown as novice teachers used to give learners work on WhatsApp, and they would take time to submit. The voice projection of the presenter (low tone voice of blended teaching*

presenter) affects the learners' attention, as they will not pay attention if the presenter is not audible enough"

Teacher 4: "*Yes, I can say yes because learners like technology, involvement, and seeing things. Some of them are visual. If I do something that fascinates them, they will behave. The traditional way of teaching makes learners make noise"*

According to the above extracts learners' concentration span becomes minimal due to BT challenges that result in disciplinary issues. Thus, Teacher 1 indicates that "*discipline to learners is for a limited period. Because during the process, they cannot ask questions to the smartboard, so if they have a question, they tend to ask their friends, which disturbs the class and causes them to lose discipline during that period*."Discipline is pivotal as novice teachers could not find it challenging to implement the BT approach. Indiscipline jeopardizes the teaching process and could fail mathematics as they might miss instructions. This violates the Teaching Presence element in the CoI model as supported by Kilis and Yildirim (2018) (see 3.7.3). On-time submission is the burning issue since learners take advantage of not being reprimanded when they do not submit on time. The reason could be that the learners need contact with their teacher or whoever is presenting in the broadcasted lesson. In agreement with this statement, Teacher 4 specifies that "*the traditional way of teaching makes learners make noise*." Moreover, this could mean that the blended teaching approach catches learners' attention to control this indiscipline in the classroom.

Furthermore, Niekerk and Webb (2016) aver that controlling learners' conduct, on the other hand, should be prioritised (see 2.7). Furthermore, one of the advantages afforded by blended teaching is that behavioural issues can be managed easily in this setting. Discipline is significant in that information from novice teachers might be cascaded to learners smoothly without wasting teaching time. Learners who are not disciplined during the blended teaching session could disrupt others who know what they want and thus affect them in learning mathematics. Disciplined is also a challenge for novice teachers during blended teaching in learning of mathematics. There are some issues that contribute misbehavior of learners. These are novice teachers' responses to this matter.

5.3.3 SUPPORT FROM FACILITATORS/SUBJECT ADVISORS

The following extracts aver to the support of teacher development.

> **Teacher 4:** "*The training by facilitators still needs to be augmented. BT requires me to do my research and consult peers to help find other tools. I have to go the extra mile, and then the district training needed to be more"*.
>
> **Teacher 6:** *"the district organises no formal novice teachers training. I volunteered that I am helping teachers like register online; they will be able to view the lessons broadcasted like this, so it is just one teacher, one or two teachers CAT teachers helping other educators with that"*.
>
> **Teacher 4***: "Facilitators once came to the our school to show us how to use smartboards, where the teacher find the graphs and how to use the unique tools on the smartboard and where to find them when teaching Mathematics, they also provide us with a broadcasting lesson from the district, so they support us…"*.

There is a need for novice teachers to be equipped with BT approaches to become more effective in mathematics teaching. According to Teacher 4, Facilitators provide training; however, there is still more to improve. Teacher 4 *specifies* that *"the training by facilitators needed to be more."* Moreover, according to Teacher 4, *"eh, I have to teach myself Geogebra tools to be effective in class. Operating with the smartboards on my own without knowing them requires training"*. The self-interaction with the smartboard is a good thing. However, the researcher is in agreement with Teacher 4 that training is essential to operate with a smartboard as a novice teacher.

Furthermore, the support provided by facilitators could benefit novice teachers to be at the standard of experienced colleagues (more than 3 years teaching experience) and beyond. However, an outcry by Diep et al. (2017) (see 2.8.2) resonates with novice teacher training. Though Teacher 4 attest that "*BT requires me to do their research and consult peers to find help with other tools*." There is an agreement with the Cognitive Presence from the CoI model by Padilla and Kreider (2018) (see 3.7.1). The novice teachers could learn from their colleagues and stimulate deep knowledge with BT

5.4 How Teachers can use Personal Teaching Experiences in Implementing Blended Teaching Approaches to Learning Mathematics.

The section below outlines how novice teachers use personal teaching experiences in implementing blended teaching approaches to learning mathematics. During semi-structured interviews and focus group discussions, Novice teachers identified these personal teaching experiences.

5.4.1 LEARNER-CENTERED APPROACH

BT is an effective tool for instructional and learning purposes (Ahmadi, 2018). This technology incorporation, such as the BT approach, could ease the entire scholarship (learning) process. However, escalating evidence shows the efficiency of this active – learning symbolised using the BT approach (Persky & McLaughlin, 2017). The views of novice teachers regarding Blended teaching are as follows.

> **Teacher 3:** "*Jaa, they are, Jaa, they are. I think it even makes them more focused unless disrupted by something. It entices them, unlike teaching, using the traditional way of teaching"*.
>
> **Teacher 6**: "*teaching becomes exciting, and they are enthusiastic when I use blended teaching, like videos. They are learners who become active in class and more curious, unlike when I am just using a textbook*".
>
> **Teacher 1:** *"I will watch the video first, then take it to learners and then afterward include learners and add on what the tutors are teaching them. I always watch relevant videos for my learners"*.
>
> **Teacher 2:** "*I try to use videos online, visual type of a thing, teacher effectiveness. I want to say something other than a learner-centered approach where I engage learners in my teaching"*.
>
> **Teacher 3:** "*teacher-learner interaction; what is it called?... Jaa learner-centered approach, I try first to find their level of understanding and build on that*."

The findings from this study are in line with assertions by Persky and McLaughlin (2017) (see 2.10.1). These assertions change learners' attitudes within the classroom, and thus in agreement with Teacher 6, *"teaching becomes more interesting, and learners are enthusiastic when I use blended teaching, like videos*. However, the effectiveness of a learner-centered approach advocates learners in charge of their knowledge construction. In agreement with Teacher 3 and teacher 1, that *"I will watch the video first, then take it to learners and then include learners. Moreover, add what the tutors teach them"* —making learning easier as novice teachers prepare thoroughly and watch the video before the learners can view it.

These 3 teachers agree and their assertions agree with Persky and McLaughlin (2017). Then, learner – centred approach entices the learners and makes them (learners) in charge of their learning. This could make them remember the concepts as they have developed it from what their prior knowledge.

5.4.2 BENEFITS OF BLENDED TEACHING

Blended teaching's main objective is to incorporate virtual teaching with traditional ways of teaching. This way of teaching benefits teachers and learners during pandemic eras like Covid. There might be hindrances to implementing this Blended Teaching; however, if the novice teachers are innovative enough, they could be far from being distorted by using BT in learning mathematics. The following extracts emanated from the interviewed teachers.

> **Teacher 2***: "Today's learners are technologically advanced and technology inclined. If I use blending traditional teaching with technology, I contribute to that and makes teaching enjoyable; learners just get excited. Also, it removes boredom in the classroom. Learners can be motivated by the use of technology*."
>
> **Teacher 4**: "*Learners develop a different eye on the concept; they discover a way to understand a particular image and most things by themselves. If I show them a visual, it will help them for exam purposes and discover on their own that they want to relate to real-life situations."*
>
> **Teacher 2**: "*Ja Mathematics by nature, they say it is challenging. The Learner has to use many senses to understand and use visual aspects; I cannot over-emphasize them. Moreover, through blended teaching, there is a visual aspect, even the use of colour, such as the use of Geogebra when plotting graphs using different colours. In that way,*

It does assist learners, even those with short listening spans, that visual aspect with the motions and audio plays a role."

The extracts above agree that blended teaching is beneficial in learning mathematics as learners gain insight from this approach. In addition, there is an increased engagement with the BT between learners and novice teachers, as asserted by (Deschacht & Goeman, 2015; Graham, 2019) see 2.9.1. This increased engagement benefits the novice teacher because learners become independent and critical thinkers. As asserted by teacher four (4) that "*Learners develop a different eye on the concept; they discover a way to understand a particular image and most things by themselves*. Thus, teacher 4 concurs with applying constructivist perspectives (Mal & Adhya, 2020) (see 3.5).

These extracts also alluded to the fact that today's learners show experience with technology which then impacts learners being fascinated with the execution of blended teaching approaches. Teacher 2 indicates that, "*Today's learners are technologically advanced and technology inclined. If use blending traditional teaching with technology, I contribute to that and makes teaching enjoyable; they just get excited. Also, it removes boredom in the classroom. Learners can be motivated by the use of technology"*. In agreement with Teacher 2, Today's learners get destructed easily. Destructed classroom might be the reason of lacking visuals in classrooms. Blended Teaching tools sort to keep the learners' attention to the end of the lesson and even motivate them to practice at home without being supervised by their instructor (novice teacher).

5.4.3 UNDERSTANDING OF BLENDED TEACHING

These were the findings from the novice teachers who participated in the study regarding the understanding of BT.

Teacher 1*: "BT combines online and in-person teaching, using technology and manual things."*

Teacher 5: "*BT uses smartboards and gadgets such as (thinking) projectors to teach mathematics."*

Teacher 6: *"blending teaching uses technology in mathematics and not just technology like cell phones. It is also about using different materials in education, like a projector. It can be a digital project or an overhead projector. If I use something other than a*

textbook, it can be a smart board or whiteboard, so utilization of different materials, not just a book."

