

**The effectiveness of smart board in enhancing Grade 6 Technology
teachers' creativity at Nkomazi East Circuit in Mpumalanga
Province, South Africa**

By

NDWANDWE KHANYISILE PRECIOUS



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Supervisor: Prof. M. S. Ramaligela

Co-supervisor: Dr. T. I. Mtshali

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ABSTRACT

Creativity is very important in education as it makes learners to fully concentrate throughout the learning and teaching process. Hence, the purpose of this study was to explore the effectiveness of a smart board in enhancing Grade 6 Technology teachers' creativity at Nkomazi East Circuit in Mpumalanga Province. The theory of creativity was used as a lens in the study, and the 9E instructional model was used to guide and understand classroom activities. The qualitative research approach and the case study design were used to gather and analyse data. Data collection involved both non-participant observations and semi-structured interviews. Four schools with smart boards were purposively sampled. The participants of the study included four Technology teachers and eight learners. All four teachers were interviewed and observed teaching using the smart boards, while the eight learners participated in interviews. To analyse the data, the study used deductive content analysis.

The findings of the study revealed that smart boards are effective in enhancing teachers' creativity, as they were able to make their lessons more interesting, exciting and effective, and developed learners' creative thinking skills. They could access the internet to search for online resources which include but are not limited to diagrams, pictures, online quizzes and YouTube videos to creatively present their lessons in the classroom. Different smart board programmes such as the smart notebook, animation, PowerPoint presentations, as well as the show and hide features were also used to enhance creativity. With the help of the smart board, the teachers were also able to use a variety of teaching methods to correct learners' misconceptions and to develop their creative thinking skills. The study recommends that smart boards be utilised as a tool to enhance teachers' creativity, which ultimately develops learners' creative thinking skills. Future research may focus on investigating the extent to which smart board features improve learners' creative thinking skills and understanding of various topics.

Keywords: Effectiveness, smart board, enhancement, creativity, creative teaching, creative thinking, Technology, and teachers

DECLARATION

I NDWANDWE KHANYISILE PRECIOUS declare that the study titled “THE EFFECTIVENESS OF SMART BOARD IN ENHANCING GRADE 6 TECHNOLOGY TEACHERS’ CREATIVITY AT NKOMAZI EAST CIRCUIT IN MPUMALANGA PROVINCE” submitted to the University of Limpopo, as a requirement for the Master’s Degree in Technology Education, is my own work. This study has not been submitted to any university, college, institution of higher education or any other university by anyone. I, therefore, state with full confidence that it is my own work in design and execution, and that all material contained has been dully acknowledged.



NDWANDWE KHANYISILE PRECIOUS (Student)

26/06/2023

DATE



RAMALIGELA S.M (Supervisor 1)

27/06/2023

DATE



MTSHALI T.I. (Supervisor 2)

27/06/2023

DATE

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DEDICATION

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TABLE OF CONTENTS

ABSTRACT	I
DECLARATION.....	II
ACKNOWLEDGEMENT	III
DEDICATION.....	IV
TABLE OF CONTENTS	V
LIST OF TABLES	VIII
LIST OF FIGURES	IX
ACRONYMS.....	X
CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE STUDY	1
1.1 Background and motivation.....	1
1.2 Problem statement.....	5
1.3 Purpose of the study	6
Research questions	6
1.4 Objectives.....	Error! Bookmark not defined.
1.5 Research methodology.....	6
1.5.1 Research approach and design	6
1.5.2 Population and Sampling	7
1.5.3 Sampling	7
1.5.4 Data Collection Techniques	8
1.5.5 Data Analysis.....	9
1.6 Significance of the study.....	10
1.7 Chapter division.....	10
1.8 Summary of the chapter	12
CHAPTER 2: LITERATURE REVIEW AND THEORETICAL FRAMEWORK.....	13
2.1 Introduction	13
2.1.1 Teachers' perceptions of the effectiveness of the smart board in enhancing the teachers' creativity	13
2.1.2 The effectiveness of the smart board in enhancing the teachers' creativity.....	15
2.1.3 Learners' perceptions towards the use of the smart board.....	19

2.1.4	Theory of creativity	20
2.1.5	9E instructional model	21
2.2	Summary of the chapter	23
CHAPTER 3: RESEARCH METHODOLOGY.....		25
3.1	Introduction	25
3.2	Qualitative research approach	25
3.3	Case study design	26
3.4	Population	26
3.5	Sampling.....	26
3.6	Data collection techniques.....	28
3.6.1	Semi-structured interview	28
3.6.2	Non-participant observation	29
3.7	Data analysis	29
3.7.1	Semi-structured interviews.....	30
3.7.2	Non-participant observation	31
3.8	Trustworthiness of the qualitative research instruments	32
3.8.1	Credibility.....	32
3.8.2	Transferability	32
3.8.3	Dependability.....	33
3.8.4	Confirmability.....	33
3.9	Ethical considerations	33
3.10	Summary of the chapter	35
CHAPTER 4: DATA ANALYSIS AND DISCUSSION		37
4.1	Introduction	37
4.2	How the smart board can enhance the teachers' creativity?.....	37
4.2.1	Interesting lesson	38
4.2.2	Exciting lesson.....	44
4.2.3	Effective lesson	45
4.2.4	Develop learners' creative thinking skills.....	50
4.3	Summary of the findings	57

4.4	Summary of the chapter	58
CHAPTER 5: CONCLUSION AND RECOMMENDATION.....		60
5.1	Introduction	60
5.2	Conclusion	60
5.3	Limitations and recommendations	62
5.3.1	Limitations	62
5.3.2	Recommendations.....	62
5.4	Summary of the chapter	63
REFERENCES		64
ANNEXTURE A TOOL 1: SEMI-STRUCTURED INTERVIEW SCHEDULE (TEACHERS' INTERVIEW).....		74
ANNEXTURE B: TOOL 2: OBSERVATION SCHEDULE.....		75
ANNEXTURE C TOOL 3: SEMI-STRUCTURED INTERVIEW SCHEDULE (LEARNERS' INTERVIEW).....		77
ANNEXURE D: LETTER TO REQUEST PERMISSION TO CONDUCT RESEARCH		79
ANNEXURE E: LETTER TO REQUEST PERMISSION TO CONDUCT RESEARCH		80
ANNEXURE F: LETTER TO THE PRINCIPAL.....		81
APPENDIX A: ETHICAL CLEARANCE CERTIFICATE		82
APPENDIX B: APPROVAL LETTER FROM THE MPUMALANGA DEPARTMENT OF BASIC EDUCATION.....		83
APPENDIX C: APPROVAL LETTER FROM THE CIRCUIT MANAGER.....		84
APPENDIX D: ACCEPTANCE LETTER FROM THE PRINCIPALS.....		85
ANNEXURE G: PARENTS CONSENT FORM		88
ANNEXURE H: LEARNERS CONSENT FORM		89
ANNEXURE I: LEARNERS' LETTER OF ASSENT		90
ANNEXURE J: LETTER OF ASSENT TRANSLATED TO SISWATI LANGUAGE		91
APPENDIX E: EDITING PROOF		92

LIST OF TABLES

Table 1.1: smart board features and descriptions.....	4
Table 3.1: Description of the teachers (participants) according to gender, age, and experience in the use of the smart board and the qualifications	27
Table 3.2: Description of the learners according to gender, age group and year of experience using the smart board.....	30

LIST OF FIGURES

Figure 1.1: Diagram showing the features that are found in the smart board.....	3
Figure 2.1: Picture of a smart board.....	17
Figure 2.2: Creativity theory in collaboration with the 9E instructional model.....	23
Figure 4.1: Electric circuit diagram on a smart board.....	39
Figure 4.2: Electric circuit.....	47
Figure 4.3: Picture of a smart board showing summary video.....	51
Figure 4.4: Picture of a learner drawing an electric circuit.....	52
Figure 4.5: Free hand drawing of an electric circuit on smart notebook.....	53
Figure 4.6: Picture of a learner using a smart notebook.....	55
Figure 4.7 : Simple circuit.....	58

ACRONYMS

ICT -	Information Communication Technology
MST-	Mathematics, Science and Technology
DBE-	Department of Basic Education
MDBE-	Mpumalanga Department of Basic Education
SMT-	School Management Team
TREC -	Turfloop Research and Ethics Committee
RQ-	Research Question
NACCCE -	National Advisory Committee on Creative and Cultural Education
No-	Number
IWB-	Interactive White Board
CAPS-	Curriculum and Assessment Policy Document

CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Background and motivation

Creativity in the class is now the subject of great interest to teachers in many schools in the world (Hashimi, Muwali & Zaki, 2019). A study conducted by Chien and Hui (2010) focused on “Creativity in early childhood education: Teachers’ perceptions in three Chinese societies”. The study found that teachers are barriers to creativity and have an influence in improving factors of creativity. Henriksen, Richardson and Mehta (2017) highlighted that teachers are wrestling with thinking creatively about instructive issues of practice. Moreover, Nikolopoulou (2018) indicates that innovative teaching tools and current systems are not enough. Consequently, it is essential for educators to receive appropriate training to embrace innovations and to enhance creativity within educational institutions. Nonetheless, Wood and Ashfield (2008) discovered that teachers' utilisation of diverse forms of media, including videos, graphics, animations, and texts can enhance their ability to teach in a creative manner. Similarly, Eksi and Yesilyurt (2018) support the view that a smart board can motivate creativity by allowing teachers to present visual material supported by audio and animations. Moreover, the Curriculum and Assessment Policy Statements (CAPS) for technology education states that the subject stimulates learner’s innovativeness and develops their creative skills, which enhance their ability to use practical skills to solve real-life problems in order to improve their environment (DBE, 2011), which attests to the importance of creativity. Hence, this study seeks to explore how smart boards can enhance Technology teachers’ creativity in their classroom practice.

Currently, there is a growing level of interest in smart board technology, which is defined as an electronic board that shows data by being connected to a laptop or to a desktop device. Both teachers and learners can use the smart board by writing on it using a special pen or their fingers (Malkawi, 2017). Through the use of the board, teachers can record, replay and save their presentations of lessons (Malkawi, 2017). Smart boards have access to online resources which can help in searching for up-to-date contents on the World Wide Web. Furthermore, the board can be used to discuss topics in detail using various media forms such as images, videos, audios or even

power points (Mohite & Raverkar, 2021). Hence, a smart board is a great tool that can be used by Technology teachers to improve their creativity. Francis (2017) emphasises that learners have grown up with technology around them and teachers must adapt to this new lifestyle.

There are many studies on technology education globally. For instance, Neo and Neo's (2013) study explores learners' creativity and design skills through a multimedia project in a Malaysian classroom. Shubina and Kulakli (2019) examined pervasive learning and technology usage for creativity development in education. Alsaleh (2020) focused on teaching critical thinking skills, while Cropley (2020) looked at creativity-focused technology education in the age of industry. Similarly, there are many studies on Technology Education in South Africa. For example, Makgato (2012) conducted a study that identified constructivist methodologies, while Kola (2015) conducted a study on critical thinking skills. Nkosi's (2020) study explored creative thinking skills in a Grade 9 Technology classroom. Gumbo's (2020) study focused on an indigenous perspective of technology education, while Ramaligela's (2021) looked at pre-service Technology teachers' content and instructional knowledge. However, there is a dearth of research on the effectiveness of the use of the smart board in enhancing Technology teachers' creativity, especially in South Africa. Hence, this study explored the effectiveness of a smart board in enhancing Technology teachers' creativity in the classroom.

A smart board is a multimedia technology that allows the users to insert images, fonts, and thematic software programmes that can be used, viewed and manipulated by multiple people using a special stylus or their finger on the screen (De Vita, Verschaffel & Elen, 2017). The board has a software package that allows teachers to type and to highlight specific information. It increases or decreases the size of texts and images so that they are visible to all learners in the classroom (Hennessy & London, 2013). Additionally, the authors state that information can be presented in a way that allows content to be recorded. Interactive smart boards help to present content more easily, and increase students' engagement. They also reduce the workload, and use time more efficiently, while planning and organising lessons better (Ahmad, Muhammad & Bakhsh, 2021). The following is a diagram of a smart board showing features and a table showing features and descriptions of the board.

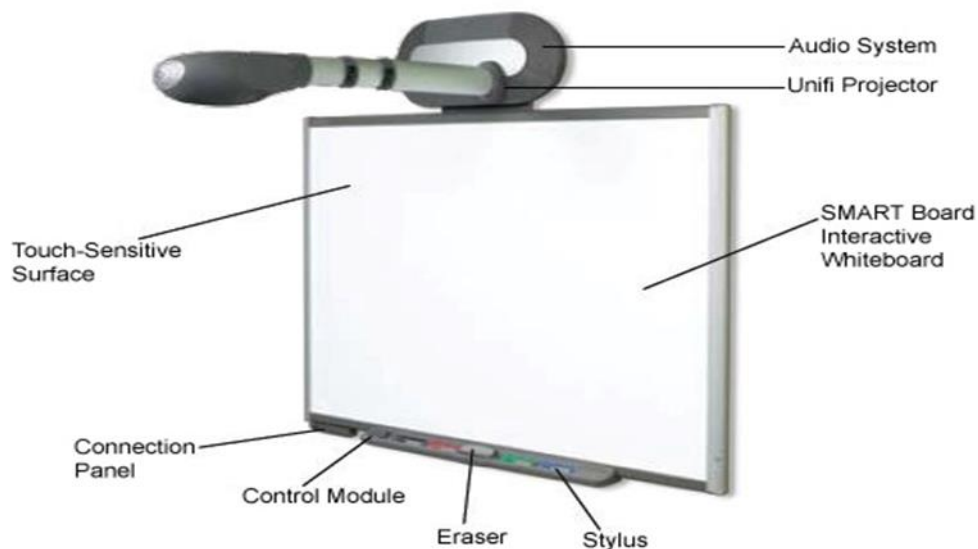


Figure 1.1: Diagram showing features of a smart board

To motivate the study, Nikolopoulou (2018) states that the promotion and improvement of creativity can be achieved by integrating new technologies like smart boards, provided that there is a comprehension of their potential and ample opportunities for learners to engage in various creative processes. Similarly, Page and Thorsteinsson (2017) comment that the connection between technology and creativity is a key issue to be considered in the 21st century's educational system. Hence, innovative tools like smart boards hold significant potential in fostering creative collaboration. For example, they enable the development of new applications for creating and sharing content, including videos, audios, images and websites. Platforms like YouTube provide space for diverse creators to share their content (Nikolopoulou, 2018). It was reported by Nonthamand (2020) that learners can exchange opinions and summarise content through a video conference. Smart boards allow the presentation of content in a visual form, thereby making concepts clearer (Tsayang et al, 2020). The following table (table 1.1) describes features of a smart board.