Teacher 8: "understands *that teaching involves smartboards, in most cases using technology material."*

These respondents agree that blended teaching is the incorporation of technology with traditional ways of teaching. Teacher 1 is in line with Kanuka (2014) (see 2.2) that "*BT combines online and in-person teaching, using technology and manual things*." The blending teaching benefits makes a novice teacher to deliver curriculum in the comfort of his space and time without contacting the learners. Blended teaching is understood by teacher 8 *"as teaching that has to do with smartboards, in most cases using technology material*." Similarly, there is an agreement with Teacher 5 "*that BT uses smartboards and gadgets such as (thinking) projectors to teach mathematics*." Similar sentiments with Teacher 6 are that blended teaching is a flipped classroom that uses various technology-related materials and "*understands that blending teaching uses technology in mathematics and not just technology like cell phones*." *It is also about using different materials in education, like a projector"*.

Moreover, blended teaching understanding seems to escalate the need for new practices and approaches as there was a Covid outbreak in the country (Cahapay, 2020). Blended teaching understanding is the knowledge shown by novice teachers towards this approach. The benefits of novice teachers' understanding of the BT approach might give a preconceived impression that they practice it in their respective schools. There are challenges associated with this approach, which include the teacher's inability to use them even when they are dispatched to their schools by DBE.

These could result in these devices gathering dust in the school lock rooms or people who are not relevant using them, thus doing things unrelated to mathematics content. Further critiques suggest that this BT is more facilitator (novice teacher) knowledge creation than learner knowledge creation.

5.4.4 NOVICE TEACHER'S PERCEPTIONS

The blended teaching integration could enhance learner-centered procedures as professionals believe in that (Laumakis et al., 2019). Moreover, Borstorff and Lowe (2007) observed that e-learning allows students at institutions of higher learning to pursue their careers as a way to

assess the impact of Blended Teaching. Others perceive blended teaching to be valuable and practical. The driven usefulness of BT could have an impact that enhances novice teachers' conceptual understanding. Moreover, novice teachers' show increased satisfaction with the learners they teach. Outlined responses from respondents are as follows:

> **Teacher 2:** "*a lot; it does help me, especially with real-life problems. It does help the me, I don't want to lie"*.
>
> **Teacher 3:** "*BT has contributed to conceptual understanding instead of an algorithm when I teach platonic solids in Grade 9; in the past, a learner used to see a 3D shape in 2 D plane"*.
>
> **Teacher 3:** *"I think it expanded my knowledge, and even if there are no BT tools, I can teach without them*."
>
> **Teacher 4:** "*BT is time-consuming because sometimes you have to move from one app to another from the smartboard to the laptop; it takes time, but prompt and thorough preparation helps learners and is beneficial to learners because there is limited time* provided.
>
> **Teacher 5:** "*It reminds me of the concepts I have forgotten and helps my visual learners*."

Teacher 2 agrees that the BT tools help represent real-life problems. "Blended teaching expands learners' knowledge as they can even visualise and see the unseen, as attested by "*as a novice teacher reminds me of the concepts I have forgotten and helps my visual learners*." The visualisation of mathematics through BT approaches benefits mathematics instruction as learners can visualise mathematical concepts, as attested by Teacher 5. *As a novice teacher, it reminds me of the concepts I have forgotten and helps his visual learners*", even in the absence of BT. Similarly, Teacher 5 agrees with Teacher 3*"*.

Blended teaching advantages the learners of this generation as they can see things that some could not see. BT execution by novice teachers could stimulate learners' prior knowledge. In agreement, Teacher 5 "*well, as I said, neither the other terms whereby I want to be prepared a lesson, and I want to check their prior knowledge concerning the topic in that way other than writing to the chalkboard* ."The implication is that novice teachers in the Fourth Industrial Revolution era have a technological advantage compared to the previous generations.

5.5 Blended Teaching Tools That Novice Teachers uses to Improve Mathematics Teaching and Learning Experience.

The section below outlines blended teaching tools used by novice teachers to improve mathematics teaching and learning experience. Novice teachers identified these BT during interviews conducted.

BLENDED TEACHING TOOLS

> **Teacher 1:** "*Smartboards as they are in LTSM, Laptops, and Projectors. I have made an example of an online tutor"*.
>
> **Teacher 2:** "*Of course, my cell phone to access learners for WhatsApp groups, whereby I create a WhatsApp group with my learners so that I do not exchange information even after hours, courtesy of the department with smartboards and internet connectivity*."
>
> **Teacher 3:** "*I think it is the smartboards, the overhead projectors, eh, these videoed content*."
>
> **Teacher 4:** "*one of them is smartboards that we mainly have, a laptop with HDMI to project some work if smartboard, sometimes the USB if the smartboard does not have the app in the cell phone*."
>
> **Teacher 5:** "*Projector, whiteboard, smartboards, cables involved and laptop chargers, etcetera*."
>
> **Teacher 6:** "*resources laptop because I use my computer to plan and maybe do a slide show presentation and videos. I use eBooks, books, my laptop, projector, and a smart board*".
>
> **Teacher 8:** "*Projector, smart board, Geogebra for Euclidean Geometry. We have many maths boards that one can use that do not depend on power*".

The above teachers' assertions align with the table adopted by Zinovieva et al. (2021). Moreover confirms that these novice teachers use most Blended Teaching tools tabulated in the table. There are benefits and also disadvantages to using technology. In agreement with Teacher 8, "*we do have many boards within maths that one can use that do not depend on the power*." The implication is that most of the tools used in mathematics are electronically

dependent. As confirmed by Teacher 5, *"Projector, whiteboard, smartboards, cables involved and laptop chargers, etc."*

The use of BT tools, such as mobile technologies (smartphones and tablets), is increasing among researchers and practitioners in teaching and learning (Borba et al., 2017). South African schools benefit because the outcomes of blended teaching and the different functions of these BT tools could promote success among the poor-performing grade 12 (Zinovieva et al., 2021). Novice teachers responded as follows regarding the blended teaching used to improve mathematics instruction and learning experience.

5.6 SOLUTIONS TO THE IDENTIFIED CHALLENGES

The interviewed (semi-structured and focus groups) novice teachers acknowledged hindrances during the execution of blended teaching and highlighted deliberations in 5.3. This unit outlines the resolutions to the identified hindrances indicated by respondents.

5.6.1 IMPROVING NOVICE TEACHERS' EXPERIENCE WHEN EXECUTING BLENDED TEACHING

> Teacher 2: "*unless I am innovative, I have a clear way out or prepared for his teaching, and the power goes off, or when I am most innovative, I can have a plan B*."
>
> Teacher 3: "*eh, usually when we announce load shedding, we make other plans we improvise so that the lesson does not get disturbed*."

According to the above teachers, BT teaching needs one to be innovative such that they continue with teaching even in the absence of electricity. This could imply that as they prepare their lessons, they might even prepare for alternatives such as the diagram represented below in Figure 5.2.

A novice teacher-guided teaching and learning expertise occurs online (over the Internet). It is one where all learners participate in the understanding and where the understanding embraces two-way interaction between learner and learner or learner and novice teacher (Wu & You, 2022). The experiences of novice teachers are essential in that they should be able to manage the classroom regardless of the hindrances that could come in their teaching space. The experience contributes immensely; the training on using alternative tools to keep track of the Annual Teaching Plan (ATP) should be done. The same elaborated sentiments transpired:

The innovation is essential as it fosters novice teachers to develop themselves to meet the blended teaching standards of this 4IR. Moreover, this could imply that novice teachers should prepare in advance so that if there is load shedding, they can continue with the lesson without any disturbance. The following figure is the diagram showing one of the alternatives used when novice teachers experience load shedding.

Figure 5. 2: Teaching aid example during load shedding

The extracts above show the need for using these whiteboards as they work as both the screen and the novice teacher can scribble on them to explain mathematics during load shedding. In agreement, teacher 3 affirms that *"I must be ready for anything. Technology cannot disappoint the lesson"*.

5.6.2 Supporting Novice Teachers to use Personal Teaching Experiences in Implementing Blended Teaching Approaches to Learning

Wu and You (2022) aver that teaching and learning expertise under the guidance of a novice teacher is placed in an online space (virtually over the Internet). Furthermore, it contributes to the understanding simultaneously, which comprises two-way interaction between the learner or learner and novice teacher. There are various supports that can be provided to novice teachers so that they can be effective in the implementation of blended teaching. These efforts ensure that novice teachers are confident enough to execute blended teaching in learning mathematics. The statement aligns with Diep et al. (2017) that novice teachers and school leaders should be trained to leverage technology effectively to help learners learn. The Teacher

Development Unit in the Department of Basic Education could make the training possible, including the facilitators supporting their teachers with the content gap.

Moreover, BT helps equip novice teachers to become independent thinkers and workers who work with boldness and confidence even if they have few years of teaching mathematics. The following extracts are outlined in response to the support provided to novice teachers. So that novice teachers can teach mathematics effectively and efficiently.

> **Teacher 4:** *The training by facilitators needed to be more. It required researching and consulting peers to help find other tools.*
>
> **Teacher 6:** "*Yes, they do assist because they are this document, facilitators/ Subject advisors give us the extra class activities, and I saw that they already got the soft copies the novice teacher got from the facilitator.*"
>
> **Teacher 4:** *"Facilitators once came to the teachers' school to show us how to use smartboards, where I find the graphs and how to use the unique tools on the smartboard and where to find them when teaching Mathematics, they also provide us with a broadcasting lesson from the district, so they support us. The departmental laptops provided by the district also have offline smartboards, making them easy to use at home. So that when I go to class, I know where to find the tools".*

The above indicates that novice teachers expect support from their facilitators/subject advisors. According to Teacher 1, he would love more support regarding the training provided by the facilitators as they end up asking their peers. Though, Teacher 4 agrees that t*he departmental laptops provided by the district also have offline smartboards, making them easy to use at home. So that when I go to class, I know where to find the tools".* This support should be provided until the novice teachers become confident in the learning area. The answer to the load-shedding issue that impacts poor signal and connectivity is that novice teachers could use their departmental laptops while offline in preparing for the lessons conducted when there is no load shedding as alluded by Teacher 4.

5.6.3 The use of Blended Tools by Novice Teachers to Improve Mathematics Teaching and Learning Experience.

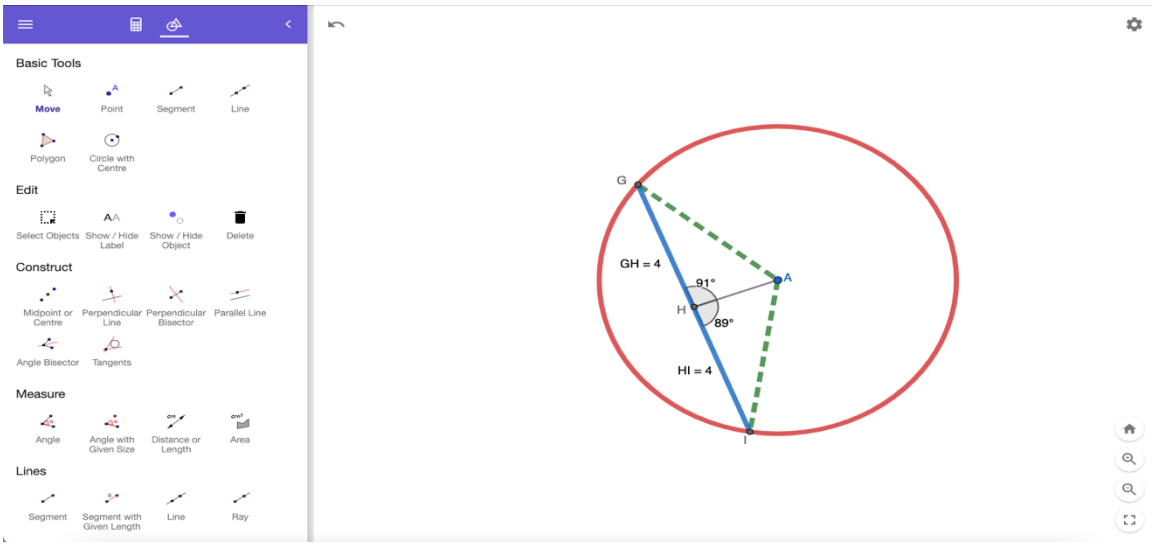
The use of BT tools (Mobile technologies), such as smartphones and tablets, in teaching and learning, is increasing among scholars and practitioners (Borba et al., 2017). The global

pandemic fostered blended teaching tools that enhance learners' conceptual understanding. This conceptual understanding makes learners to be individual thinkers with logical thinking. These individual thinkers can visualise content that could help them remember things taught in the past. The respondents made the following assertions regarding the question.

> **Teacher 5:** "*it reminds me of the concepts I have forgotten and helps my visual learners*."
>
> **Teacher 8:** "*and yes, it did; it feels like I said, it did add value; it should; if I do not understand specific topics, I check them and then get them to start doing different examples; it does help; there is even Geogebra how to get an angle within a short period they do enhance once knowledge*."

The above extracts show that BT tools benefit learners by enhancing conceptual understanding as it reminds them of content they have forgotten. According to Teacher 6, the diagram below is an example of Geogebra that helps learners to enhance their understanding and visualise mathematics.

Figure 5. 3: An example of a Geogebra presentation



5.7 Summary of chapter 5

This chapter covered the data analysis and findings and data presentation of the overall findings obtained from semi-structured interviews and focus group interviews, as well as the statistical data gathered from literature sources. These discussions highlighted the challenges experienced by novice teachers during the execution of blended teaching, perceptions of novice teachers about the impact of blended teaching in learning mathematics, and blended teaching tools used by novice teachers to improve mathematics teaching and learning. These components were discussed in response to the identified objectives (see 5.3, 5.4, and 5.5). Good practices to enhance conceptual understanding of mathematics through Blended Teaching tools were discussed as threats to the implementation of this approach. The chapter that follows presents this research findings and conclusions.

CHAPTER SIX: FINDINGS AND CONCLUSIONS

6.1 Introduction

The previous chapter presented this study's results. This chapter presents this study's findings and conclusion. This study investigated the perspectives of novice teachers about the impact of blended teaching on learning mathematics. In this chapter, the researcher critically discusses the qualitative findings outlined in Chapter 5 to answer the research questions. Moreover, this chapter is divided into themed sections starting with the discussion of understanding of blended teaching by novice teachers, the perception of blended teaching in the learning of mathematics, and challenges experienced by novice teachers when executing blended teaching. The themes were formulated around the research questions guiding the study and consistently used for structuring chapters 2, 3, 5, and 6.

6.2 Aim of the Study

The study's primary aim is the selected novice teachers' perspectives on using the blended teaching approach in learning Mathematics.

The related objectives of the study were as follows

- To examine some challenges that novice mathematics teachers experience when executing blended teaching.
- To describe how novice teachers can use personal teaching experiences in implementing blended teaching approaches to learning Mathematics.
- To ascertain which BT tools used by novice teachers could improve mathematics teaching and learning experience.

6.3 Summary of the Study

Teaching mathematics in the Fourth Industrial Revolution (4IR) era offers novice mathematics teachers daunting challenges. BT incorporates face-to-face and online classroom learning to develop extensive skills and knowledge transferrable to the workplace (Lowe, 2019) (see 1.3). Anderson (2016) and Mpungose (2020) highlight that BT could solve some of the current teaching problems and address the educational backlog during Covid-19 challenges (see 1.3).Anderson (2016) and Mpungose (2020)confronted novice teachers about the unrealistic responsibilities of making BT a success, despite the lack of adequate resources from the DBE and unclear policy directives regarding blended teaching. Furthermore, Mavani (2016) maintains that the DBE's technology equipment, such as computers and tablets, needs to be more utilised because many teachers need to gain experience effectively using this technology in the classroom. Despite using various aids in teaching the learning area, novice mathematic teachers still experience challenges during crisis times, such as during the COVID-19 pandemic. Chapter 2 of this study further highlighted it. Teachers seem to be experiencing challenges that impact in blended teaching approach. Thus, Borba et al. (2017) contend that the attributes of mobile devices (portability, availability, access to the Internet), including their broad recognition among the youth and others, have made portable devices capable of growing the limits of mathematics instruction and learning beyond the four walls of the teaching space (classroom).

Furthermore, due to challenges associated with implementing these blended teaching tools, novice teachers need help to exercise them to maximise. Thus, the drawback is that it has a potential for plagiarism behaviour and internet signal strength, including devices that support it (Arkorful & Abaidoo, 2015; Irfan, 2015; Irfan et al., 2020). Based on this backdrop, therefore, the study investigated the impact of BT by novice teachers on learning mathematics, despite inadequate but essential hardware and software resources.

The constructivist approach guided the study, complemented by the Community of Inquiry model (CoI) as an analytical framework. Constructivist approaches embrace collaborative and concerted learning strategies involving analytical and meditative reasoning (Nanjappa & Grant, 2003). The application of Constructivism and technology is on the invention of the teaching atmosphere.

This study is a qualitative study used to collect in-depth particulars on a specific topic (Rahi, 2017). This method's objective is to perceive the participants' views, beliefs, and perceptions (Hennik, Hutter & Bailey, 2020). Thus, the researcher utilised the inductive method of reasoning as there are several views and perceptions of novice teachers about the impact of blended teaching in mathematics learning.

Thematic analysis was utilised to analyse and interpret data (see 4.2.5). The findings showed that in order for novice teachers to be effective in implementing blended teaching, the following implementation is needed: 1) Equipping novice teachers must be the priority so that they can teach mathematics using blended teaching even when experiencing challenging times, 2) Novice teachers should be able to use personal teaching experiences in implementing blended teaching approaches to learning Mathematics, and 3) novice teachers ascertainment for BT tools to use which could improve mathematics teaching and learning experience and 4) Blending the traditional way of teaching with the virtual teaching to be effective in implementation of BT.

The following sections summarise the support novice teachers require to teach mathematics using blended teaching. Furthermore, BT will help them, even when experiencing challenging times, the capability of using their personal teaching experiences – implementing blended teaching approaches and BT tools used by novice teachers to improve mathematics teaching and learning experience.