Table 1.1: Features of a smart board

Feature	Description
Interactive Touchscreen	A touch-sensitive display that allows users to interact with the board using their fingers or a stylus.
Pen and Gesture Recognition	The board can recognise different types of input, such as handwriting, drawing and gestures.
Multi-User Capability	Multiple users can simultaneously interact with the board, making it suitable for collaborative work.
Wireless Connectivity	The ability to connect wirelessly to other devices, such as computers, tablets or smartphones.
Digital Ink	Users can write or draw on the board using a digital pen or stylus, which provides a natural writing feel.
Integrated Audio	Built-in speakers or audio output ports to enhance multimedia presentations or video playback.
Screen Recording	The ability to record the screen and audio, allowing users to capture and share their presentations or lessons.
Object Recognition	The board can recognise objects placed on its surface, such as shapes, symbols or special markers.
Integrated Operating System	Some smart boards have an integrated operating system that offers additional features and applications.
Internet Connectivity	The board can connect to the internet, enabling access to online resources, content or collaborative tools.
File Sharing and Storage	Users can save, access and share files directly on the board, eliminating the need for external storage devices.
Built-in Apps and Software	Pre-installed applications and software designed for interactive learning, presentations or productivity.
Remote Control	Some smart boards come with a remote control that allows users to navigate or control the board from a distance.
Height Adjustability	The board can be adjusted in terms of height to accommodate users of different heights or preferences

1.2 Problem statement

In the past years, the Department of Basic Education (DBE) provided smart boards to most Mathematics, Science and Technology (MST) schools and their feeder schools in Mpumalanga Province. The boards were installed in Grade 6 classrooms to teach Mathematics, Science and the Technology subjects. The main purpose was to enhance effective teaching and learning, while preparing the learners for high school. However, Khoza, Kekana and Dlamini (2019) report that the boards in the feeder schools are rarely used by the teachers, partly because they are not sure of their benefits in teaching and learning. Some teachers think that the boards are there to replace them as authoritative sources of information, and ultimately, they will take away their jobs (Oriji & Amadi, 2016). The shortage of teacher training in creativity can be the motive why most teachers do not employ creative activities through the use of these boards in the classrooms (Mroz & Ocetkiewicz, 2021). The boards are, however, being utilised by the School Management Team (SMT) to review and analyse school results (Van Niekerk, 2015).

As a Technology teacher, the researcher realised that the smart boards are not used to teach and learn Technology. If used adequately, they could be great tools to teach creativity. In the researcher's school, the observation is that some teachers are not using the smart board. This was further confirmed by teachers in other schools. This experience was also identified by Oigara and Wallace (2012) that most teachers did not use the boards. In addition, there are very few teachers in schools that completely welcome the use of technologies, or prepared to learn how to use them in their classrooms (Oriji & Amadi, 2016). However, according to the researcher's experience as a teacher, teachers' reluctance to use technologies such as smart boards, especially during the Covid-19 pandemic process where online learning was encouraged frustrated an alternative way of assisting most of the learners to understand various concepts with ease. Researchers such as Ghavifekr, Kunjappan, Ramasamy and Anthony (2016) argue that lack of teachers who use Information Communication and Technology (ICT) tools in their classroom practice may further result in a lack of opportunities for more creativity in classrooms. Hence, this study sought to explore the effectiveness of smart boards in enhancing Technology teachers' creativity in the classroom.

1.3 Purpose of the study

The purpose of this study was to explore the effectiveness of the smart board in enhancing Grade 6 Technology teachers' creativity at Nkomazi East Circuit in Mpumalanga Province. To achieve the study purpose, the study was guided by the following research questions:

Main research question

- What is the effectiveness of the smart board in enhancing Grade 6 Technology teachers' creativity at Nkomazi East Circuit in Mpumalanga Province?

1.3.1 Research questions

- What are the teachers' perceptions of the effectiveness of the smart board in enhancing creativity in the teaching of Technology?
- How can a smart board enhance Technology teachers' creativity in the classroom?
- What are the learners' perceptions of the use of the smart board in the Technology classroom?

1.4 Research methodology

Research methodology is characterised as numerous techniques that are utilised in a review to gather information, which are then utilised as a reason for reference, examination, clarification and assessment (Best & Kahn, 2016). In this study, the research methodology was achieved by designing and conducting semi-structured interviews and non-participant observations with participants from four selected schools.

1.4.1 Research approach and design

1.4.1.1 Research approach

In this study, the qualitative research approach was employed. The purpose of using this approach was to gather comprehensive descriptive data concerning specific phenomena to gain a deeper understanding of the subject being investigated or observed (Merriam & Grenier, 2019). Additionally, Creswell (2013) defines qualitative research as a method that seeks to explore participants' viewpoints in order to comprehend the phenomenon being studied. Moreover, qualitative research enables

researchers to explore diverse perspectives within a community regarding a specific research topic (Choy, 2014). Furthermore, this study was exploratory in order to explore the effectiveness of a smart board in enhancing Technology teachers' creativity.

1.4.1.2 Research Design

A case study design was used to explore the effectiveness of the smart board in enhancing Technology teachers' creativity in the classroom. Using case studies, the researcher can explore the motives behind specific actions of participants, thus providing proof and findings (Rauch, van Doorn & Hulsink, 2014). In addition, the study used a multiple case study design, which allows the collection of complete data from multiple sources in a variety of locations (Unluer, 2012). The research design therefore drew together various case studies from four primary schools that were already using smart boards as teaching tools in Nkomazi East Circuit.

1.4.2 Population and Sampling

1.4.2.1 Population

According to Omona (2013), the term population refers to a group of individuals, objects or events from which the researcher can generalise and make them the focus of the study for their research findings. The target population of this study was Technology teachers and learners from primary schools at Nkomazi East Circuit in Mpumalanga Province. There are 15 primary schools at the circuit.

1.4.3 Sampling

Sampling is the procedure of selecting a predetermined number of participants from the entire population (Alvi, 2016). A method known as purposive sampling was used to select the participants. Purposive sampling allows the researcher to select relevant participants of the study (Guarte & Barrios, 2006). This method was used to ensure that only Technology teachers with knowledge of using the smart board participate in the study.

To explore the teachers' perceptions of the effectiveness of a smart board in enhancing their creativity, the study purposively selected four Technology teachers who were using smart boards in their classrooms from four primary schools within Nkomazi East Circuit in Mpumalanga Province. The four teachers were purposively

sampled to respond to Research question 1, which included interviews, and Research question 2 (RQ2). The teachers were selected based on their teaching experience of using the smart board, and their willingness to participate in the study. Lastly, to explore the effectiveness of the smart board in enhancing the teachers' creativity, the researcher interviewed eight learners based on their perceptions of the use of the smart board during the teaching and learning process (RQ3). The researcher purposively sampled Technology learners for interviews, which means there were two learners per teacher. Only learners who were good in using the smart board were selected.

1.4.4 Data Collection Techniques

As this was a qualitative study, the researcher conducted semi-structured interviews and non-participant observations with the participants. The researcher started by conducting semi-structured interviews with the teachers, then observed them when they were creatively teaching using the smart board. Lastly, the learners were interviewed.

1.4.4.1 Semi-Structured Interview

Cohen, Rogelberg, Allen and Luong (2011) define an interview as an instrument that gives participants an opportunity to share their clarification of the world they live in to make sense of circumstances according to their understanding. A semi-structured interview is defined as a verbal exchange in which the interviewer seeks to obtain information from another person by asking questions (Longhurst, 2003). The 9E instructional model together with the theoretical framework were used to develop the semi-structured interview schedule, which consisted of nine questions and was used to answer RQ1, which focused on Technology teachers' perceptions of the effectiveness of using the smart board in enhancing creativity. The interviews were conducted with the teachers.

To respond to RQ3, which focuses on learners' perceptions of the use of the smart board in the Technology classroom, the theoretical framework together with the 9E instructional model were used to develop the interview schedule which also consisted of nine questions. The interviews were conducted with the learners immediately after the classroom observations.

1.4.4.2 Non-Participant Observation

To respond to RQ2, which focuses on how a smart board can enhance Technology teachers' creativity in their classroom practice, the study employed non-participant observation, which involves the documentation of actions performed by an external observer who simply records these actions without engaging or interacting with the individuals being observed (Bless, Higson-Smith & Sithole, 2013). The researcher was able to collect primary data in a natural setting that had not been altered in any way through non-participant observations. The study's participants were observed by the researcher in their classrooms. During the observations, the observation schedule was filled, and notes were taken. Videos were also recorded in some of the schools. Based on the 9E, the observation schedule was created. In some schools, videos and pictures were taken to confirm the observation schedule.

1.4.5 Data Analysis

Data analysis is the process of a continuous review of what information is available to the researchers to deepen their understanding and meaning so that they are able to draw conclusions from the data (Noble & Smith, 2014). To analyse qualitative data, the researcher used data analysis steps as outlined by Mabuza, Govender, Ogunbanjo and Mash (2014), which involve familiarisation, the development of a thematic index, charting, interpretation and confirmation. The sections below outline how the collected data from the semi-structured interviews and non-participant observations were analysed.

1.4.5.1 Semi-structured interviews

To analyse semi-structured interviews, deductive content analysis was used. This is a content analysis method which is used when there are existing perspectives, prior research results, theories or conceptual frameworks concerning the phenomenon of interest (Mayring, 2014). Information obtained from semi-structured interviews was transcribed from the voice recorder into a word document and was stored in a computer file for analysis. The researcher quoted the participants. The data was coded into themes and categories and analysed based on the purpose of the study. The themes were derived from the theory of creativity, and categories from the 9E instructional model.

1.4.5.2 *Non-participant observation*

To analyse data from observations, the study used deductive content analysis, which allowed the researcher to initiate the analysis by employing predetermined categories established by the theory or previous research discoveries (Armat, Assarroudi, Rad, Sharifi and Heydari, 2018). The video data was manually transcribed into text form by quoting what was observed during the observation to provide a detailed description of information (Creswell, 2018). Data on the observation schedules was analysed and coded into themes and categories. The themes were drawn from the creativity theory, and the categories from the 9E instructional model. The themes and categories from the observation schedules were used to understand how a smart board can enhance the teachers' creativity.

1.5 Significance of the study

The study contributed to the literature on how to utilise a smart board to enhance teacher's creativity. The results of the study served as a secondary source for the identified gap, and provided solutions to the issues that other researchers in this area needed to address. This meant that other researchers were able to find information on the use of a smart board for creativity. The study guided the Department of Basic Education officials on how the board can enhance teachers' creativity. It provided a good understanding of how to stimulate learners' creative thinking skills in the Technology classroom. The study introduced teachers to a new teaching approach that encouraged creativity during the teaching and learning process, and assisted other researchers who sought to investigate the impact of using smart boards on teachers' creativity and engagement in the Technology classroom. Furthermore, the study assisted the Department of Basic Education to promote the implementation of the boards in schools to foster creativity. In this way, it added knowledge on how these boards can enhance teachers' creativity.

1.6 Chapter division

CHAPTER 1: BACKGROUND AND MOTIVATION OF THE STUDY

Chapter 1 presented the contextual background and rationale for the study, aiming to establish a comprehensive understanding of how smart boards can enhance teachers' creativity. It offered insights into creative teaching, and provided guidance on utilising smart boards to enhance creativity in classrooms. The chapter also discussed the

problem statement, theoretical framework, research questions, study purpose, methodology overview, significance of the study and summary of chapter content.

CHAPTER 2: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Chapter 2 reviewed the literature on teachers and the learners' perceptions towards the use of smart boards and their effectiveness in enhancing teachers' creativity in the classroom. This chapter also discussed the way in which the theory of creativity and the 9E instructional model were used in the study. The chapter summary was also presented.

CHAPTER 3: RESEARCH METHODOLOGY

Chapter 3 provided information on the approach utilised and the perspective from which it was positioned in the study. Details were given regarding the research design and how the population and sampling were conducted. The chapter also explained the methods employed in data collection, including semi-structured interviews and non-participant observations. Additionally, an outline of the framework employed in the study was presented, which guided the development of the data collection instruments. The chapter further described the process of data analysed, and the trustworthiness of the qualitative research instruments as well as the ethical considerations. Lastly, the summary of the chapter was presented.

CHAPTER 4: DATA ANALYSIS AND DISCUSSIONS

This chapter presents the collected analysis on the purpose of the study. A discussion on non-participant observations and the semi structured interviews was included. The data from observations was firstly analysed and discussed, and teachers' interviews were used to support the findings, and learners' interview findings were used to support the conclusion per theme. The literature was also used to support the summary per category. A summary of findings was also provided.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS OF THE STUDY

In Chapter 5, the introduction, conclusion on the findings, limitations and recommendations were outlined. The chapter also included a presentation of the summary of the study.

1.7 Summary of the chapter

This chapter discussed the introduction, the background to the study, the problem statement, the preliminary literature, the theoretical framework, the research purpose and questions, the research methodology as well as the chapter division.

The next chapter provides a detailed literature review on the three research questions of the study. The chapter discussed the theory of creativity in relation to the 9E instructional model, which was employed to explore how a smart board can enhance teachers' creativity. Further discussions on why the theory was suitable for this study were presented. Lastly, the summary was presented.

CHAPTER 2: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

The previous chapter presented the contextual background and rationale of the study. The aim was to establish a comprehensive understanding of how a smart board can enhance teachers' creativity. The chapter offered insights into creative teaching and provided guidance on utilising the boards to enhance creativity in classrooms. The chapter also provided the problem statement, preliminary literature, theoretical framework, research questions, study purpose, methodology overview, significance of the study, ethical considerations, and a summary of chapter content.

In this chapter, the researcher reviewed, summarised and compared the information collected on teachers' perceptions of the effectiveness of smart boards in enhancing creativity in the classroom. Additionally, the chapter provided literature on the effectiveness of the boards in enhancing the creativity. The literature also discussed learners' perceptions regarding the use of the boards. Lastly, the chapter discussed the theory of creativity in relation to the 9E instructional model, which was employed to explore how smart boards can enhance teachers' creativity.

2.1.1 Teachers' perceptions of the effectiveness of the smart board in enhancing creativity

For the schools to effectively introduce technology, they need teachers' positive beliefs and support. Teachers who are used to working with computers and other forms of technology are more open to the idea of using the boards (Mustapha, 2018). Although the teachers exhibited positive attitudes towards the utilisation of the smart boards, a significant number of them faced challenges in integrating this technology due to a lack of necessary skills. Therefore, there is a need for training. Similarly, Lindberg, Olofsson and Fransson (2017) found that teachers lack fundamental knowledge in using computers, which hindered their ability to effectively incorporate Information Communication and Technology (ICT) in education. Consequently, they lacked creativity. Another study by Alfaki and Khamis (2018) discovered that teachers in English language classrooms had not received in-service training in integrating smart boards. As a result, they emphasised the importance of providing continuous support

to teachers, encompassing both pedagogical and technical aspects. They need training to be up to date with the various skills that can be used to increase the level of learner engagement in the classroom through using smart boards (Karsenti, 2016).

An investigation into how teachers in primary schools in Rwanda felt about the use of ICT revealed that ICT tools helped learners to communicate with teachers, and performed better because it was easier for them to understand (Munyengabe, Yiyi, Haiyan & Hitimana, 2017). Teachers' enthusiastic responses suggested that they would be more motivated to use smart boards than other teaching methods. This suggests that they would profit from involving the smart board in the classrooms. According to the teachers, the smart board eliminated the need for paper printing and copying. Consequently, it made subjects fun, interesting and simple to present, and allowed teachers and learners to review the lessons they had learned that day (Chau et al., 2020). They further said that the boards made it easy to teach the subjects, as it made it fun and interesting, and let teachers and learners to go back to earlier lessons.

Bıçak (2019) indicates that the majority of teachers reported that the use of smart boards in the classrooms increased learners' motivation and participation. Perhaps, teachers need more training on how to effectively use the boards in their teaching. The majority of them have learned how to use the tool by themselves, so they have not fully grasped its significance and did not make effective use of it (Zoltan, Magdaş & Dulamă, 2019). Additionally, the board can facilitate creativity among teachers by using e-learning in a lesson through video clips to explain concepts, show programming, introduce learners' work to the rest of the class, make progress flip-charts, change texts and deal with handwriting, save notes made on the board for later use and update notes quickly and consistently (Hall & Higgins, 2005). Moreover, it was reported by Bakadam and Asiri (2012) that most teachers stressed that they believed that the smart boards would give them different teaching methods suitable for conveying content to learners and would improve learning methods. Torres and Kunt (2012) report that new concepts can be introduced using pictures and videos, which is possible using the boards. However, teachers need training to be up to date with the various skills that can be used to increase the level of learner engagement in the

classroom through the use of the smart boards (Karsenti, 2016). Hence, the study aimed to explore the effectiveness of the smart board in enhancing teachers' creativity.