6.4 Possible Solutions to the Challenges Identified

The following sections are in response to the research questions that favoured conditions that made the reported solutions materialise.

6.4.1 Challenges Experienced by Novice Mathematics Teachers When Executing Blended Teaching

The President of the RSA declared Covid-19 a national disaster, as revealed by literature. The teachers were encouraged to employ blended teaching approaches to save the academic year (cf. 2.6). The findings from this current research suggest that even when novice teachers experience challenges, they should be equipped to teach mathematics without electricity. Electricity is considered the one that makes a good signal for implementing blended teaching

to its maximum point. Prior studies cf. (2.6) assert that teachers had to experience the new normal for the first time as the resources, knowledge, or support were insufficient. Furthermore, this unprecedented situation resulted in teachers adapting their teaching, thus changing their teaching methods. Thus this could confirm the notion that the load shedding we have that results in poor network signal could negatively impact blended teaching in mathematics learning (cf. 2.6).

The current study found that when there is load shedding, there will be network signal problems, which could lead to poor connection.

Previous studies found that the drawback emanates from blended teaching, which has a potential for plagiarism behaviour. Moreover, internet signals strength, including devices that support its connection (cf. 2.6). This study found that learner discipline is among the challenges experienced by novice teachers during the blended teaching execution. Surprisingly, learner discipline seems to be triggered by internet connectivity as some learners need to be used to the internet; this might make them misbehave when connected, thus searching for content that is not educational. Moreover, pupils in disadvantaged areas like townships could not access digital resources, such as blended teaching tools required for online learning at home.

The study also found that the support provided by facilitators, referred to as subject advisors, and was insufficient. The literature agrees that novice teachers and school leaders should be trained to leverage technology effectively to help students learn (cf. 2.8.2). Moreover, this could help to ensure that novice teachers get a thorough orientation on using the BT tools when teaching mathematics.

6.4.2 Novice Teachers' Perception of the Influence of BT in Learning Mathematics

Literature attests that the blended teaching approach encourages communication between instructors and learners. Those are stable balances, with cohesive influence and limitless access to information on the internet. (cf. 2.9.1).

Furthermore, it underscores the importance of human interaction in learning enhanced by technology through BT and beyond the classroom environment. (cf. 3.2). Previous studies found that through collaboration, virtual communities, instant messaging, and blogging, the

transformation of learning goal of learning transformation is to make higher education more valuable daily (cf. 2.9.1).

The blended teaching benefits represented might differ depending on the institutional environment and the conceptual frameworks used. Blended learning, for example, offers learners access to flexible learning settings and allows them to voice their ideas, build learning communities, use a range of learning techniques, and repeat and reinforce learning. Moreover, as mentioned in the literature, Blended learning's fundamental purpose is to inculcate a teaching experience that affords the most efficient and effective teaching and effective in creating open communique for teaching and learning (cf. 2.9.1).

The current study found that learners benefit from novice teachers when using the blended teaching approach as a teacher will teach them with a different personality and perspective than the novice teacher who is still new in the teaching fraternity with no experience. Furthermore, blended teaching saves time as learners' prior knowledge is recalled easily with blended teaching tools.

Blended teaching is beneficial because it removes novice teachers' boredom as may become interested in the blended teaching tools employed by instructors in teaching mathematics. In addition, novice teachers show interest in visualisation as blended teaching tools make them understand abstract concepts in mathematics.

The usage of eBooks caters to the shortage of textbooks as they (eBooks) are user-friendly during the teaching of Mathematics. Novice teachers can scribble using a marker that is not on the smartboard, explaining concepts that need elaboration.

Novice teachers formulate a document with many examples so learners can practice on their phones at home. Moreover, this gives learners more understanding because now they will be getting more examples, and novice teachers can also give them videos, for example, when broadcasted lessons are on YouTube. Furthermore, learners get a better insight into the knowledge, which improves their understanding because teachers can show them videos on how to apply that understanding to real-life situations.

Additionally, blended teaching improves understanding of abstract concepts such as two- and 3-dimensional shapes. It makes the novice teacher project (using a projector) information to get prior knowledge effectively of what they have done in the previous grades. Similarly,

Geogebra also assists novice teachers in explaining how to draw inverse graphs, making them independent critical thinkers even without blended teaching tools.

6.4.3 Blended Teaching Tools used by Novice Teachers to Improve the Learning Experience in Mathematics

Previous literature found that Flipped classrooms, mobile devices via ubiquitous Wi-Fi, e-mentoring programs, tutorials, assistance for multilingualism, and learning analytics are all innovative. The used Blended learning practices in South African schools (cf. 2.11.1) has become the standard at many schools. Prior studies have noted that in synchronous learning, remote students participate in face-to-face sessions using synchronous technologies, among others, such as web, YouTube videos, and video conferencing. Furthermore, because the usage of blended learning apps varies extremely context-specific within each school, it is hard to offer an entire list of all applications. The current study found that novice teachers use the following blended teaching tools in implementing the BT.

- Laptops with HDMI
- Projectors
- WhatsApp groups
- Smartphones
- Internet connectivity
- Whiteboard
- YouTube videos
- GeoGebra
- eBooks

6.5 Limitation to the Study

The conducted study was in four (4) schools in the Sedibeng West District of Gauteng Province. If more schools participated in the research, they could be a difference in the research findings (results). Therefore, these findings cannot be generalised as they were conducted in only four schools. However, even though they cannot be generalised but their application still implies schools with similar results and provide guidelines to schools that are different.

Another limitation is that the researcher is employed full-time, so he faced many challenges as the teachers no longer having sabbatical leave.

- Time: the researcher made provisions to balance work, family, and studies.
- Participation of teachers: two educators were absent from the focus group interviews as they had commitments beyond their control. However, they permitted the researcher to utilise the data collected during semi-structured interviews.

6.6 Recommendations

- Novice teachers should be trained by the teacher development division in the Department of Education so that they can bridge the gap from teacher training institutions of higher learning.

- Workshops organised by the department should be more frequent for novice teachers for their development from the gaps in blended teaching.

- These laptops could be helpful if charged so that if novice teachers experience load shedding, they can group learners and teach the lesson that is offline without any hindrances. Then calls for the facilitators and teacher development unit to support these educators so that they can teach mathematics even in the absence of internet connectivity and signal.

- Through the facilitators/ subject advisors' support and the Department of Basic Education, this could build teaching management, building understanding so that novice teachers can be confident with the execution of BT in their direct instruction with learners when learning mathematics.

- Novice teachers should attend their classes on time - which might lead to learners utilising the internet connectivity effectively as they are under supervision.

- Data-free blended teaching tools should be developed to assist learners even if there is load shedding since it does not solely depend on connectivity.

- Learners should be restricted from viewing content that is not educational on those blended teaching tools by restricting the settings and privacy of the search engines.

- There should be a policy for the blended teaching tools dispatched to learners that non-educational material must not be in those devices, and should they be found, the device will be confiscated.

- The study had limitations and delimitations. There are these suggestions for further research:

- A similar study can be extended to other provinces in South Africa.
- Good novice perceptions about blended teaching are fundamental to any success of mathematics teaching. More research should be conducted on the effectiveness of blended teaching in equipping novice teachers for the real world of teaching.
- The study found novice teachers' perceptions paramount to blended teaching; hence a comparative study that evaluates varying novice teachers and learners should be done.

6.7 Suggestions for Future Research

The following areas of researching Blended teaching and learning need to be investigated:

- Perspectives of learners and curriculum managers, such as Departmental Heads and Deputy Principals, need to be investigated.
- There is a need for the investigation of blended learning perspectives of learners' needs.

6.8 Conclusion

A summary of the study was provided in this chapter. Moreover, this section provided findings and recommendations that could help novice teachers perceive the impact of blended teaching on learning mathematics. The chapter further discussed the limitations of the blended study.

6.9 Summary

Teaching mathematics in the Fourth Industrial Revolution (4IR) era offers novice mathematics teachers daunting challenges. Despite using various aids in teaching the learning area, novice mathematic teachers still experience challenges during crises such as during the COVID-19 pandemic era. Such challenges escalated and confirmed the preconceived notion perceived by others that mathematics is a challenging learning area. This study sought to investigate the perspectives of novice teachers on the impact of blended teaching and learning mathematics in Sedibeng West District.

The study involved eight novice teachers from four selected schools. Blended Teaching (BT) approaches to novice teachers are intended to ensure that they are effective in their teaching so that learners can gain a deeper insight into mathematics. The researcher adopted a case study design involving thematic analysis of responses from novice mathematics teachers. The researcher conducted semi-structured interviews and focus group interviews on collecting the data.

It emerged from the study that there were various perspectives of novice teachers about the impact of blended teaching on learning mathematics. These included the impact of load-shedding, benefits of blended teaching, perceptions of novice teachers, and hindrances of BT. Novice teachers from both private and public schools ascribed their perceptions of the challenges associated with blended teaching tools. Anticipations are that the findings of this study will give curriculum designers, district directors, school management teams, and mathematics teachers a clear overview of how these perceptions could be addressed across the board.