Teachers' perceptions and beliefs are key in ensuring that the Information Communication and Technology (ICT) operation is effective (Albugami & Ahmed, 2015). The effective coordination of ICT in classrooms depends on teachers' mentalities and convictions in relation to technology (Khan, Hasan & Clement 2012). However, Beghetto (2019) reports that teachers view creativity as one more responsibility or as something extra. Their attempt to use the smart board could be a different method of teaching to meet learners' needs (Bdiwi, Runz, Faiz & Cherif, 2019). In addition, Eksi and Yesilyurt (2018) report that smart boards can stimulate creativity by enabling teachers to present visual material that is supported by audios and animation.

Moreover, Mustapha (2018) reports that teachers who have computer skills showed an uplifting outlook towards the utilisation of the smart boards. Even though some teachers demonstrated positive attitudes towards the use of the boards, most of them lack skills of integrating them (boards); therefore, training opportunities need to be provided. In the same footing, Lindberg, Olofsson and Fransson (2017) report that teachers feel that they lack knowledge on how to use technology tools in the classrooms, which makes them lack creativity during the classroom teaching and learning process.

2.1.2 The effectiveness of the smart board in enhancing the teachers' creativity

First and foremost, the way the smart boards are used in the classroom determines their effectiveness (Jelyani, Janfaza & Soori, 2014). A smart board is an electronic white display that is sensitive and can be written with a finger or a special stylus (A'salmi & Ambusaidi, 2016). A printer, projector and a computer are all connected to the smart board, so it enables the user to convert handwritten comments into digital characters that can be used in videos and office programmes (Aldalalah, 2021). Additionally, the board enables the user to convert hand drawings such as geometric shapes into digital drawings, which fosters creativity in the classroom (Khosa, 2020).

The board offers teachers better approaches and helps learners to enhance their creative thinking skills, as the touchscreen capacities permit them to contact and collaborate with the board, which likewise makes examples fascinating (Khosa, 2020). This is supported by Tsayang, Batane and Majuta (2020), who argue that the utilisation of the numerous features of the smart board, such as You Tube videos, pictures, and simulation tools improve learners' understanding of concepts. Wetzels, Kester and Van Merriënboer (2011) revealed that prior knowledge stimulation was initiated by means of pictures and diagrams. Similarly, Sidney, Shirah, Zahrn and Thompson (2022) highlighted that the diagrams may play a critical role in helping learners to make use of their intensive prior knowledge. Hughes, Salamonson and Metcalfe (2020) highlighted that learner's engagement and the learning experiences were impacted positively by the employment of weekly quizzes.

Teachers benefit greatly from smart boards, particularly during the lessons. The teacher can use the board by using a stylus or a finger to touch the screen (Akar, 2020). They can carry out numerous roles with the smart board, for example, they can add and drop, or cut and duplicate things. They can also highlight handwritten notes, as well as convert them into texts, and save drawings, notes and annotations for later use. They can also print. Furthermore, smart boards show movements and recordings to all the understudies in the classroom. They capture and save screenshots so that they can be retrieved, examined and modified when necessary when using the internet (Balta & Duran, 2015). The software that comes with smart boards encourages teacher creativity. Below (Figure 2.1) is a picture of a smart board.

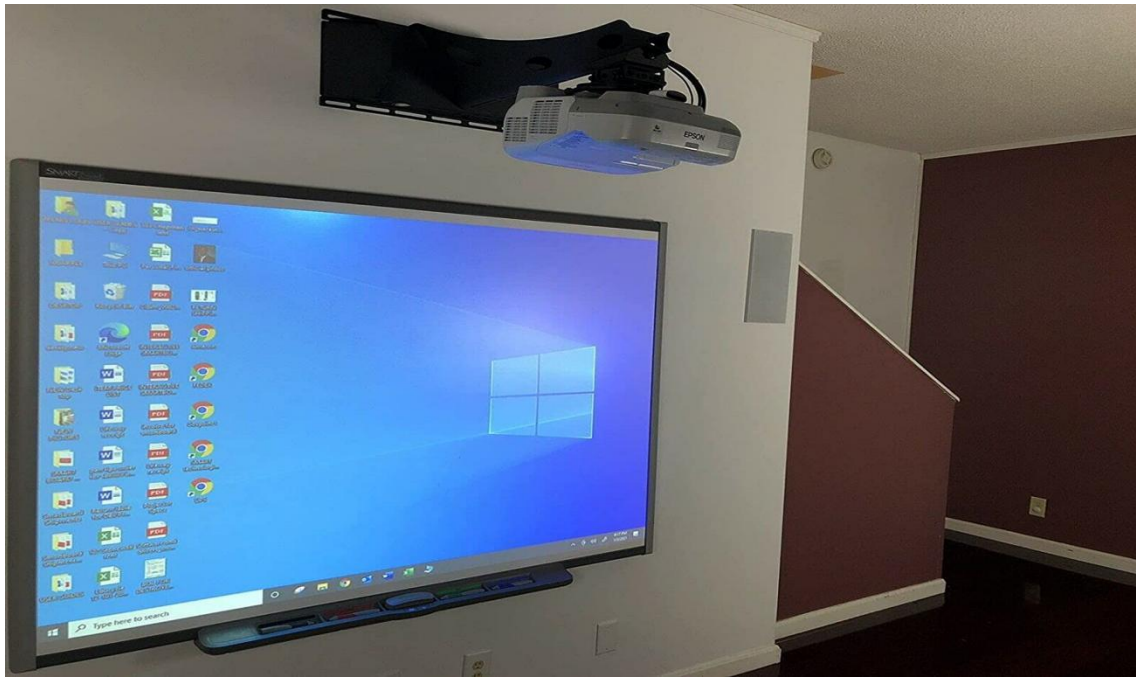


Figure 2.1: Picture of a smart board

However, there has been much thought on what the teachers have to know for them to be able to use technology such as smart boards effectively in the classroom, as well as the competencies that are needed to develop creative learners (Mishra & Mehta, 2017). Moreover, teachers have to be equipped with the necessary skills and knowledge to teach technology education (Ankiewicz, 2021). A study by Bidaki and Mobasheri (2013) revealed that computer-literate teachers were confident in using smart boards because they were familiar with some operational aspects that were common to both a computer and a smart board.

Hence, teachers must overcome a number of obstacles when promoting creativity, which include but are not limited to, lack of knowledge that is based on the use of smart boards and the misconceptions about creativity and the creative process (Robinson, 2017). Teachers play an important role in the development of learners' creative thinking by posing many questions to stimulate their thinking, by using techniques of excitement, and by following up and observing their activities continuously to reach the correct consistent finishes (Aldalalah, 2021). This is because the boards allow the presentation of content in a visual form, thereby making concepts clearer (Tsayang et al, 2020).

PowerPoint is used by presenters to summarise key concepts in as few words as possible using bullet points (Craig and Amernic, 2006). A study by Torres and Kunt (2012) report that new concepts can be introduced through the use of pictures and videos.

By leveraging the capabilities of a smart board, teachers can generate a blend of video and animated lessons that would have been unattainable in a conventional classroom setting (Esteves, Fiscarelli, and Bizelli, 2015). The utilisation of various pens provided by smart boards enables teachers to selectively emphasise specific parts of the content. For instance, by employing a magic pen, they can highlight relevant information that will fade away after a brief period, thereby fostering creativity (Khosa, 2020). Tsayang et al. (2020) reported that the utilisation of numerous features of the board, such as You Tube videos, pictures and simulation tools improves learners' understanding of concepts. Zhao (2019) revealed that an interactive quiz is a learning evaluation medium that can be used by many teachers and researchers. In addition, the evaluation of computer-based boards delivers results quickly and accurately.

Moreover, Horng, Hong, ChanLin, Chang and Chu (2005) came up with two suggestions in the development of creative teachers. Firstly, creative teachers should begin with teacher-training programmes. They should be equipped with knowledge and creative strategies while stirring their motivations. Secondly, schools should hold workshops for creative teachers, and invite experienced creative teachers, professionals, and others to share their experiences, the ways of developing creativity, and of improving teaching strategies. Hence, the study sought to explore the effectiveness of smart boards in enhancing teachers' creativity.

Maher, Phelps, Urane and Lee (2012) found that the software connected to the boards is specifically considered for teaching and learning, thereby allowing teachers to link texts, images and videos for later reference. It states that the information can be presented to the learner in a way that allows recording. Interactive smart boards help to present content more easily, and increase student engagement, reduce the workload, and use time more efficiently, while planning and organising lessons becomes better (Ahmad et al., 2021).

Creative education is therefore about teaching specific content in different ways (Cheng, 2018). Additionally, teachers teach creatively by being creative in choosing and using resources to make the lessons more interesting and engaging through the use of smart boards (Wood & Ashfield, 2008). Therefore, the study sought to explore the effectiveness of the smart board in enhancing teachers' creativity in the Technology classroom.

2.1.3 Learners' perceptions towards the use of the smart board

In a study by Chau et al. (2020), the researcher reported that learners embraced a positive perception, and agreed that the adoption of the smart board during the course of the class was effective. Similarly, a study by Han and Okatan (2016) endorsed that learners have positive attitudes towards smart boards, regardless of the technical challenges that they face during integration. This means that learners are also enjoying and supporting the use of smart boards in classrooms. However, teachers must overcome multiple obstacles in promoting creativity, which includes a lack of knowledge on the use of smart boards and misconceptions about creativity and the creative process (Robinson, 2017).

The use of technology and the way in which information is presented through colourful, interactive and fun activities is seen by learners as intriguing and motivating. This enables them to learn a lot in a short time. It also makes it easy for them to do demonstrations to help learners understand. In addition, the use of smart board multimedia may enhance the interest and learning of learners, who find lectures challenging when used as the only means of communication (Warnock, Boykin & Tung, 2011). Learning can be enhanced if both audios and videos are introduced into the classroom through the use of educational technology such as the smart board; hence, introducing both videos and audios into the classroom environment enhances the learning process because learners can process audio and video images independently (Warnock et al., 2011). In addition, Terlumun, Appollm, Ibrahim, Mamman, Yusuf and Ibrahim (2018) reported that You Tube videos renovate learners' existing knowledge or bring new knowledge to them.

A study by Schut (2007) reported that learners found the smart board to be interesting because it was engaging, and offered multimedia aspects. The study also reported

that the smart board was used as a tool to improve teaching through enhanced visuals and notes. Furthermore, the students held the belief that the board had a positive impact on teachers, enhancing their ability to explain concepts and fostered creativity. Similarly, Baker, Good boy, Bowman and Wright (2018) documented the positive perceptions of learners regarding the use of PowerPoint, which is a software commonly found on smart boards. The study found that the learners perceived the teachers who used PowerPoint as more organised, as they believed that the PowerPoint helped to hold their attention and quickened the class's pace Theory.

Min and Siegel (2011) report that learners' perceptions only marginally favour the use of smart boards. Not a single learner in the study preferred learning without technology, and only half of the learners found the smart boards more appealing. In addition, Chau, Zainuddin, Ling, Ng and Yang (2020) found that the use of smart boards brings fun and variety to learning, as the learners develop positive attitudes. Since learners do not only learn but enjoy the lessons, they will always look forward to the classroom.

Smart board technology has a positive impact on learners' creativity since they will develop their own ideas after going through online resources that the smart board offers (Aldalalah, 2021). The learners use the board for entertainment purposes, while some use it for their own presentation (Mihai, 2020). Teaching using smart boards is more fun, exciting, engaging and enjoyable. It provides many opportunities for the learners as it allows them to access a number of resources in a short space of time (Sigh & Mohamed, 2012). Hence the study sought to explore the effectiveness of the smart board in enhancing teachers' creativity in the Technology classroom.

2.1.4 Theory of creativity

This study adopted the theory of creativity which was developed by the National Advisory Committee on Creative and Cultural Education (NACCCE) in 1999. Creativity is defined as a creative activity that is intended to produce unique and valuable results (NACCCE, 1999). The theory further says that creativity can be viewed in terms of two angles, which are creative teaching and teaching for creativity. Teaching creatively means that teachers employ creative approaches to make learning more interesting,

exciting and effective, and teaching for creativity means developing learners' creative thinking (NACCCE, 1999). The theory of creativity was used as a lens to understand how the smart board can enhance teachers' creativity in the Technology classroom. This study looked at creative teaching as well as teaching for creativity. The teachers had to look into the various aspects of creativity when using a smart board for creativity. The ways in which the smart board can give teachers opportunities to teach creatively, and the ways in which the board can help learners to develop their creative skills are included herein. Teaching creatively may incorporate the teacher's use of media such as videos, animation, designs and texts with hyperlinks to records, web sites and related content which might bring about intriguing, energising and powerful instruction. Furthermore, creativity begins with lesson planning and preparation, so teaching for creativity would necessitate the use of a smart board by the teacher to enhance the process rather than the product. Consequently, to explore how the smart board can really enhance the teacher's creativity in a classroom, this study explored teachers' creativity by taking a look at how they make their lessons more interesting, exciting and effective, and how they develop learners' creative thinking skills.

In this study, an **interesting lesson** means a lesson that catches learners' attention through the teacher's use of an extensive range of media on the smart board, such as videos, animation, graphics and texts with hyperlinks to documents, websites and associated content. An **exciting lesson** means a lesson that is taught using the above-mentioned wide range of media such that the learners enjoy it. **Effective lesson** means a lesson that led to an engaging and creative presentation. **Developing learners' creative thinking skills** means the way teachers use the smart board to improve the learning process rather than the product.

To understand teachers' creativity, the researcher adapted the 9E instructional model, which was developed by Ramaligela, Ogonnaya and Mji (2019) as a classroom activity model. Hence, the study involved the 9E instructional model as a classroom activity guide.

2.1.5 9E instructional model

The study also adapted the 9E instructional model, which is a classroom activity model, which was introduced by Bybee (1997) as the 5E instructional model, whereby

the 5E represents the five learning cycles. The instructional model was later expanded to the 7E by Eisenkraft (2003). Then Ramaligela et.al. (2019) further expanded on it to 9E. According to Ramaligela et al. (2019), the 9E instructional model provides different stages that can be followed in the presentation of a lesson in the classroom. Hence, the 9E instructional model was relevant in the study to explore how the smart board can enhance the teacher's creativity in the Technology classroom. This instructional model was also used to present and analyse data. According to Ramaligela et al. (2019), the 9E instructional model involves the following phases: the **elicit, elaboration, explanation, exploration, evaluation, enclosure, enlightening, engagement and the exchange phase.**

Ramaligela et al. (2019) described the 9E instructional model categories as follows: the **elicit phase** involves stimulating the learners' prior knowledge. The **elaboration phase** is about the connection of the existing knowledge with a new concept. The **explanation phase** has to do with the continuous explanation of different concepts to improve learners' understanding. The **exploration phase** relates to the introduction of new concepts, processes or skills in a consistent way to avoid confusion. The **evaluation phase** looks at the ongoing assessment of learners' learning that needs to be done along the way during interactions with them in the presentation stages. The **enclosure phase** summarises the concepts. The **enlightening phase** is about the application of the topic-specific strategies that are relevant to the topic. The **engagement phase** involves the ongoing involvement of learners throughout the lesson as active participants, which assists them to develop conceptual understanding. The **exchange phase** examines the use of learners' ideas to identify a teachable moment. For instance, using their responses to build an understanding of different concepts and to rectify learners' misconceptions.

In this study, the **elicit phase** refers to how teachers creatively used smart board features to develop *interesting* questions that draw learners' previous knowledge. The **elaboration phase** was about how the teachers used the smart board to access *interesting* online educational resources to build on learners' existing knowledge. The **explanation phase** looked at how teachers used the smart board to *effectively* explain specific concepts using different online resources or programmes. The **exploration phase** related to how teachers used smart board programmes to *interestingly*

introduce new concepts to learners. The **evaluation phase** was about how teachers used the smart board to design assessments that stimulate *the learners' creative thinking skill*, and the **enclosure phase** how they used the smart board to summarise concepts in an effective way for clear understanding. The **enlightening phase** was about how teachers used the smart board to access *exciting* online resources or programmes for describing a complex idea in a simple way, and the **engagement phase** how they used the smart board to continuously engage learners throughout the learning and teaching process, thereby *provoking their creative thinking skills*. The **exchange phase** was about how the teachers used the smart board programmes together with the learners' ideas to correct misconceptions in a way that developed their *creative thinking skills*. The following diagram (Figure 2.2) shows the theoretical framework that was incorporated with the 9E instructional model:

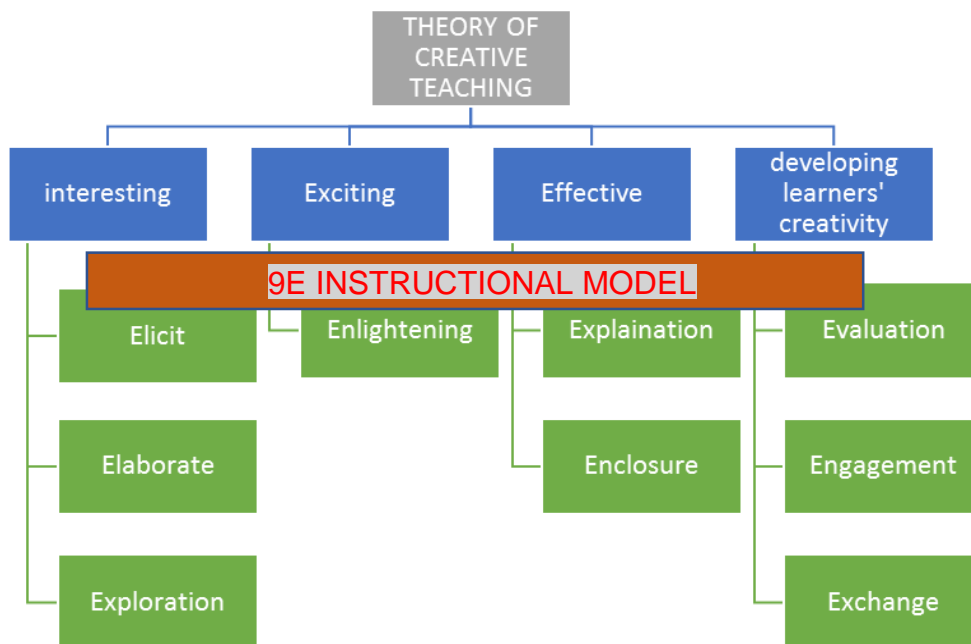


Figure 2.2: Creativity theory in collaboration with the 9E instructional model

2.2 Summary of the chapter

This chapter reviewed the literature on teachers' perceptions of the effectiveness of smart boards in the classrooms to enhance creativity. It further outlined the effectiveness of the board in enhancing teachers' creativity. Lastly, it reviewed the literature on learners' perceptions of the effectiveness of the smart board in the classrooms. The chapter also discussed the theory of creativity and how it works together with the 9E instructional model.

The chapter below provided a detailed discussion of the qualitative research approach employed in this study. It examined the case study and research design utilised. Furthermore, the chapter presented information concerning the study's population, and highlighted the use of purposive sampling as the chosen sampling method. The data collection methods utilised, namely semi-structured interviews and non-participant observations were also described. Notably, the chapter discussed how the qualitative data obtained from these methods were analysed. The chapter also explored the trustworthiness of the qualitative research instruments, discussed the ethical considerations, and lastly, provided a summary of its content.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter reviewed, summarised and compared the information collected on teachers' perceptions of the effectiveness of the smart board in enhancing creativity in the classroom. Additionally, the chapter provided literature on the effectiveness of the boards in enhancing teachers' creativity in the classroom. The literature also discussed learners' perceptions regarding the use of the board in the classroom. Lastly, the chapter discussed the theory of creativity in relation to the 9E instructional model, which was employed to explore how the smart board can enhance teachers' creativity.

In this chapter, the research design employed to explore how the smart board can enhance creativity in the Technology classroom was discussed. The chapter also addressed the process of selecting the population from which the sample was drawn, as well as participants of the study. Furthermore, the data collection techniques used in the qualitative approach were discussed, specifically highlighting the conduct of semi-structured interviews and non-participant observations. A clear description of how the data obtained from these methods were analysed was presented in this chapter. The trustworthiness of the qualitative instruments, including aspects of credibility, transferability, confirmability and reliability was outlined and deliberated upon as well as the ethical considerations. Finally, a summary of the chapter was given.

3.2 Qualitative research approach

The study employed the qualitative research approach, which involves gathering descriptive data by listening to participants' opinions through interviews and observing their behaviours (Taylor, De Vault & Bogdan, 2016). The researcher determined that the qualitative approach was suitable for this study as it is well-suited for exploring complex concepts and phenomena (Smith & McGannon, 2018). The motivation for utilising the qualitative research approach was to explore participants' feelings, perspectives and attitudes regarding the effectiveness of a smart board in enhancing teachers' creativity. Hence, it was appropriate to use the qualitative approach to

explore the effectiveness of the smart board in enhancing the teachers' creativity in the Technology classroom.

3.3 Case study design

In order to explore the effectiveness of a smart board in enhancing teachers' creativity in the Technology classroom, this study employed a case study design. Gustafsson (2017) defines a case study as an in-depth examination of an individual, group or a unit with the aim of making generalisations across multiple units. Case studies enable researchers to explore participants' motivations for specific actions, generating evidence and findings (Rauch, Van Doorn & Hulsink, 2014). In this study, the case study design facilitated the exploration of how smart boards enhance teachers' creativity in Technology classrooms. The research design involved collecting multiple case studies from four primary schools in Mpumalanga Province, specifically within Nkomazi East Circuit, where smart boards were already being utilised.

3.4 Population

Population refers to a group of people who have related characteristics that are recognised as essential to the study by the researcher (Hartas, 2015). The targeted population of this study was Technology teachers and learners from primary schools at Nkomazi East Circuit, which consists of 15 primary schools.

3.5 Sampling

Sampling involves the selection of participants from a larger population for research purposes (Alvi, 2016). In this study, the purposive sampling technique was utilised to select a total of four teachers and eight learners as participants (Guarte & Barrios, 2006). Purposive sampling is a method in which the researcher deliberately selects individuals who can provide the required data based on their capabilities (Parahoo, 1997). This sampling technique was used to select schools that had smart boards, and Technology teachers with the knowledge of using the boards.

To answer RQ1 based on Technology teachers' perceptions of the use of smart boards in enhancing creativity, the study purposefully sampled four teachers who were using the boards in their classrooms. The teachers were then requested to participate in non-participant observations based on how the smart board can enhance their

creativity in classroom practice (RQ2). One lesson was sampled per teacher, bringing the total to four lessons. All the selected teachers were able to use the smart board and were willing to work with the researcher, who purposively selected eight learners that were interviewed on their perceptions of the use of the smart board in the Technology classroom (RQ3). This means that the researcher interviewed two learners per observed teacher and two learners per observed lesson. A fair selection of the learners was done, as only Grade 6 Technology learners who were good in using smart boards were selected to participate in the study. Four schools were purposively selected in the study on account of the fact that they had smart boards. Technology teachers who were using the boards were also selected. Table 3.1 below shows an overview of teachers who participated in the study, and Table 3.2 presents the demographic description of the selected learners.

Table 3.1: Description of teachers (participants) according to gender, age and experience in the use of the smart board and their qualifications

Participant	Gender	Age group	Years of experience in using the smart board	Qualification	
Teacher 1	Male	30-35	5	B. ed. Honours	
Teacher 2	Male	35-40	4	B. ed. Degree	
Teacher 3	Male	30-35	2	B. ed. Honours	
Teacher 4	Female	40-50	5	Pgce in technology	

Table. 3.2: Description of the learners based on gender, age and years of experience learning with the smart board

Participants	Gender	Age group	Years of experience
Learner 1	Male	10-13	5
Learner 2	Male	10-13	5
Learner 3	Female	10-13	4
Learner 4	Male	10-13	4
Learner 5	Male	10-13	2
Learner 6	Female	10-13	2
Learner 7	Female	10-13	5
Learner 8	Male	10-13	5

3.6 Data collection techniques

Data collection techniques refer to the methods or tools employed to gather data, such as surveys, interviews or observations (Can, Arnrich & Ersoy, 2019). In this study, two instruments, namely a semi-structured interview schedule and a non-participant observation schedule were utilised to collect data. Both interviews and observations were conducted at the participants' schools. The decision to employ multiple data collection techniques was considered appropriate to enhance the reliability and quality of the data. These techniques foster an interactive exchange of ideas between the researcher and participants, facilitating collaborative exploration and generating meaningful insights from the collected data (Saldana, 2021). The researcher started by conducting semi-structured interviews with Technology teachers, then she observed them when they were teaching using the smart board. Lastly, the researcher interviewed the learners immediately after the non-participant observations.

3.6.1 *Semi-structured interview*

An interview is a highly versatile tool that can be used to collect a substantial amount of data within a limited timeframe, providing value to participants (Deterding & Waters, 2021). To explore teachers' perceptions of the effectiveness of the smart board in enhancing their creativity in the Technology classroom, as well as learners' perceptions of smart board usage, this study employed semi-structured interviews, which involve an interactive conversation where the interviewer seeks to gather information by posing questions (Longhurst, 2003). The researcher aimed to gain insights into teachers' perspectives on how the smart board enhances their creativity.

In preparation for the interviews, a semi-structured interview schedule consisting of nine questions was developed. These questions were guided by the 9E instructional model and the creativity theory. The interview schedule was shared with the supervisor to ensure its reliability. The participants were afforded an opportunity to choose interview times that were convenient for them. In situations where a participant was unable to participate at the scheduled time, alternative arrangements were made to accommodate their availability. The interviews had a duration of 45 to 60 minutes and were recorded to ensure the accurate capture of responses, as relying solely on written notes may be unreliable (Jamshed, 2014). All participants provided consent for

the interviews to be tape-recorded. Subsequently, the recorded interviews were transcribed for the purpose of data analysis.

3.6.2 Non-participant observation

Participant observation is a tool used by researchers to collect data in primary research by observing the activities and behaviour of participants in their workplaces (Hedayati, 2019). Hence, to respond to RQ2, which focused on how the smart board can enhance Technology teachers' creativity in their classroom practice, the study employed non-participant observation, which involves an external observer recording the actions and behaviours of individuals without directly engaging or interacting with them (Bless, Higson-Smith & Sithole, 2013). In this form of observation, the researcher assumes a passive role and simply observes and records the unfolding events without any direct involvement.

Non-participant observations provided an opportunity for the researcher to collect primary data. An observation schedule was developed and guided by the 9E instructional model and the theory of creativity. The schedule consisted of nine categories where teachers were observed. It was then sent to the supervisor for verification. The researcher used a journal to take notes as well as an observation schedule to record everything that was happening in the classroom for all the categories. Pictures and videos were taken as teachers and learners were creatively using the smart board. Each teacher was observed only once in a double class period, which lasted for at least one hour.

3.7 Data analysis

According to Bengtsson (2016), data analysis involves interpreting and understanding information obtained from individuals regarding a specific phenomenon through various research strategies. The qualitative analysis involved examining the data obtained from semi-structured interviews and non-participant classroom observations. The analysis also involved examining the data obtained from semi-structured interviews and non-participant classroom observations. Qualitative data analysis is a process involving interpreting raw data and extracting its underlying meanings by identifying, assessing, observing, illustrating, coding and describing patterns, trends, themes and categories (Mathipa & Gumbo, 2015). The following sections discussed

how data from semi-structured interviews and non-participant observations were analysed.

3.7.1 Semi-structured interviews

To analyse data from semi-structured interviews in both RQ1 and RQ3, a deductive content analysis approach was used, as the themes and categories were pre-determined (Azungah, 2018). The themes were derived from the creativity theory, and categories from the 9E instructional model. To ensure prompt analysis and prevent an overwhelming amount of data, audio recordings from semi-structured interviews were reviewed, transcribed and coded immediately after each survey activity (Cohen, Rogelberg, Allen & Luong, 2011). The transcriptions of the interview recordings were typed verbatim using a word document, with the researcher accurately capturing the participants' exact words without making any additions (Mabuza et al., 2014). The researcher established codes based on similarities among different responses, identifying emerging patterns (Mabuza et al., 2014). The categories were derived from the 9E instructional model, while the themes were drawn from the creativity theory. The researcher followed a five-step process to analyse data, which included familiarisation, thematic indexing, charting, interpretation and confirmation (Mabuza et al., 2014). These steps facilitated the researcher's understanding of the data, identification of themes and categories, organisation of the data into meaningful themes and categories, interpretation of the findings, and confirmation of analysis.

3.7.1.1 Familiarisation

Familiarisation involves the researcher's review of raw data multiple times before initiating the analysis (Mabuza et al., 2014). In this study, the researcher listened to the interview recordings to become acquainted with the available data.

3.7.1.2 Development of a thematic index

During this stage, the researchers generate a list of codes derived from the interview transcripts and observation notes, and organise the data into relevant categories to facilitate organisation and interpretation (Mabuza et al., 2014). In this study, the researcher developed codes based on the familiarisation process, and grouped the same type of data under relevant codes.

3.7.1.3 *Charting*

According to Mabuza et al. (2014), charting involves creating tables that correspond to the developed thematic index and are aligned with the study's theoretical framework to guide the research towards its objectives. In this study, a table was used to present the collected data, and a highlighter was employed to code important information based on the study's aim, theoretical framework, and the 9E instructional model.

3.7.1.4 *Interpretation*

The researcher also quoted other authors who revealed similar findings in similar studies. The researcher has the flexibility to interpret the data based on participants' explanations of key concepts or the identification of patterns in their responses (Mabuza et al., 2014). In this study, the researcher analysed and interpreted the highlighted quotes in relation to the themes derived from the creativity theory and the categories identified through the 9E instructional model. Additionally, the researcher incorporated relevant findings from other studies conducted by different authors who reported similar outcomes.

3.7.1.5 *Confirmation*

Confirmation is the process of revising collected data (Birt et al, 2016). In this study, the participants were given an opportunity to view their data and to make corrections and comments based on the results to ensure the reliability of the findings.

3.7.2 *Non-participant observation*

To analyse the data collected through observation, the study used deductive content analysis. The observation schedule and notes were analysed through the use of deductive data analysis as themes and categories were predetermined. Mayring (2014) highlighted that this type of analysis is employed when there are existing categories, previous research findings, theories or conceptual frameworks pertaining to the phenomenon under investigation. The process was guided by the theoretical framework, the 9E instructional model and the purpose of the study. The videos were transcribed into word document. Notes that were taken during observations were also analysed based on RQ2, the purpose of the study, the creativity theory from which the themes were derived, as well as the 9E instructional model from which categories were derived. Pictures for each observed teacher were used as evidence to support the findings. The researcher used and followed the five steps of qualitative data analysis

as explained in 3.7.1, namely familiarisation, thematic indexing, charting, interpretation and confirmation (Mabuza et al., 2014).