REFERENCES

Adil, M., Nagu, N., Rustam, A., & Winarsih, E. (2022). Interpretive Paradigm on Development of Science and Accounting Research. *International Journal of Humanities Education and Social Sciences (IJHESS)*, *1*(4).

Ahmadi, Dr. M. R. (2018). The Use of Technology in English Language Learning: A Literature Review. *International Journal of Research in English Education*, *3*(2), 115–125. https://doi.org/10.29252/ijree.3.2.115

Al-Huneidi, A. M., & Schreurs, J. (2012). Constructivism Based Blended Learning in Higher Education. *International Journal of Emerging Technologies in Learning*, *7*(1), 4–9. https://doi.org/10.3991/ijet.v7i1.1792

Almusharraf, N. M., & Khahro, S. H. (2020). Students' Satisfaction with Online Learning Experiences during the COVID-19 Pandemic. *International Journal of Emerging Technologies in Learning*, *15*(21), 246–267. https://doi.org/10.3991/ijet.v15i21.15647

Babbie, E. & Mouton, J. (2018). The practice of social research. Cape Town: Oxford University Press. Bertram, C. & Christiansen, I. (2021). Understanding research: An introduction to reading research (2nd Edition). Pretoria: Van Schaik.

Bertram, C. & Christiansen, I., (2020). Understanding research: an introduction to reading research 2nd ed. Pretoria: Van Schaik.

Blanchard, P.N. & Thacker, J.W. (2013). Effective Training Systems, Strategies and Practices. New Jersey: Pearson Education.

Bless, C., Higson-Smith, C. & Sithole, S. L. (2020). Fundamentals of social research methods: An African perspective. Cape Town: Juta.

Borba M.C., Askar P., Engelbrecht J., Gadanidis G., Llinares S., & Aguilar M.S. (2017). Proceedings of the 13th International Congress on Mathematical Education ICME-13 Monographs. In Gabriel K. (Ed.), *Digital Technology in Mathematics Education: Research over the Last Decade* (pp. 221–287). SpringlerOpen. http://www.springer.com/series/15585

Bougie, R., & Sekaran, U., (2020). Research methods for business: a skills building approach 8th ed. New Jersey: Wiley.

Brutus, S. (2019). Self-reported limitations and future directions in scholarly reports: analysis and recommendations. Journal of Management, 39: 48–75.

Bryman, A. (2016). Social research methods. Oxford: Oxford University Press.

Carter, C. (2018). Successful dissertations: The complete guide for education, childhood and early childhood studies students (2nd Edition). London: Bloomsbury Publishing.

Chase, S. (2018). Narrative inquiry: Towards theoretical and methodological maturity. In Denzin, N.K. & Lincoln, Y.S. (Eds). The SAGE handbook of qualitative research (5th Edition). California: SAGE.

Chirinda, B., Ndlovu, M., & Spangenberg, E. (2021). Teaching mathematics during the COVID-19 lockdown in a context of historical disadvantage. *Education Sciences*, *11*(4). https://doi.org/10.3390/educsci11040177

Chirinda, B., Ndlovu, M., & Spangenberg, E. (2021). Teaching mathematics during the COVID-19 lockdown in a context of historical disadvantage. *Education Sciences*, *11*(4). https://doi.org/10.3390/educsci11040177

Cohen, L., Manion, L. & Morrison, K. (2018). Research methods in education. London: Routledge.

Cohen, L., Manion, L. & Morrison, K. (2019). Research methods in education. London: Routledge.

Creswell, J. & Plano Clark, V. (2018). Designing and conducting mixed methods research. California: SAGE.

Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, Mixed Methods approaches (4 th Edition). SAGE.

Creswell, J.W. (2017). Research design: Qualitative, quantitative and mixed methods approaches (4th Edition). Los Angeles: SAGE.

Cronje, J. C. (2020). Towards a new definition of blended learning. *Electronic Journal of E-Learning*, *18*(2), 114–135. https://doi.org/10.34190/EJEL.20.18.2.00

Dane, F.C. (2018). Evaluating research: Methodology for people who need to read research (2nd Edition). London: SAGE.

DeJonckheere, M., & Vaughn, L. M. (2019). Semi structured interviewing in primary care research: A balance of relationship and rigour. *Family Medicine and Community Health*, *7*(2). https://doi.org/10.1136/fmch-2018-000057

Denzin, N.K. & Lincoln, Y.S. (Eds.). (2018). The SAGE handbook of qualitative research (5th Ed). California: SAGE.

Devlin, A. S. (2018). The research experience. Planning, conducting and reporting research. London: SAGE.

Du Plooy-Cilliers, F. (2019). Research paradigms and traditions. In Du Plooy-Cilliers, F., Davies, C. & Bezuidenhout, R.M. eds. Research matters. Claremont: Juta.

Durdella, N. (2019). Qualitative dissertation methodology: A guide for research design and methods. California: SAGE.

Edelen, D., & Skukauskaitė, A. (2022). Untangling constructionisms: Social constructions of qualitative research pedagogies. In *Engaging students in socially constructed qualitative research pedagogies* (pp. 21-41). Brill.

Elias, M.J. & Theron, L.C. (2018). Linking purpose and ethics in thesis writing: South African illustrations of an international perspective. In Maree, J.G. Complete your thesis or dissertation.

Eller, W.S., Gerber, B.J. & Robinson, S. (2018). Public administration research methods: Tools for evaluation and evidence-based practice. London: Routledge.

Eppard, J., & Rochdi, A. (2017). *A Framework for Flipped Learning.*

Eze, R., Masha, A. K. & Seeletso, M. (2022). Key steps in presenting the summary of a study. In Adu, E. & Okeke, C. I. (Eds.) Fundamentals of research in humanities, social sciences and science education: A practical step-by-step approach to a successful research journey. Pretoria: Van Schaik.

Ferreira, R. (2018). Writing a research proposal. In Maree, K. (Ed.). (2018). Complete your thesis or dissertation successfully: Practical guidelines. Cape Town: Juta.

Fouché, , C.B. & Delport, C.S.L. (2018). Introduction to the research process. In De Vos, A.S., Strydom, H., Fouché, C.B. & Delport, C. S. L. Research at grassroots for the social sciences and human service professions. Pretoria. Van Schaik.

Garrison, D. R. (2022). Shared Metacognition in a Community of Inquiry. *Online Learning Journal*, *26*(1), 6–18. https://doi.org/10.24059/olj.v26i1.3023

Gaudet, S. & Robert, M. (2018). A journey through qualitative research: From design to reporting. London: SAGE.

Gómez Chova, Louis., López Martínez, A., & Candel Torres, I. (2021). 13th International Conference on Education and New Learning Technologies, 5th-6th July, 2021. online proceedings. 10179–10189.

Gunawan, F., Nababan, M. R., Syukri, H., & Burdah, I. (2022). Revisiting interpretive translation method: A case study of Muhammad Thalib's Quranic translation. *Jordan Journal of Modern Languages and Literatures*, *14*(1), 111-127.

Headmaster. (2018). Hatfield Christian School Prospectus: Training leaders to Serve Nations. *Online*, 1–16.

Hennink, M., Hutter, I. and Bailey, A., (2020). Qualitative research methods. Sage.

Hennink, M., Hutter, I. and Bailey, A., (2022). Qualitative research methods. Sage.

Hoftsee, E. (2018). Constructing a Good Dissertation: A Practical Guide to Finishing a Masters, MBA or PhD on Schedule.

Horn, M., & Staker, H. 2017. The rise of K–12 blended learning. Retrieved from http://www.projectred.org/uploads/The-Rise-of-K-12-Blended-Learning.pdf (Accessed May, 4, 2021)

Ḥusaynī, S. H. & Rajabī, M. R. (2022). The semantic and epistemological position of mystery from the viewpoints of Gabriel Marcel and Muṣṭafā Malikiyān. Journal of Contemporary Islamic Studies, 4(1): 129-138.

Irfan, M., Kusumaningrum, B., Yulia, Y., & Widodo, S. A. (2020). Challenges During The Pandemic: Use Of E-Learning In Mathematics Learning In Higher Education. *Infinity Journal*, *9*(2), 147. https://doi.org/10.22460/infinity.v9i2.p147-158

Irfan, M., Kusumaningrum, B., Yulia, Y., & Widodo, S. A. (2020). Challenges During The. *Infinity Journal*, *9*(2), 147. https://doi.org/10.22460/infinity.v9i2.p147-158

Iris Padilla, B., & Evans Kreider, K. (2018). *Community of Inquiry Framework for Advanced Practice Nursing Students*. www.npjournal.org

Iris Padilla, B., & Evans Kreider, K. (2018). *Community of Inquiry Framework for Advanced Practice Nursing Students*. www.npjournal.org

Johnson, B. & Christensen, L. (2020). Educational Research: Quantitative, qualitative and mixed methods approaches. Los Angeles: SAGE.

Kilis, S., & Yıldırım, Z. (2018). Investigation of community of inquiry framework in regard to self-regulation, metacognition and motivation. *Computers and Education*, *126*, 53–64. https://doi.org/10.1016/j.compedu.2018.06.032

Kivunja, C. (2018). Distinguishing between theory, theoretical framework, and conceptual framework: A systematic review of lessons from the field. *International Journal of Higher Education*, *7*(6), 44–53. https://doi.org/10.5430/ijhe.v7n6p44

Kumar, R. (2018). Research methodology: A step-by-step guide for beginners (5th Edition). London: SAGE.