3.8 Trustworthiness of the qualitative research instruments

3.8.1 Credibility

Credibility means that the findings drawn from the collected data should be valid and match the reality of the phenomenon being researched (Mabuza et al., 2014). Lincoln and Guba (1985) recommend a set of activities that can help in improving the credibility of research results. These are prolonged engagement in the field, persistent observation, triangulation, checking interpretations against raw data, peer debriefing, and member checking. In order to establish the credibility of this research study, the researcher underwent a process of supervision, starting from the development of research questions and continuing through to the compilation of the final report under the guidance of a supervisor (Foster, 2004). This allowed for constructive feedback from both the supervisor and other student researchers, enabling refinement of various aspects of the research report. The inclusion of detailed descriptions of direct quotes from participants' interview responses aimed to assist readers in assessing the alignment of the findings with reality. The researcher also shared the data analysis and interpretation with the participants, inviting their evaluation and offering suggestions for corrections where mistakes were identified. Through peer briefing, the researcher presented the research findings to peers, seeking their input, which contributed to improving the quality of the research outcomes and identifying gaps in the research questions (Anney, 2014). Research writing retreats were also attended to in order to receive help from peers and supervisors.

3.8.2 Transferability

Transferability refers to the process of providing sufficient contextual information in a study, allowing readers to determine if the prevailing conditions resemble familiar circumstances and if the findings can be applicable to different contexts (Cho, 2017). Ensuring transferability involves providing a comprehensive description of the study. In this study, the researcher provided detailed explanations of all the processes, including the target population and sampling, data collection tools, and data analysis methods. The findings were made more meaningful to others through descriptive narratives. The sampling strategy, research methods, participant characteristics and

study settings were explained to enhance the transferability of the findings (Mabuza et al., 2014).

3.8.3 Dependability

Dependability and confirmability serve similar purposes, and the researcher employed methods to ensure the validity of both concepts. According to Elo, Kääriäinen, Kanste, Pölkki, Utriainen and Kyngäs (2014), dependability refers to the consistency of gathered data over time and in various contexts. To ensure these objectives, the researcher conducted a thorough and meticulously planned study, which encompassed the research design, its implementation, and provided detailed information about the data collection process. The researcher demonstrated flexibility and openness during the entire data collection process, ensuring that participants were fully informed about the procedures involved. The supervisor maintained close oversight of the researcher, carefully scrutinising the researcher's data collection methods, data analysis techniques, and study findings. Additionally, the supervisor assessed all interpretations and conclusions to determine their alignment with the gathered data.

3.8.4 Confirmability

Confirmability refers to finding ways to show the outcomes that emerge from the participants' data (Abdalla, Oliveira, Azevedo & Gonzalez, 2018). It is established when the reader perceives that the outcomes accurately represent the participants' actual experiences rather than influenced by the researcher's personal opinions or beliefs (Mabuza et al., 2014). In this study, the participants' responses were carefully recorded, and both the research process and findings were shared with experts for verification. Peer debriefing was also conducted to validate the interpretation and coding decisions (Foster, 2004).

3.9 Ethical considerations

When gathering data, qualitative research must consider a few ethical considerations, such as the following: informed consent, voluntary participation, confidentiality, anonymity, the deception of the subjects, as well as the analysis and reporting of the findings. This must all be done without causing harm to the subjects (Babbie & Mouton, 2001). These ethical issues are discussed below.

3.9.1 Permission to carry out the research study

Ethical clearance was requested from the University of Limpopo, Turfloop Research and Ethics Committee (TREC). The researcher also requested approval to conduct the study from Mpumalanga Department of Basic Education (MDBE). After obtaining the approval from the DBE, other stakeholders, including the Nkomazi East Circuit Manager, the School Management Team (SMT) as well as the participants were provided with evidence of approval to carry out the research study from the Department of Basic Education.

3.9.2 Informed consent

Informed consent includes providing participants with a clear picture of the nature of the study, withdrawing their participation in the study at any time without penalty and explaining whether there are any risk factors in the study (Patten & Newhart, 2017). Before starting the interviews and the observations with the participants, the researcher handed out informed consent forms to all the participants and explained everything about the interviews and the observations as well as the contract. The researcher asked the participants permission to record the interviews and to take videos during the observations (Punch, 2005). The teachers were asked to fill in the consent form that was obtainable from the University of Limpopo's postgraduate guide, and were informed that they can remove themselves from the study at any stage of the process.

3.9.3 Voluntarily participation

Participation in the study was entirely voluntary and in accordance with ethical considerations (Babbie, 2016). The participants were given an opportunity to provide informed consent by signing consent forms. They were assured that they could withdraw from the study at any time without facing any consequences or needing to provide a reason (Babbie & Mouton, 2001). It was emphasised that there were no anticipated risks associated with their involvement in the study, while the potential benefits were also clearly communicated

3.9.4 Anonymity and Confidentiality

This means that the safety of participants' identity and those who have access to the shared material is limited to how much access they should be given (Babbie & Mouton, 2001). Therefore, in this research study, the researcher ensured anonymity and confidentiality as the information was recorded using pseudonyms. Numbers were also used to indicate the names of the participants, e.g. Teacher 1 or Learner 2. This was done during the pre-meeting session where the researcher introduced the study's

aims to the participants. The data obtained was kept safe in a file, and no one had access to it except the researcher and the supervisor. The collected data was only used for this research study. The participants' responses could not be recognised by any person after the research study was conducted (De Vos et al., 2011). The research sites were kept confidential, as school names were not mentioned. The researcher used numbers for school names e.g., School 1.

3.9.5 Benefits

The study added knowledge and skills to Technology teachers on how to use the smart board for creativity in the classroom. The study introduced the teachers to the new teaching approach that has encouraged creativity during teaching and learning. The learners gained knowledge and understanding from topics taught using the smart board.

3.9.6 Adhere to COVID-19 protocols.

As a researcher, it was necessary to consider COVID-19 regulations to avoid the spread of the virus. The researcher ensured that the participants wore masks, and that a hand sanitiser was applied. A social distance of 1,5m between the participants was maintained. The windows were wide open to bring in fresh air and the number of learners were limited to avoid overcrowding.

3.10 Summary of the chapter

The research design employed to explore how smart boards can enhance creativity in the Technology classroom was discussed in this chapter. The chapter also addressed the process of selecting the population from which a sample was drawn, as well as the participants that formed part of the study. Furthermore, the data collection techniques used in the qualitative approach were discussed, specifically highlighting the conduct of semi-structured interviews and non-participant observations. A clear description of how the data obtained from these methods were analysed was presented. The trustworthiness of the qualitative instruments, including aspects of credibility, transferability, confirmability and reliability was outlined and deliberated upon as well as the ethical considerations. Finally, a summary of the chapter was given.

The next chapter provides a detailed analysis and discussion of the collected data based on the purpose of the study. Semi-structured interviews for both teachers and learners were used to support the findings of the study from observations. The

researcher started by analysing observation data. This was supported by findings from teachers' interviews per category; followed by summary of the findings per theme, which was supported by literature; and lastly, the conclusion was drawn in terms of themes, which was supported by learners' interviews. The chapter also provides the summary of findings.

CHAPTER 4: DATA ANALYSIS AND DISCUSSION

4.1 Introduction

The previous chapter discussed the methodology of the study, which included qualitative approach and case study design. Secondly, the population, the sampling size and sample techniques used were also discussed. Lastly, the data collection, analysis techniques, and trustworthiness of the qualitative research instruments.

This chapter analysed and discussed the findings from the semi-structured interviews and non-participant observations. Four Technology teachers participated on the non-participant observations which was focusing on how smart board can enhance teacher's creativity, and the semi-structured interviews which was based on the teachers' perception on the effectiveness of the smart board to enhance teacher's creativity. Eight learners were only interviewed based on their perceptions towards the use of smart board in the classroom. The data were analysed based on the purpose of the study. Themes and categories were used to group or arrange the data, the themes were drawn from the creativity theory and the categories from the 9E instructional model. The researcher started by analysing the data from the observations tool, then the interviews for teachers were used to support the findings from observations, and the learners' interviews were used to support the conclusion per theme. The literature was used to support the summary per category. Pictures for teacher 3 were also presented as evidence of the findings per category. Lastly, the summary of the findings and chapter summary were also presented.

4.2 How the smart board can effectively enhance the teachers' creativity?

The non-participant observations were done in term three when the observed Grade 6 Technology teachers were teaching based on the topic of electrical conductors and insulators which is a topic that follows after the electric circuit. Four teachers were observed on how they use the smart board to enhance their creativity in the classroom. As stated in Chapter 2, the teachers were observed on how they used the smart board to make their lessons more **interesting, exciting, effective** and **develop the learners' creative thinking skills** which were the themes. Each teacher was

observed during all the nine phases of classroom activity that were outlined by Ramaligela et al. (2019) which were categories. The categories were discussed per each theme below:

4.2.1 Interesting lesson

This theme was observed during the elicit phase, elaboration phase, and exploration phase.

4.2.1.1 Elicit Phase

The elicit phase involved how the teachers creatively used the smart board features to develop *interesting* questions that elicited the learner's previous knowledge.

To assess the learners' prior knowledge, various methods were employed by the teachers, including the use of diagrams, PowerPoint presentations, and the question-and-answer approach. For instance, Teacher 1, 2 and 3 utilized diagrams, with **Teacher 1** introducing the lesson by displaying an electric circuit diagram on the smart board. The learners were then tasked with filling in the names of the components using a special pen. Interestingly, many learners expressed a strong desire to directly write on the smart board. **Teachers 2** used animations using the power point with diagrams display different questions based on the previous lesson and asking the learners to respond to the questions in groups. The learners came up with different answers, although they did want to work in groups. Similarly, **Teacher 3** began the lesson by presenting an electric circuit diagram and requesting the learners to identify the components depicted. In response, numerous learners eagerly raised their hands, indicating their willingness to approach the smart board and write down their answers. Teacher 3's classroom implementation is substantiated by the accompanying picture below.

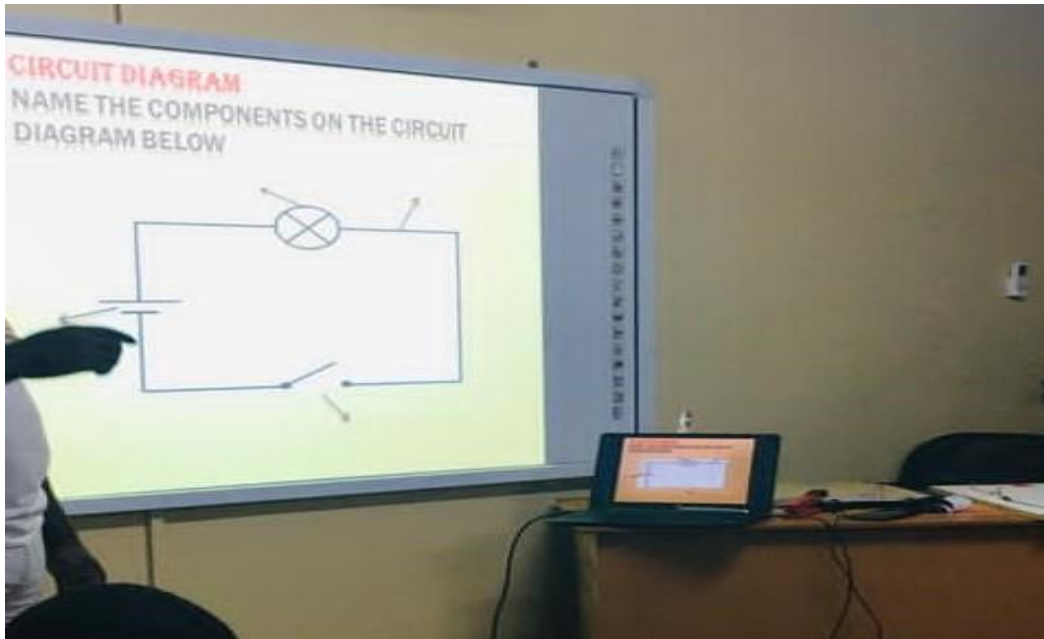


Figure 4.1: Teacher 3 -Electric circuit diagram on a smart board

In agreement with one another, all three teachers expressed their belief in the effectiveness of using videos and diagrams to engage learners and activate their prior knowledge. During the interviews, **Teacher 1** emphasized the potential of the smart board, stating, "*The smart board can be instrumental in eliciting learners' prior knowledge. I can utilize various diagrams and videos sourced from the internet to remind the learners of what they have previously learned.*" Similarly, **Teacher 2** shared a similar perspective, affirming that, "*the smart board can aid in eliciting learners' prior knowledge by incorporating different diagrams through PowerPoint presentations and utilizing videos from the internet*". **Teacher 3** also recognized the value of the smart board in this regard, explaining, "*The smart board can assist me in eliciting learners' prior knowledge because learners are able to visually and physically interact with the diagrams displayed on the screen. Even if they have forgotten the subject matter, seeing it projected on the smart board serves as a reminder.*"

In contrast, **Teacher 4** started by asking the learners questions and by requesting them to name all the components that are found in an electric circuit diagram. A few learners raised their hands to respond to the question, which means the lesson was not interesting. Interestingly, during the interviews, **Teacher 4** also said that "*Yes, smart board can assist, because through smart board we can save and retrieve notes or questions papers based on what they have learnt, then they could be asked*

questions of the lesson or subject matter". This was the teacher who also used the question and answer method during the observation.

In summary, the study findings indicated that the majority of teachers effectively elicited learners' prior knowledge, while one teacher struggled to do so in an interesting manner. The teachers utilized the smart board to create and present diagrams, as well as deliver PowerPoint presentations, with the aim of making the lessons more interesting during the prior knowledge elicitation process. Specifically, they displayed an electric circuit diagram on the smart board, clearly depicting its components, and prompted the learners to label them. Although the use of PowerPoint presentations was not identified as particularly interesting, the learners still displayed interest and actively participated. Notably, the use of diagrams aligns with the findings of Wetzels et al. (2011), who highlighted the efficacy of pictures and diagrams in stimulating prior knowledge.

4.2.1.2 Elaboration phase

The elaboration phase involves how the teachers use the smart board to access interesting YouTube videos or online educational resources to elaborate on the learners existing knowledge.

It was observed that teachers effectively utilized the smart board to build on the learners' existing knowledge in an interesting manner through the use of diagrams, pictures, and YouTube videos. The majority of teachers primarily relied on diagrams and pictures to elaborate on the learners' existing knowledge. For instance, **Teacher 2** displayed pictures of a wire and a rubber to illustrate the difference between conductors and insulators. The learners showed heightened attention when these visuals were presented on the smart board. Similarly, **Teacher 3** prompted the learners to identify the functions of various components in an electric circuit diagram, displaying relevant pictures on the smart board. **Teacher 4** utilized an electric circuit diagram to explain the flow of electricity and supplemented the explanation with a practical demonstration using real circuit components. The learners displayed increased attentiveness during the practical demonstration as the teacher illustrated how the components functioned.

In confirmation, even during the interviews, all the three teachers maintained the use of diagrams and pictures as a creative way to build on learners' existing knowledge. For instance, **Teacher 2** responded that, *“Yes, because most of our learners are good at learning by visualising things, As the teacher would show the diagrams or pictures based on the lesson to be presented.”* Similarly, **Teacher 3** also indicated that, *“I will prepare a lesson include material like images or videos that would connect to their everyday experiences”*. However, one teacher used a question and answer method. During the interviews, **Teacher 4** said that *“yes, since smart board is an interactive board, learners learns a lot through smart board since they can apply their knowledge in solving daily problems or even daily experience e.g., educational games, even seeking different kind of information even learning different concepts”*.