Kumar, R. (2019). Research methodology: A step-by-step guide for beginners (5th Edition). London: SAGE.

Kumar, R. (2020). Research methodology: A step-by-step guide for beginners (5th Edition). London: SAGE.

Leavy, P. (2017). Research design: quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches. New York: Guilford Press.

Leedy, P.D. & Ormrod, J.E. (2021). Practical research: Planning and design (12th Edition). New Jersey: Prentice Hall.

Li, W., Lipping, P. & Khan, Q. (2018). Research methods in education. London: SAGE.

Linake, M., Maphosa, C. & Mthethwa-Kunene, K. E. (2022). The synergy between paradigms and research approaches. In Adu, E. & Okeke, C. I. (Eds.) Fundamentals of research in humanities, social sciences and science education: A practical step-by-step approach to a successful research journey. Pretoria: Van Schaik.

Louw, L. (2021). Managerial competencies. In Hellriegel, D., Slocum, J., Jackson, S.E., Louw, L., Staude, G., Amos, T., Klopper, H.B., Louw, M., Oosthuizen, T., Perks, S. & Zindiye, S. Management (5th Edition). Cape Town: Oxford University Press Southern Africa.

Lowe, D. 2019. Roadmap of a blended learning model for online faculty development. *Invited feature article in distance education report*, 17(6), 1–7.

Lumadi, M. W. (2022). Writing limitations, recommendations and suggestions for further studies. In Adu, E. & Okeke, C. I., (eds.) Fundamentals of research in humanities, social sciences and science education: A practical step-by-step approach to a successful research journey. Pretoria: Van Schaik.

Macqueen, K. M., Guest, G., & Namey, E. (2005). *Qualitative Research Methods: A Data Collector's Field Guide, Natasha Mack & Cynthia Woodsong.* www.fhi360.org.

Makamure, C. (2016). *Learning to teach secondary school mathematics from practice: An exploration of the Zimbabwean pre-service teachers' year-long field experiences*.

Mal, B. C., & Adhya, D. H. (2020). Constructivism-Based Blended Teaching Learning for Transforming Indian Higher Education Bimal Chandra Mal Association of Indian Universities New Delhi (India).

Malinina, I. (2013). Blended Learning as an Effective Mean to Increase Motivation for Studying English as a Second Language.

Maree K. (2016). *First Steps in Research* (J.W. Creswell, L. Ebersohn, I. Eloff, R. Ferreira, N.V. Ivankova, J.D. Jansen, J. Nieuwenhuis, J. Pietersen, & V.L. Plano Clark, Eds.; Second Edition). Van Schaik.

Maree, K. (2020). *First Steps in Research* (J.W. Creswell, L. Ebersohn, I. Eloff, R. Ferreira, N.V. Ivankova, J.D. Jansen, J. Nieuwenhuis, J. Pietersen, & V.L. Plano Clark, Eds.; Second Edition). Van Schaik.

Maree, K. (2022). *First Steps in Research* (J.W. Creswell, L. Ebersohn, I. Eloff, R. Ferreira, N.V. Ivankova, J.D. Jansen, J. Nieuwenhuis, J. Pietersen, & V.L. Plano Clark, Eds.; Second Edition). Van Schaik.

Matshaphalala, M.D.J. (2017). The ethical intelligence imperative in public administration research. Journal of Public Administration, 52(1.1): 297-304.

Mavani, D. P. 2016. A critical analysis of whether visualisation capabilities in dynamic geometry software develop meaning making in terms of conceptual and procedural understanding of mathematical concepts in selected Grade 11 learners. Unpublished University Proposal.

McNabb, D.E. (2018). Research methods in public administration and non-profit management (4th Ed). London: Routledge.

Menon, S., Suresh, M., & Raghu Raman, R. (2022). Curriculum agility in higher education. *Journal of Further and Higher Education*, 1-20.

Moate, R. M., & Cox, J. A. (2015). Learner-Centered Pedagogy: Considerations for Application in a Didactic Course. *The Professional Counselor*, *5*(3), 379–389. https://doi.org/10.15241/rmm.5.3.379

Mooi, E., Sarstedt, M. & Mooi-Reci, I. (2018). Market research: The Process, Data, and Methods Using Stata. Melbourne: Springer.

Morgan, B. & Sklar, R. (2018). Sampling and research paradigms. In Maree, K. (Ed.). (2018). Complete your thesis or dissertation successfully: Practical guidelines. Cape Town: Juta.

Mpungose, C. B. (2020). Is Moodle a Platform to Decolonise the University Curriculum? Lecturers' Reflections. *Africa Education Review*, *17*(1), 100–115. https://doi.org/10.1080/18146627.2018.1479645

Muhajirah, M. (2020). Basic of learning theory:(behaviorism, cognitivism, constructivism, and humanism). *International Journal of Asian Education*, *1*(1), 37-42.

Nardi, P.M. (2018). Doing survey research: A guide to quantitative methods. London: Routledge.

Neuman, L. (2014). Social research methods: Qualitative and quantitative approaches (7th Ed). Essex: Pearson.

Nieuwenhuis, J. (2020). Introducing qualitative research. In Maree, K. (ed.) First steps in research (3rd Edition). Pretoria: Van Schaik.

Nieuwenhuis, J. (2022). Introducing qualitative research. In Maree, K. (Ed.). First steps in research. Pretoria: Van Schaik.

Nortvig, A. M., Petersen, A. K., & Balle, S. H. (2018). *A Literature Review of the Factors Influencing E-Learning and Blended Learning in Relation to Learning Outcome, Student Satisfaction and Engagement*. *16*(1), 46–55. www.ejel.org

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, *16*(1). https://doi.org/10.1177/1609406917733847

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, *16*(1). https://doi.org/10.1177/1609406917733847

O.Nyumba, T., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution*, *9*(1), 20–32. https://doi.org/10.1111/2041-210X.12860

O'Sullivan, E., Rassel, G., Berner, M. & Taliafero, J.D. (2017). Research methods for public administrators (6th Edition). London: Routledge.

Oosthuizen, I.J., Smit, M.H., Roussow, J.P., Van Der Bijl, A.J & Oosthuizen, 2020. Aspects of education law. 1st ed. Pretoria: Van Schaik Publishers.

Oyedele, V. I. (2016). Factors that Affect Professional Development in Education on Teacher Efficacy in Chipinge District High Schools. www.idpublications.org

Pascoe, G. (2019). Sampling. In du Plooy-Cilliers, F., Davis, C. & Bezuidenhout, R. Research matters. Cape Town: Juta.

Patten, M.L. & Newhart, M. (2018). Understanding research: An overview of the essentials (10th Edition). New York: Routledge

Patton, M.Q. 2015. Qualitative research and evaluation methods (4th Edition). California: SAGE.

Persky, A. M., & McLaughlin, J. E. (2017). The flipped classroom – from theory to practice in health professional education. In *American Journal of Pharmaceutical Education* (Vol. 81, Issue 6). American Association of Colleges of Pharmacy. https://doi.org/10.5688/ajpe816118
Polit, D.F. & Beck, C.T. (2020). Nursing research: Generating and assessing evidence for nursing practice. Philadelphia: Wolters Kluwer.

Rahi, S. (2017). Research Design and Methods: A Systematic Review of Research Paradigms, Sampling Issues, and Instruments Development. *International Journal of Economics & Management Sciences*, *06*(02). https://doi.org/10.4172/2162-6359.1000403

Sahni, J. (2019). Does Blended Learning Enhance Student Engagement? Evidence from Higher Education. *Journal of E-Learning and Higher Education*, *2019*, 1–14. https://doi.org/10.5171/2019.121518

Salkind, N. J. (2019). Exploring research. London: Pearson.

Saunders, L., Lewis, P., Thornhill, A. & Bristow, M. (2019). Understanding research philosophy and approaches to theory development. In Saunders, M., Lewis, P. & Thornhill, A. (Eds.). Research methods for business students. London: Pitman Publishing.

Saunders, M. & Lewis, P., (2018). Doing research in business and management: an essential guide to planning your project. London: Pearson.

Schunk, D. H. (2012). Learning theories: an educational perspective. Pearson.

Seabi, J. (2018). Research designs and data collection techniques. In Maree, J.G. K. (Ed.). Complete your thesis or dissertation successfully: Practical guidelines. Cape Town: Juta.

Sharp, J.A., Peters, J. & Howard, K. (2016). The management of a student research project (3rd Edition). London: Routledge.

Sotuku, N. & Duku, S. (2015) Ethics in human sciences research. In Okeke, C. & Van Wyk, M. (2015). Educational research: An African perspective. Cape Town: Oxford University Press Southern Africa.

Tshabangu, I. (2015). Interpretive research: Construction of meanings. In Okeke, C. & Van Wyk, M. (2015). Educational research: An African perspective. Cape Town: Oxford University Press.

van Niekerk, J., & Webb, P. (2016). The effectiveness of brain-compatible blended learning material in the teaching of programming logic. *Computers and Education*, *103*, 16–27. https://doi.org/10.1016/j.compedu.2016.09.008

Van Wyk, M. (2015). Afrocentricity as a research philosophy. In Okeke, C. & Van Wyk, M. Educational research: An African perspective. Cape Town: Oxford University Press Southern Africa.

Walliman, N. (2018). Research methods: The basics (2nd Edition). London: Routledge.

Wild, J. & Diggines, C. (2015). Marketing research (3rd Edition). Cape Town: Juta.

Wolhuter, C. (2022). Identification and selection of a research topic. In Adu, E. & Okeke, C. I. (Eds.) Fundamentals of research in humanities, social sciences and science education: A practical step-by-step approach to a successful research journey. Pretoria: Van Schaik.

Wu, L., & You, J. S. (2022). Synchronous or Asynchronous Course: Business Students' Perspectives on an Optimized Modality of Online Teaching and Learning. *Journal of Marketing Education*, *44*(2), 265–284. https://doi.org/10.1177/02734753221093740

Yin, R. 2018. Case study research and applications designs and methods, 6th ed. Singapore: SAGE.

Yousufi, U. (2020). An Integrative Review of Flipped Classroom Model. *American Journal of Educational Research*, *8*(2), 90–97. https://doi.org/10.12691/education-8-2-4

Yustina, Syafii, W., & Vebrianto, R. (2020). The effects of blended learning and project-based learning on pre-service biology teachers' creative thinking skills through online learning in the COVID-19 pandemic. *Jurnal Pendidikan IPA Indonesia*, *9*(3), 408–420. https://doi.org/10.15294/jpii.v9i3.24706

Zikmund, Babin, B.J., Carr, J.C. & Griffin, M. (2019). Business research methods. South Western: Cengage Learning.

Zinovieva, I. S., Artemchuk, V. O., Iatsyshyn, A. v., Romanenko, Y. O., Popov, O. O., Kovach, V. O., Taraduda, D. v., & Iatsyshyn, A. v. (2021). The use of MOOCs as additional tools for teaching NoSQL in blended and distance learning mode. *Journal of Physics: Conference Series*, *1946*(1). https://doi.org/10.1088/1742-6596/1946/1/012011

APPENDIX A: Ethical Clearance Approval

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS UV

GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

17-Mar-2022

Dear Mr Lukholo Raxangana

Application Approved

Research Project Title:
PERSPECTIVES OF NOVICE TEACHERS ABOUT THE IMPACT OF BLENDED TEACHING ON LEARNING OF MATHEMATICS

Ethical Clearance number:
UFS-HSD2022/0035/22

We are pleased to inform you that your application for ethical clearance has been approved. Your ethical clearance is valid for twelve (12) months from the date of issue. We request that any changes that may take place during the course of your study/research project be submitted to the ethics office to ensure ethical transparency. furthermore, you are requested to submit the final report of your study/research project to the ethics office. Should you require more time to complete this research, please apply for an extension. Thank you for submitting your proposal for ethical clearance; we wish you the best of luck and success with your research.

Yours sincerely

Dr Adri Du Plessis
Chairperson: General/Human Research Ethics Committee

Dr Adri du Plessis
Digitally signed by Dr Adri du Plessis
Date: 2022.03.17 13:54:32 +02'00'

205 Nelson Mandela Drive
Park West
Bloemfontein 9301
South Africa

P.O. Box 339
Bloemfontein 9300
Tel: +27 (0)51 401 9337
duplessisA@ufs.ac.za
www.ufs.ac.za

APPENDIX B: Permission to Conduct Research Approval

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

Enquiries: Ms. M.A Mosia
Sub-Directorate: ISSP- Policy and Planning
Tel: (016) 594 92 81
Cell: 066 487 2663
Ref: ISSP- P & P

TO	:	**PRINCIPALS OF 4 SELECTED HIGH SCHOOLS IN SW DISTRICT**
FROM	:	**DISTRICT DIRECTOR: T.I MASEKO**
DATE	:	**24 JANUARY 2022**
RE	:	**PERMISSION TO ALLOW THE RESERCHER TO CONDUCT RESEARCH IN 4 SELECTED HIGH SCHOOLS IN SW DISTRICT**

Dear Colleagues

This letter serves to confirm that Raxangana L is a master's student at University of Free State in Mathematics faculty. He has been granted the approval by Head office to conduct research in 4 high schools of his choice in Sedibeng West District.

Therefore, permission is hereby granted for him to conduct research project in 4 high schools of his choice in SW District, on the topic: **Perspectives of novice teacher about the impact of blended teaching on learning of Mathematics.**

However Kindly note that prior arrangements must be done to avoid the disruptions of learning and teaching, all arrangements must be done through the office of the principal.

Regards.

Mr T.I Maseko
Acting District Director
Date: 24/1/2022

Office of the District Director: Sedibeng West
6 Samuel Street, Zone 18, Sebokeng I Private Bag X067, Vanderbijlpark, 1900
Tel: 016 594 9120 I Fax: 016 594 9399
Website: www.education.gpg.gov.za

APPENDIX C: Consent to Participate in Semi-Structured Interviews

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV

CONSENT TO PARTICIPATE IN THIS STUDY

I, the undersigned,

_____ (*participant's full names to be included*), (the "**Participant**")

confirm that I voluntarily agree to participate in the research study referred to as the

_____ (the "**Study**") in relation to

_____

and which Study is being conducted by

__Lukholo Raxangana _____

(*insert the name of the researcher*), (the "**Researcher**").

I, the undersigned Participant, further confirm that–

1. the Researcher has explained the nature, procedure, potential benefits and anticipated inconvenience of my participation in the Study;
2. I have read (or had explained to me) and understood the Study as explained in the attached information sheet;
3. I have had sufficient opportunity to ask questions and am prepared to participate in the Study;
4. I understand that my participation in the Study is entirely voluntary and that I am free to withdraw at any time without penalty (if applicable);
5. I voluntarily provide the UFS and the Researcher with my personal information and consent to the UFS and the Researcher collecting, disclosing and processing my personal information in order to conduct the Study and any related activities in relation thereto;
6. I hereby acknowledge and confirm that I understand the purpose for which the UFS and the Researcher may collect, store, use, delete, destroy, outsource, transfer or otherwise process, as the context and circumstances may require and as contemplated in terms of POPIA, my personal information as set out herein;
7. I am aware that the findings of the Study will be anonymously processed into a research report, journal publications and/or conference proceedings and that my personal information will be aggregated and deidentified at such stage;
8. I also give the UFS permission to share, without notification, the collected data with other researchers at the UFS or other Higher Education Institutions. This permission is dependent on the same principles of ethical research practices, anonymity/confidentiality, safekeeping of information, and other issues listed above applying.

I, the Participant, agree to the recording of the semi – structured *interviews*.

Full Name of Participant: _____
Signature of Participant: _____ Date: _____
Full Name(s) of Researcher(s): _____
Signature of Researcher: _____Date: _____

APPENDIX D: Consent to participate in Focus Group interviews

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV

CONSENT TO PARTICIPATE IN THIS STUDY

I, the undersigned,

_____ (*participant's full names to be included*), (the "**Participant**")

confirm that I voluntarily agree to participate in the research study referred to as the

_____ (the "**Study**") in relation to

_____

and which Study is being conducted by

_____Lukholo Raxangana _____

(*insert the name of the researcher*), (the "**Researcher**").

I, the undersigned Participant, further confirm that–

1. the Researcher has explained the nature, procedure, potential benefits and anticipated inconvenience of my participation in the Study;
2. I have read (or had explained to me) and understood the Study as explained in the attached information sheet;
3. I have had sufficient opportunity to ask questions and am prepared to participate in the Study;
4. I understand that my participation in the Study is entirely voluntary and that I am free to withdraw at any time without penalty (if applicable);
5. I voluntarily provide the UFS and the Researcher with my personal information and consent to the UFS and the Researcher collecting, disclosing and processing my personal information in order to conduct the Study and any related activities in relation thereto;
6. I hereby acknowledge and confirm that I understand the purpose for which the UFS and the Researcher may collect, store, use, delete, destroy, outsource, transfer or otherwise process, as the context and circumstances may require and as contemplated in terms of POPIA, my personal information as set out herein;
7. I am aware that the findings of the Study will be anonymously processed into a research report, journal publications and/or conference proceedings and that my personal information will be aggregated and deidentified at such stage;
8. I also give the UFS permission to share, without notification, the collected data with other researchers at the UFS or other Higher Education Institutions. This permission is dependent on the same principles of ethical research practices, anonymity/confidentiality, safekeeping of information, and other issues listed above applying.

I, the Participant, agree to the recording of the *focus group discussions*.

Full Name of Participant: _____

Signature of Participant: _____ Date: _____

Full Name(s) of Researcher(s): _____Lukholo Raxangana_____

Signature of Researcher: _____Date: ____2022/02/28

APPENDIX E: Semi-Structured Schedule

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
EDUCATION
OPVOEDKUNDE

SEMI – STRUCURED INTERVIEW SCHEDULE (PROVISIONAL)

The following items based on proposed main questions will be asked during the semi – structured interviews.