In contrast, **Teacher 1** introduced a YouTube video demonstrating the flow of current through a wire (conductor), which captured the learners' significant interest. However, during the interviews Teacher 1 said something different, that he uses diagrams to elaborate on the learners existing knowledge. For instance, **Teacher 1** said *“Yes, you can display different diagrams for learner's understanding, and that's what they see every day, so they relate and learn easy”*.

In summary, the findings of the study indicate that the teachers effectively utilized the smart board to build on the learners' prior knowledge in an interesting manner. They employed various visual aids such as diagrams, pictures, and videos to build upon the existing knowledge of the learners. Notably, the participants demonstrated an interesting use of diagrams and pictures with vibrant colours to explain the concepts of insulators and conductors. The inclusion of visuals, such as a picture of a wire and a rubber, effectively conveyed the distinctions between these components. The learners showed a strong interest in the visually appealing content presented on the smart board. These findings align with the research conducted by Tsayang et al. (2020), who reported that the integration of different features of the smart board, including You Tube videos, pictures, and simulation tools, contributed to an enhanced understanding of the learning concepts among the learners.

4.2.1.3 *Exploration phase*

The exploration phase involved how the teachers use the smart board programmes to interestingly introduce new concepts to the learners. To introduce the new concepts to the learners in an interesting way, the teachers used effective online resources, real objects, power points with diagrams, images or pictures, videos and the smart notebook through the smart board.

However, most participants were using clear diagrams and pictures. For an example; **Teacher 1** used the diagrams and the images that were downloaded from google to introduce the concept of how the insulator works on a circuit diagram. The diagrams were colorful and interesting. **Teacher 2** displayed the example of an insulator and a conductor. A picture of a wire and a picture of a rubber were displayed to explain the difference between the two components. The learners focused more on the activity which was on the smart board. **Teacher 3** used diagrams and videos from the internet to explain and relate the concepts. The learners paid more attention to the video. **Teacher 4** used a smart notebook to draw the circuit diagram using smart board. The drawings were done by hand. The teacher also had the real electric circuit to show the learners how electricity flows through. Learners were more interested to the way in which the teacher uses the smart note book.

In confirmation, during the interviews, **Teacher 1** said that *“yes, a smart board itself is a new technology, part of the IoT (Internet of things), the technology conveyed more than new terms”*. **Teacher 2** mentioned that *“Yes, a smart board allows teachers to browse the web, where there are many learning resources including videos, diagrams and more that can be used to introduce new concepts. Teacher 3 said that “yes, it does. Because as a teacher you can use good to search better definition of a term, Smart board accommodates all the teaching and learning styles, meaning a video can be used to explain, even a diagram can be used to introduce a concept”*. However, one other teacher could not use the online diagrams, but they had drawn it by hand. During the interviews the teacher indicated that the videos and the diagrams from the internet assist him to introduce new concepts to the learners. **Teacher 4** said that *“Yes, as a teacher, I display a picture which relate to the topic and ask learners to look at the illustration and ask what do they think. For an example, as Technology teacher if I teach about electric circuit, I play videos showing lights and another without lights at*

night and ask the learners to say what are they seeing, what do they think, and how will the situation impact people living in that area. Then the learners will know that they will be talking about current flow”.

In summary, the study revealed that the teachers employed various strategies to introduce new concepts to the learners in an interesting manner. One approach involved presenting PowerPoint presentations that included diagrams, images, and pictures, as well as utilizing YouTube videos and the smart notebook feature for freehand drawing on the smart board. However, the predominant method used by the teachers was the use of diagrams and pictures to captivate the learners' interest while introducing new concepts. This approach aligns with the findings of Torres and Kunt (2012), who emphasized the effectiveness of utilizing pictures and videos for introducing new concepts. By incorporating visual stimuli, the teachers fostered an interactive learning environment where the learners could actively observe, think, and discuss the presented material.

In conclusion, when assessing how teachers use the smart board to make their lesson interesting in Technology classroom, the study found that teachers were able to make a lesson interesting during the elicit phase, the elaboration phase and the exploration phase. The teachers used diagrams, pictures, power point presentations, YouTube videos, and free hand drawings using the smart notebook to make their lessons interesting. This mode of using the smart board to make lessons interesting was also asserted by the learners when they indicated that their teachers used diagrams, pictures and YouTube videos to present lessons in an interesting way. For example, during the learners' interviews **Learner 4** said that, *“my teacher started by introducing us to the lesson and then projected a related diagram and posed questions based on the diagram”*. **Learner 2** said that, *“my teacher used a YouTube video based on real life situation connecting with the lesson to be taught, we all watch it and then tell on what we have noticed.”* **Learner 6** said that, *“my teacher used the smart notebook to illustrate the concepts and it was very interesting”*.

4.2.2 Exciting lesson

It is very important for the teachers to plan exciting lessons when developing the lesson plan. This theme was observed during the enlightening phase.

4.2.2.1 Enlightening phase

The enlightening phase involves how the teachers use the smart board to access *exciting* online resources for describing a complex idea in a simple way.

To clarify and describe the various concepts to the learners in a simple way, the teachers used pictures, diagrams and videos. However, half of the teachers used videos together with diagrams to clarify and describe the concepts in an exciting way. For instance, **Teacher 1** used animations, diagrams, and pictures in the power point presentation to explain an insulator and conductor. The learners were very excited to see the animated slides. The teacher also used a very short YouTube video to give clarity and to summarise the whole lesson. The learners were all glued to the smart board watching the video. **Teachers 3** also used a video based on conductors and insulators to clarify how they work when they are connected in a circuit. The learners were excited to watch the video.

Both teachers confirmed what was observed, for example, during interview For example, **Teacher 1** highlighted that: *“Yes, because of its interactive ability and connection to the internet, for an example, using google as my search engine to find a particular term or description can bring insight by displaying different or synonymous terms with regards to searched item”*. The learners concentrated to the board for they were excited to watch the video. Similarly, **Teacher 3** said, *“Yes, I think smartboard can assist a lot in relating different concepts. As a teacher when teaching a certain concept, I will be able to search and find information based on the concepts, as a smartboard has access to internet”*. Of which the teacher was talking of using google search to find the videos for clarifying concepts”.

The other half used only diagrams and pictures to clarify the concepts. For an example, **Teacher 4** used diagrams for giving clarity to the learners based on insulators and conductors. Teacher 4 confirmed what was done during the observations. For an example, He said *“Yes, I definitely agree. Smart board is a learning friendly tool for learners where the teachers can create activities where learners can learn in different platforms, some can learn from integrating diagrams and pictures and relate to the activities”*. **Teacher 2** used clear pictures and notes that were presented in points form on the smartboard. The learners were interested to see the pictures and they seemed to understand the lesson. **Teacher 2** also confirmed what was observed on teacher 1 and 3, that the diagrams and videos assist in simplifying the concepts. For example, during the interviews the teacher said that, *“smart board can relate different concepts, teachers can access a video from YouTube to relate, and even diagrams can be used together with different colours”*.

In summary, the study found that, to clarify and describe the various concepts to the learners in a simple and exciting way, the teachers used animations, power point with diagrams, pictures and videos. However, most of the teachers used videos and diagrams. This is supported by Tsayang, Batane, and Majuta (2020) who reported that the learners indicated that the capabilities of the smart boards to present information in this visual way greatly assisted them in understanding the concepts better.

In conclusion, it was more exciting to watch the videos than just seeing diagrams and pictures. This way of using the smart board to make lessons exciting was also asserted by the learners when they indicated that their teachers used videos during the teaching and learning process. For example, **Learner 5** said that *“In my class we are enjoying when my teacher uses smart board, we are watching videos”*. **Learner 4** said that *“my teacher is using clear diagrams to explain”*. **Learner 6** said that, *“it is really exciting to see the teacher displaying some pictures in the class to relate different concepts”*. **Learner 8** said that *“in my class, they normally use online diagrams or tables”*.

4.2.3 Effective lesson

An effective lesson can make the learners to understand the content better, this theme was observed throughout the explanation phase and in the enclosure phase.

4.2.3.1 *Explanation phase*

The explanation phase involved how the teachers use the smart board to *effectively* explain specific concepts using different programmes or online resources.

The teachers used diagrams with videos, power points, and the smart notebook to explain a concept in an effective way. However, most of them used the smart notebook and the diagrams to explain concepts, for an example, **Teacher 3** used the smart notebook on the smart board to draw the circuit diagram to explain to the learners. The teacher also used voice and screen recording to record anything that was written on the screen and the teacher's voice during class to share the recordings with the learners. **Teacher 4** used the smart notebook on the smart board to draw the circuit diagram for explanation to the learners.

Even during the interviews, Teachers 3 and 4 indicated that they use different ways to explain the concepts. For an example **Teacher 3** said *“There are many methods that I can use to explain different concepts through smart board, such as writing notes or playing a related video in the class”*. **Teacher 4** said that, *“smart board can integrate different concepts at once, by relating the concepts or differentiating concepts at once through videos or diagrams, it also promotes the tentatively of technology concepts and relating with scientific concepts even in other learning areas more especially processing to be linked with electrical system and control with electricity in real life”*. Teachers 3 and 4 also indicated the use of videos to explain concepts.

In contrast, **Teacher 1** used different diagrams together with a YouTube video which was downloaded from the internet to explain about the insulator and the conductor. The learners were attracted by the diagrams. This was confirmed even during the interviews. For an example, **Teacher 1** said that *“smart board makes learning more enjoyable by incorporating visual components. Learners are better able to absorb the concepts being taught because the classes are audio-visual”*.

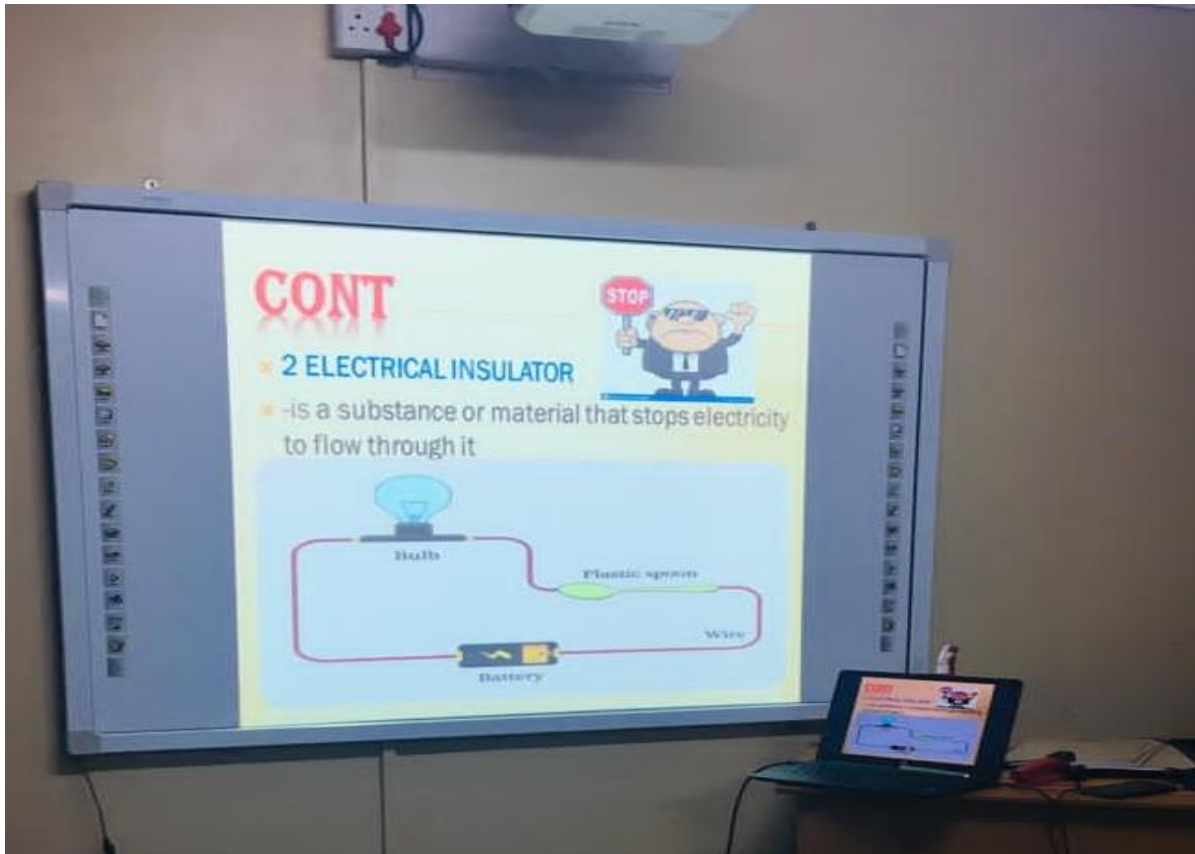


Figure 4.2: Electric circuit

However, this other teacher had a different way of explaining concepts. **Teacher 2** used the power point presentation, where the explanations were in bullets form. The captions were colourful, and the font size was big enough, so most of the learners concentrated on the board. Although during the interviews the teacher just indicated how the smart board would assist in the process of finding not presenting. For an example, **Teacher 2** said that *“yes, a smart board can assist in explaining of concepts, a teacher can give different explanation of one concept, it also elaborates more, you can consult difference scholars from online”*.

In summary, the findings revealed that, *the* smart board was used by the teachers to access diagrams with videos, and the power point, smart notebook for explaining concepts in an effective way. However, most of them used diagrams and the notebook to draw some of the diagrams as they were explaining different concepts and enhanced the learners’ understanding. This is because the boards allowed the presentation of content in a visual form, thereby making concepts clearer (Tsayang et al., 2020).

4.2.3.2 *Enclosure phase*

The enclosure phase involved how the teachers used the smart board for summarising concepts in an effective way.

To summarise concepts in an effective way, YouTube videos, and the power points were used. However, most teachers used the power point presentations. For instance, Teachers 2, 3 and 4 used power the point presentations to effectively summarise the concepts. For an example, **Teacher 2** consolidated the learners' responses and clarified the learners' misconceptions by giving them relevant and clear explanations through displaying more diagrams on the screen. The teacher used bullets to write the summary in point form. **Teacher 3** used Power points and bulleting to summarise the concept which was captured in color pen. A video was also played to summarise a content and it was more exciting. **Teacher 4** summarised the concepts through the use of the power point presentation. The learners were taken back to the introduction, the body, and the conclusion.

This was also confirmed during the interviews, as **Teacher 2** said that *"Yes, it can assist in summarising the work, at the end of any lesson through smart board a teacher should have a summary of the whole lesson, in point form"*. In the same footing, **Teacher 3** said that *"Yes, it does. Since they are more practical than a chalkboard, I summarise concepts by displaying them on points form in the smart board"*. In contrast, **Teacher 4** said that *"Yes, it does. Because mostly smart board can integrate concepts meaning, through integrating there is a great deal of concluding this can also be revealed through diagrams and videos"*. Teacher 4 spoke of the diagrams and the videos which support the findings from Teacher 1.

However, **Teacher 3** used both power point and video and **Teacher 1** used a very short YouTube video to summarise the whole content (see the picture below). The video explained the insulator as well as the conductor and the learners were glued to the board watching the video. The teacher asked questions throughout the lesson as the YouTube video was playing to engage the learners. During the interviews, Teacher 1 indicated that he would use the document and other educational tools. **Teacher 1:** *"Yes, it does help me summarise using a "document" form of presentation and utilising*

a variety of educational databases and tools. Even better reduces the use of chalk and papers”.

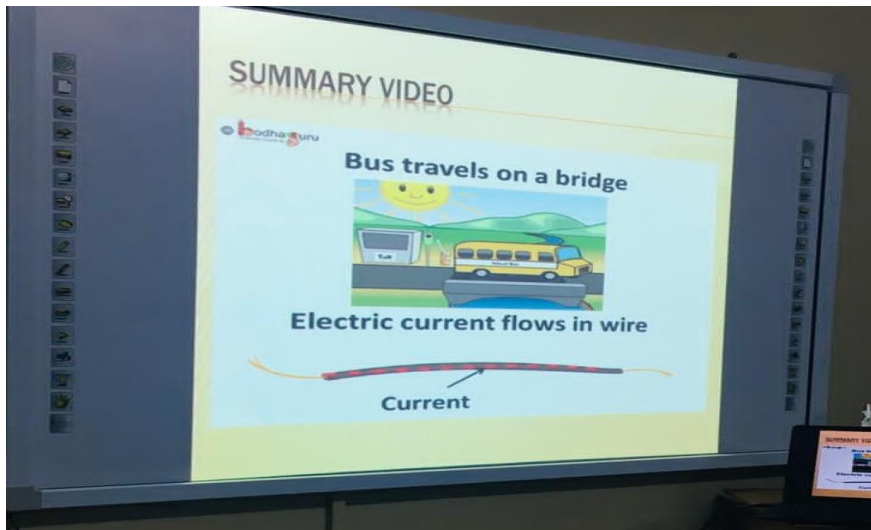


Figure 4.3: Teacher 3- picture of a smart board showing summary video

In summary, the study found that, to enclose the lesson effectively, You Tube videos and power points presentations were used, however, most teachers used the power point presentations to effectively summarise the concepts. This finding are Craig and Amernic (2006) who outlined that, the power points are used by the presenters to summarize the key concepts in as few words as possible using bullet points.

In conclusion, when exploring the teachers' use of the smart board to make their lesson effective, the findings revealed that, the smart board was used by the teachers to access You Tube videos, as well as to summarise on power point with diagrams as well as the smart notebook for explaining concepts in an effective way. However, most of them used diagrams and the smart notebook to draw some of the diagrams. This mode of using the smart board to make the lesson effective through power point presentations, YouTube videos and the smart notebook was also asserted by the learners during the interviews. **Learner 5** said that, *“The smart board helped my teacher to summarise a lesson in an effective way because he was able to display the summary in power point on the smart board”*. **Learner 6** also said that, *“My teacher used a video to summarise the lesson”*. **Learner 1** highlighted that, *“In most cases, the teacher uses diagrams to relate different concepts”*. **Learner 3** said that, *“The YouTube videos are sometimes used for more clarity and understanding”*.

4.2.4 Develop learners' creative thinking skills

The learners need to develop their creative thinking skills to solve issues in real life contexts. This theme was observed during the evaluation phase, engagement phase and in the exchange phase.

4.2.4.1 Evaluation phase

The evaluation phase involved how the teachers use the smart board to design assessments that develop the learners' creative thinking skills.

During the observations, the teachers designed a practical task, a quiz, as well as a class activity that were presented on Microsoft word to evaluate the learners' learning. However, half of the teachers used class activity displayed on word documents or power point,

For an example, **Teacher 4** presented the class activity using the power point on the smart board and the learners were asked to differentiate between the conductor and the insulator. It was also confirmed that the teacher gives class activities on the smart board through power point presentations. **Teacher 2** designed a class activity on word document, and it was displayed on the board, the learners were allowed to use their books to complete the task. They wanted to write answers on the board.

This was also confirmed from the interviews as **Teacher 2** said *"Yes, it assists me because on the smart board we save assessment tasks, I always ask the questions based on the lesson, and allow them to come and write on the smart board"*. **Teacher 4** said that, *"The learners can be assessed at different levels through different assessment strategies, activities of learners can be classified or grouped depending on the cognitive levels of learners at the same time, hence smart board can save time to do more work at less time, so most of classroom activities are done in the smart board"*.

In contrast, **Teacher 1** designed a practical task, and the learners were requested to come and draw the electric circuit on the smart board. The learners used a black pen to draw the circuit on the smart board and a red pen was used for the labels. The learners were also given a task to name the components on a diagram which was displayed on the smart board. During the interviews, **Teacher 1** indicated the use of

the diagrams, videos, as well as the test and quiz which is relevant to what has been observed. *For example, the teacher said “via smart board I can access online learning resources such as YouTube videos based on a certain topic, I can get diagrams based on the lesson to be taught, even a test or quiz can be used to evaluate learners’*

Teacher 3 used a quiz, where the learners had to provide answers on the smart board. Most learners participated. In confirmation to that, during the interviews. Teacher 3 was allowing the learners to go and write the answers on the board (see the pictures below figure 4.4 and 4.5). In confirmation, during the interviews **Teacher 3** said “Yes, I normally use the smart board to evaluate learners in the sense that I allow them to write even a test on it instead of a paper to see if they have learnt”.

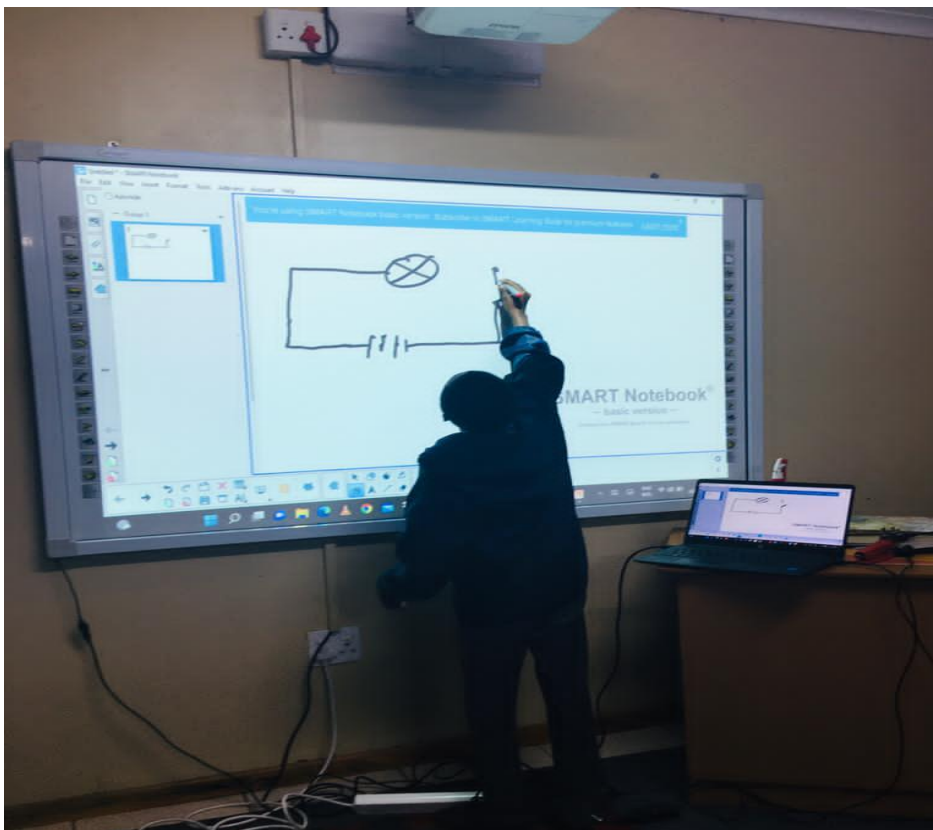


Figure 4.4: Picture of a learner drawing an electric circuit

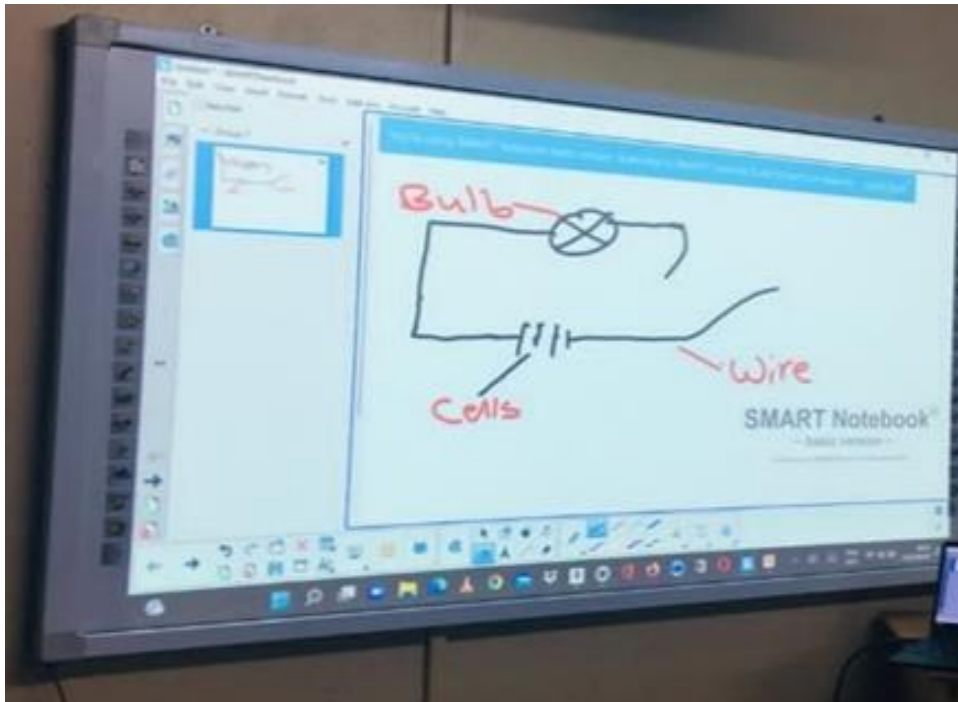


Figure 4.5: Free hand drawing of an electric circuit on a smart notebook

In summary, during the observations, the teachers designed a practical task, a quiz and class activities on word document to evaluate the learners' learning. Only the practical task and the quiz could evaluate and develop learners' creative thinking skills, since the learners had to be creative to complete the tasks. The findings are supported by Zhao (2019) that an interactive quiz is a learning evaluation medium that is used by many teachers and researchers. In addition, evaluation of computer-based delivers results fast and accurate evaluation

4.2.4.2 Engagement phase

This category looked at how the teachers engage the learners and develop their creative thinking skills.

To engage the learners in the teaching and learning process as well as to develop the learners' creative thinking, the teachers used you tube videos, quiz, shows and the hide feature, as well as the question and answer method. Most of the teachers presented the questions on the smart board and they invited the learners to respond on the smart board, for instance, **Teacher 1** asked the questions throughout the

lesson. The YouTube videos were played to engage the learners. The words were written in big font size, and they were colorful. The learners were asked to answer the questions which were displayed on the smart board using the special pen. **Teacher 4** had a quiz where the learners had to answer to assess if they were understanding the lesson. The learners were asked to go and write the answer on the smart board. It is evidenced below.

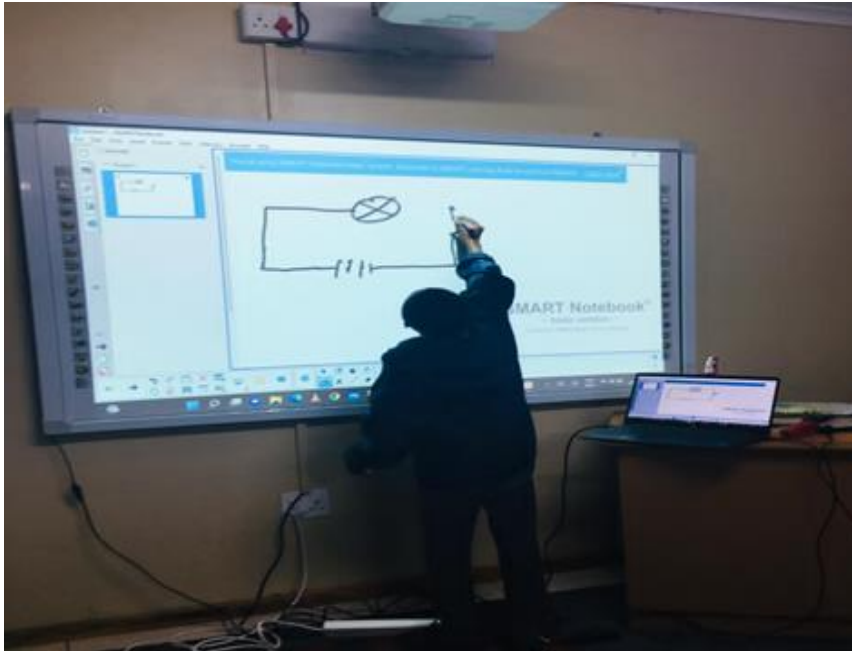


Figure 4.6: A Picture of a learner using the smart notebook

Teacher 2 involved the learners in activities by discussion and questions were imposed to the learners so that they get stimulated in the process. The teacher employed the show and hide functionality, wherein the question was displayed while the answer was concealed by dragging a coloured page over it, allowing the learners to reveal their own responses. However, only one teacher was just verbally asking the questions, for instance, **Teacher 3** was asking questions as the lesson was in progress. The learners were called to go and write their answers on the smart notebook.

The findings were also confirmed through the interviews, as all the teachers indicated that they allow the learners to go and interact with the smart board through presentations. For example, **Teacher 1** said that *“With the help of a digital board for*

classrooms, audio, video, graphics, charts, and graphs are all intelligently integrated on a single platform. The smart board's touch screen provides a fun and interactive way for learners to complete courses and stay engaged. Multiple learners can use the board at the same time, and most learners learn best when their hands-on". **Teacher 2** noted that *"I use smart board to keep learners active throughout the lesson by allowing them to interact with the board, for an example, I would ask them a question then allow them to come write their answers on the board"*. **Teacher 3** stated that, *"I would make sure I create activities that would allow the learners to participate actively. For instance, I would allow them to use the smart board so that they don't get bored"*. **Teacher 4** highlighted that, *"I usually create activities that encourages learner centeredness where they interact, as groups discusses and present on the board, cooperative learning at this point serves stimulates the interest of learners at different point of learning skills from each other as well"*.

In summary, to engage the learners in the teaching and learning process as well as to develop the learners' creative thinking, the teachers used You Tube videos, quizzes, the show and hide feature, as well as the question and answer method. This is supported by Hughes et al. (2020) findings that, the learner's engagement and the learning experiences were impacted positively by the employment of the weekly quizzes. Most of the teachers engaged the learners throughout the teaching and learning process and they developed their creative thinking skills by giving them the activity and allowing them to interact as they write their feedback. Although the teachers engaged the learners, it cannot be said that all the learners were fully engaged in the learning. Therefore, the teachers need some training to be up-to-date with the various skills that can be used to increase the level of learner engagement in the classroom through the smart board (Karsenti, 2016).

4.2.4.3 Exchange phase

The **exchange phase** involved how the teachers use the smart board programmes together with the learner's ideas to correct the misconceptions in a way that develops the learners' *creative thinking skills*.

Therefore, to use the learner's ideas to correct their misconceptions, different teaching and learning strategies, diagrams, videos and other visuals were used as learning activities during the observations. For example; **Teacher 2** used the answers that the

learners presented, or the learners' responses in the activities. The teacher further involved the learners in a constructive manner by allowing them to present information in their own understanding. All the learning styles were accommodated. **Teacher 3** used more than two teaching and learning styles, in the sense that the teacher had diagrams for the visual learners, as well as videos for the visual and the auditory learners. **Teacher 4** accommodated most of the learning styles, as diagrams were there for the visual learners, and words were there for the reading/writing learners. The learners were called to write on the board. The learners seemed to enjoy the use of the diagrams.

However, **Teacher 1** gave an activity in the form of a diagram (see the picture below) to the learners based on what they had learnt which included the answers they had been giving to the teacher. All the learners completed the task. The teacher also provided answers to the learners through the explanation on the smart note book.