1. What do you understand about blended teaching on learning of mathematics?
2. How do you find load shedding a hinderance to Blended teaching on learning of mathematics in your classroom? Is it announced?
3. What are the benefits of blended teaching on learning of mathematics?
4. What do you think are the possible resources used in Blended teaching? List them.
5. Are learners disciplined during the execution of Blended teaching? Explain.
6. How do you find blended teaching tools beneficial on learning mathematics? Please provide examples.
7. How did you use blended teaching (BT) to recall prior knowledge in learning of Mathematics? Please provide examples.
8. How frequent i.e. (no of times) do you use blended teaching in your mathematics classroom?
9. How do you make the link of visual representation using blended teaching on learning of mathematics? Please provide examples.
10. Which strategies do you employ to execute blended teaching? List them.
11. How did blended teaching equip you so that you can teach Mathematics even in the absence of using this Blended teaching tools? Please elaborate and provide examples.
12. In your view and personal experience, did blended teaching add value to the conceptual understanding of Mathematics? Please elaborate and provide examples.
13. Based on your experience, what were some limitations you identified when using Blended teaching in your teaching? Please elaborate.
14. How do Blended teaching on learning of mathematics assist you as the teacher?

The End

Thank you for your participation

APPENDIX F: Focus Group Interview Guide

NOVICE TEACHERS FOCUS GROUP INTERVIEW GUIDE (PROVISIONAL)

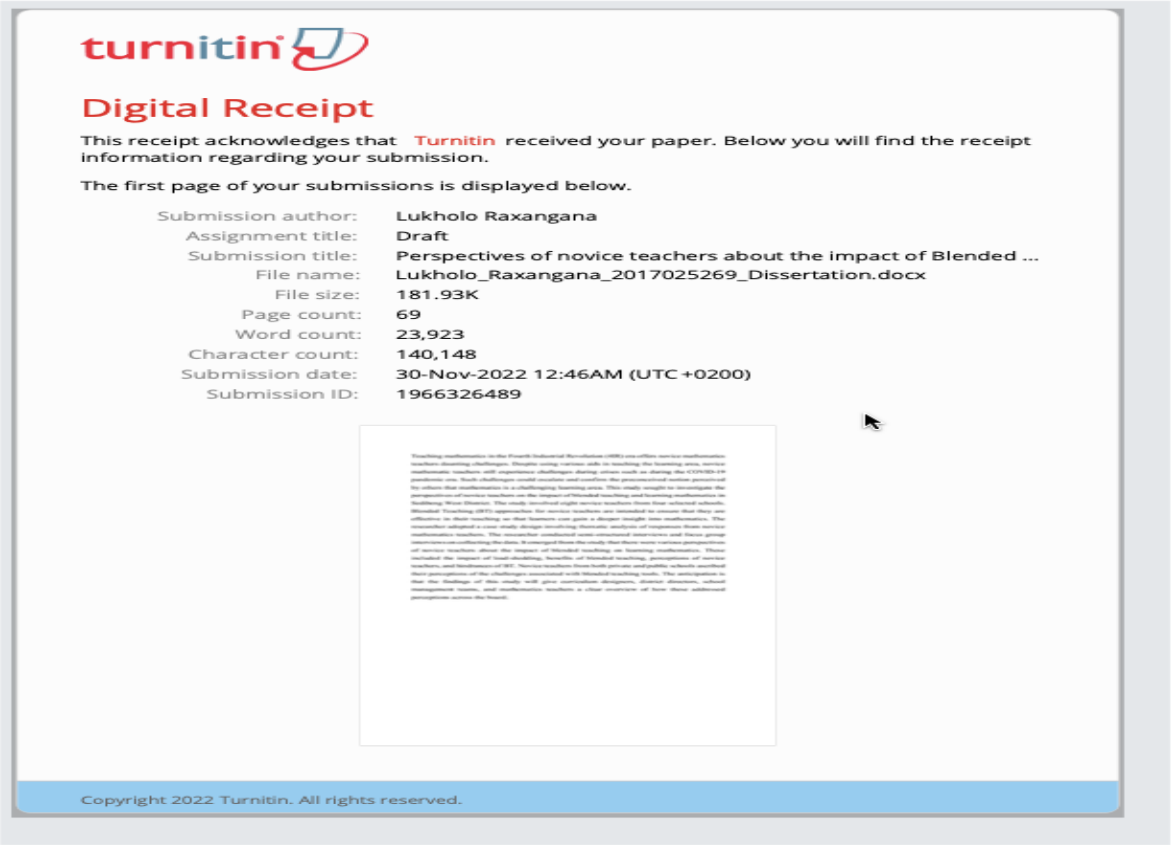
The following are the types of questions I will ask during the focus group interviews.

1. Do you experience any load shedding problems in your school that hinder execution of blended teaching? If yes, is it announced?
2. Do you have enough resources to execute blended teaching? List them.
3. Do you find any discipline issues when executing blended teaching? If yes, explain.
4. Do you find any limitations when teaching using blended teaching tools? If yes, How?
5. Do you find blended teaching useful for your learners to understand mathematics? If yes, How?
6. Do you use blended teaching (BT) in your teaching of mathematics? If yes, how?
7. Is blended teaching equipping you a teacher so that you can even teach mathematics in the absence of blended teaching tools? If yes, elaborate.
8. Do you make link of mathematics visual representation using blended teaching? If yes, How?
9. What strategies do you employ to execute blended teaching? mention them.
10. Based on your personal experience, does blended teaching add value to the conceptual understanding of Mathematics? If yes, How?
11. Is blended teaching assisting you as a teacher in teaching mathematics? If yes, How?

The End

Thank you for your participation

APPENDIX G: Turnitin Receipt and Report



turnitin

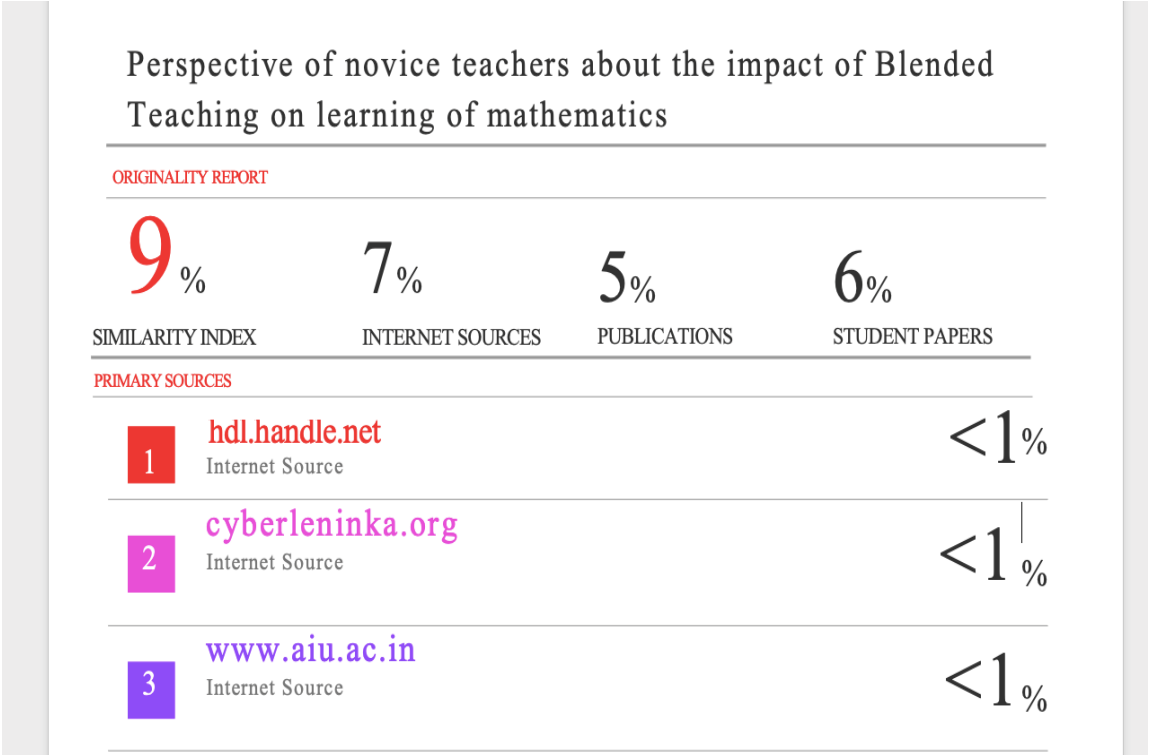
Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Lukholo Raxangana
Assignment title:	Draft
Submission title:	Perspectives of novice teachers about the impact of Blended ...
File name:	Lukholo_Raxangana_2017025269_Dissertation.docx
File size:	181.93K
Page count:	69
Word count:	23,923
Character count:	140,148
Submission date:	30-Nov-2022 12:46AM (UTC +0200)
Submission ID:	1966326489

Copyright 2022 Turnitin. All rights reserved.



Perspective of novice teachers about the impact of Blended Teaching on learning of mathematics

ORIGINALITY REPORT

9%	7%	5%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	hdl.handle.net Internet Source	<1%
2	cyberleninka.org Internet Source	<1%
3	www.aiu.ac.in Internet Source	<1%