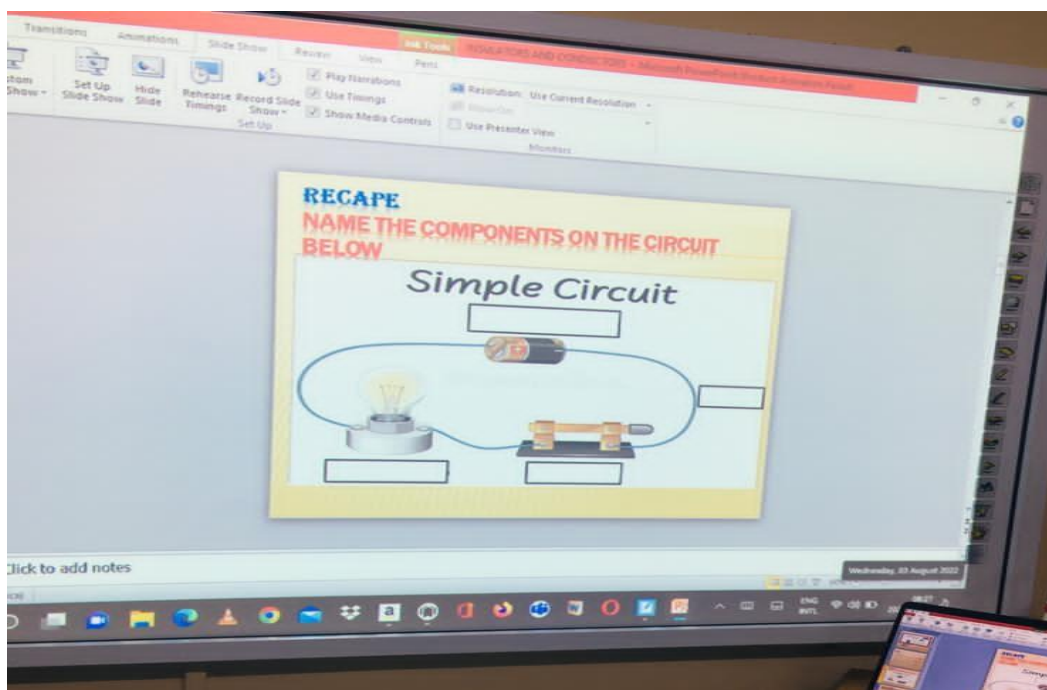


Figure 4.7: Simple circuit

In the same way, the observation findings were confirmed from the interviews that different teaching strategies are used by the teachers to correct the learners' misconceptions. For example, **Teacher 1** said that, *"Because learners can still come and write on the smart board, and the corrections can be done on smart board, as the*

*learners interact with the board they become more creative. Different teaching styles can be used through smart board". **Teacher 2** stated that, "It assists in terms of avoiding misconceptions, hence you cannot use it while you are not prepared enough, since it requires you as a teacher to plan. it is not a one way of learning, so many methods can be used to avoid misconceptions". **Teacher 3** highlighted that, "Smart board can aid me to use learners' idea to correct their misconceptions in a sense that learners can be called to give answers and the smart board can mark the answers and also provide correct ones". In the same way, **Teacher 4** said that "Through learners' interactions and responses, I can identify areas that needs attention or clarity in the form of misconception. Misconception can be corrected through presenting diagrams, answering direct questions or demonstrating. This is where I will be using their various form of response to clarify their misconception".*

In summary, the findings revealed that all the teachers could correct the learners' misconceptions through the smart board programmes and they also could develop the learners' creative thinking skills. Most teachers showed that it was really possible to use the smart board to accommodate all the types of the learners. They used different teaching and learning styles as some teachers were using videos, while some were using diagrams and pictures. The findings are in line with Bakadam and Asiri (2012) who reported that most teachers stressed that they believed that the smart boards would give them different teaching methods that were suitable for conveying a content to the learners and it improved the learning methods for the learners.

In conclusion, when exploring the teachers' use of the smart board to design lessons that develop the learners' creative thinking skills, during the observations the teachers designed a practical task, quiz to evaluate the learners' learning. Overall, the practical task and the online quiz could evaluate and develop the creative thinking skills. To engage the learners in the teaching and learning process as well as to develop the learners' creative thinking, the teachers used You tube videos, quizzes, the show and hide feature, as well as the question and answer method. However, most if the teachers exchanged ideas with the learners throughout the teaching and learning process and they developed their creative thinking skills by giving them activities and by allowing them to interact with the board as they were writing feedback. Lastly, the findings revealed that all the teachers could correct the learners' misconceptions

through the smart board programmes and through developing the learners' creative thinking skills by using different teaching and learning styles. The mode of using the smart board to present practical tasks, quizzes, class activities, You Tube videos, the question and answer method, different teaching and learning styles as well as allowing the learners to use the smart board to develop the learners creative thinking skills was also asserted by the learners, for example, **Learner 3** said that, *"The teacher asked questions based on the lesson and let us come and present on the board to engage us in the learning process"*. **Learner 2** said that *"The teacher uses quiz to evaluate our learning"*. **Learner 1** stated that, *"The teacher uses different teaching styles to accommodate every learner so that we all understand in the class"*. **Learner 7** highlighted that, *"Our teacher plays a video and ask us about the lesson we receive from it"*.

4.3 Summary of the findings

The purpose of this study was to explore the effectiveness of the smart board in enhancing the Technology teachers' creativity. When analysing the collected data from the semi -structured interviews and the non-participant observations, the study found that, a smart board can enhance the Technology teachers' creativity. As the theory stated, creative teaching involves making a lesson more Interesting, exciting, effective, and develop learners' creative thinking skills. The study found that Technology teachers were able to present lessons which were interesting, exciting, effective, and developed learners' creative thinking skills through the use of the smart board. They displayed diagrams, pictures, You Tube videos, animations, power points presentations, free hand drawings, practical tasks, quizzes, and class activities using the smart notebook.

Firstly, to make the lesson more interesting during the elicit phase, the teachers used diagrams and power point presentations to draw learners' prior knowledge. During the elaboration phase, the teachers used diagrams, pictures and You Tube videos to build on the learners existing knowledge. During the exploration phase, the teachers were demonstrating the circuit board, power point presentations with diagrams, images or pictures, You Tube videos and free hand drawing using the smart notebook that was found from smart board to introduce new concepts. **Secondly**, to make a lesson exciting through the use of smart boards in the enlightening phase, the teachers used

animation, diagrams, pictures and You Tube videos to clarify and describe various concepts. **Thirdly**, to make a lesson effective during the explanation phase, the teachers used diagrams, You Tube videos, power point presentations and smart notebook for explaining concepts in an effective way. During the enclosure phase, teachers used You tube videos and power point presentations to summarise or enclose a lesson.

Lastly, to develop learners' creative thinking skills, teachers used smart board to design practical tasks and quizzes. During the evaluation phase, teachers used practical activities and a quiz. During the engagement phase, teachers used You Tube videos, quizzes, and the question and answer method with the show and hide feature to engage the learners in the learning and teaching process. During the exchange phase, teachers exchanged thoughts with learners throughout the teaching and learning process and this enhanced their creative thinking skills by giving them activities and allowing them to interact with the board as they were writing feedback. Also exchange phase assisted the teachers to correct the learners' misconceptions through the use of different teaching strategies.

4.4 Summary of the chapter

In this chapter, the analysis and discussion of the findings obtained from both the semi-structured interviews and non-participant observations were presented. The non-participant observations focused on exploring how the smart board can enhance teacher creativity, with the participation of four Technology teachers. Additionally, the semi-structured interviews were conducted to gather the teachers' perceptions regarding the effectiveness of the smart board in enhancing their creativity. Furthermore, the perceptions of four learners regarding the use of the smart board in the classroom were also explored through interviews.

The collected data were analysed in accordance with the study's objectives. Themes and categories were utilized to organize and arrange the data, with the themes derived from the creativity theory and the categories derived from the 9E instructional model. The analysis process began with examining the data from the observations tool, which was then complemented by the insights obtained from the interviews with the teachers. The interviews with the learners were used to support the conclusions drawn for each theme. Additionally, relevant literature was utilized to provide further support and

context for the summary of each category. Notably, visual evidence in the form of pictures depicting the experiences of teacher 3 was included to substantiate the findings pertaining to each category. The researcher found that the smart board can enhance the Technology teachers' creativity. The findings revealed that, the teachers presented their lessons which were more interesting, exciting and effective. They also developed the learners' creative thinking skills through the use of the smart board. They displayed diagrams, pictures, You Tube videos, animations, power points presentations and free hand drawings through the smart note book, practical tasks, quizzes, as well as class activities using the smart notebook during the lesson presentations.

The following chapter outlined the conclusion that was drawn from the findings, and the limitations that emerged during the whole process of data collections. It also includes the recommendations from the study findings and the chapter summary.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Introduction

The previous chapter analysed and discussed the findings from the semi-structured interviews and non-participant observations. The data were analysed based on the purpose of the study. Themes and categories were used to group or arrange the data, the themes were drawn from the creativity theory and the categories from the 9E instructional model. The non-participant observation was the primary data collection tool, then the interviews for teachers were used to support the findings from observations, and the learners' interviews were used to support the conclusion per theme. The literature was also used to support the summary of the findings per category. The summary of the findings and chapter summary were also presented.

Therefore, this chapter outlines the conclusion that was drawn from the findings, and the limitations that emerged during the whole process of data collections. It also includes the recommendations from the study findings.

5.2 Conclusion

The purpose of the study was to explore the effectiveness of the smart board in enhancing the Technology teachers' creativity. The study was guided by the theory of creativity as a lens through which to look at the study and the 9E Instructional model that was used as an activity guide to understand the study. The themes were drawn from the theory and the categories were drawn from the 9E instructional model. The study found that the smart board was effective in enhancing the Technology teachers' creativity. The findings revealed that the smart board was able to assist the teachers to successfully make their lessons more interesting, exciting, effective, and developed the learners' creative thinking skills.

The findings of the study revealed that; **firstly**, to make a lesson more interesting when eliciting the learners' prior knowledge, the teachers use diagrams and power point presentations to formulate the questions. During the elaboration phase, the teachers use diagrams, pictures and You Tube videos to elaborate on the learners existing knowledge. During the exploration phase, the teachers use power point presentations

with diagrams, images or pictures, as well as You Tube videos and free hand drawing to introduce new concepts to the learners.

Secondly, to make a lesson exciting through the use of the smart board in the enlightening phase, the teachers used animation, diagrams, pictures and You Tube videos to clarify and describe various concepts. **Thirdly**, to make a lesson effective during the explanation phase, the teachers used diagrams with You Tube videos, power point presentations, as well as the smart notebook for explaining concepts in an effective way. In the enclosure phase, the teachers used You tube videos and power point presentations to summarise or enclose a lesson.

Lastly, to develop the learners' creative thinking skills, the teachers used the smart board to design practical tasks, online quizzes, as well as class activities that were presented on Microsoft word to evaluate the learners' learning progress. During the engagement phase, the teachers used You Tube videos, online quizzes, as well as the question-and-answer method with the show and hide features to engage the learners in the learning and teaching process. During the exchange phase, the teachers exchanged ideas with the learners throughout the teaching and learning process and they developed their creative thinking skills by giving them activities and by allowing them to interact with the board as they were writing feedback and different teaching strategies to correct the learners' misconceptions.

In conclusion, the study found that most teachers were using diagrams and You Tube videos in all the themes to enhance their creativity. Therefore, it is proven that a smart board can indeed enhance the teachers' creativity compared to the chalkboard. Without a smart board, it is almost impossible for the teachers to make a lesson to be more interesting, exciting, effective, and develop the learners' creative thinking skills. The findings of this study are a call for the DBE and other relevant people (i.e. teachers) to consider and encourage the use of the smart boards in the schools as it is a good tool for enhancing the teachers' creativity.

5.3 Limitations and recommendations

5.3.1 Limitations

The aim of this study was to explore the Grade 6 Technology teachers' creativity. The research was limited to Technology teachers and learners from the Nkomazi East Circuit schools, excluding other circuits. Consequently, the sample size was small, which restricts the generalizability of the findings to a larger population. Future research should aim to include a more extensive participant pool. Furthermore, only the perspectives of Technology teachers and learners were explored, neglecting the insights of other subject teachers. To gain a comprehensive understanding of the effectiveness of smart boards in enhancing creativity, future studies should encompass different grades and solicit input from various teachers. The study relied on a sample of four Technology teachers for semi-structured interviews and non-participant observations, along with eight Technology learners for semi-structured interviews. With such limited participation, additional participants may have yielded different outcomes. Future research should consider including teachers of other subjects as participants in studies related to creativity through the use of smart boards. While this study employed qualitative research methods, future investigations could benefit from employing both qualitative and quantitative approaches.

5.3.2 Recommendations

Looking at the study's findings, the smart board was successful in making the lessons more interesting, exciting, effective, and developed the learners' creative thinking skills; therefore, it is recommended as a great tool for enhancing the teachers' creativity. Through its interactive nature and the access to the internet, the smart board can enhance the teachers' creativity. The teachers should utilise the smart boards in their classrooms to enhance their creativity. The Mpumalanga Department of Basic Education should provide more smart boards to the schools. The curriculum developers should ensure that teachers are provided with content which can be presented using the smart boards and they must organise workshops or trainings for the teachers to learn more about the smart board programmes to improve their creative skills. Therefore, the study recommends that the smart board be utilised as a greater tool for enhancing the teachers' creativity which ultimately develop learners' creative thinking skills. Future research may focus on investigating the extent to which

the smart board features improve learners' creative thinking skills and understanding of various topics.

Future research should also focus on other circuits and provinces, as this study was conducted at the Nkomazi East circuit in the Mpumalanga Province. Future research should be conducted with other grades since this study focused on Grade 6. This study employed qualitative research as stated in Chapter 3, so future research studies could use both the qualitative and the quantitative methods. The participants were few, maybe more participants were going to give different results. The teachers teaching other subjects should also be considered as participants in future studies that are related to creativity through the use of the smart board.

5.4 Summary of the chapter

This chapter presented the conclusion that was drawn from the findings, and the limitations that emerged during the whole process of data collections. It also presented the recommendations from the study findings and the chapter summary.

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ANNEXTURE A TOOL 1: SEMI-STRUCTURED INTERVIEW SCHEDULE (TEACHERS' INTERVIEW)

Duration: 45 to 60min

Date:

During the presentation of lesson, smart board provide opportunities for creativity through teaching that is interesting, exciting, effective, and develop learner's creative thinking skills. However, we want to know the teachers' perceptions on the effectiveness of smart board in enhancing Technology teachers' creativity.

1. Elicit phase
 - a. Do you think smart board can assist you to elicit learners' prior knowledge in an interesting way? Why?
2. Elaboration phase
 - a. Do you think smart board can connect learners' everyday experience with the topic to make the learning more interesting? Please explain.
3. Exploration phase
 - a. Do you think the smart board assist you to introduce new concept to learners in an effective way? Can you explain how?
4. Enlightening phase
 - a. Do you think smart board assist you to relate different concepts to the topic in an exciting way? Can you explain how?
5. Engaging phase
 - a. Can you explain how do you use smart board to keep learners as active participants and also to develop learners' creative thinking skills?
6. Evaluation phase
 - a. Do you think smart board assisted your teacher in evaluating your learning and develop creative thinking? How?
7. Explanation phase
 - a. Do you think smart board assist you to explain different concepts in an interesting way in order to enhance learners' understanding? Explain how?
8. Enclosure phase
 - a. Do you think smart board help you to summarize concept in an effective way? Why?
9. Exchange phase
 - a. Do you think smart board assist you to use learners' ideas to correct their misconception as well as to develop learner's create thinking? Why?

ANNEXTURE B: TOOL 2: OBSERVATION SCHEDULE

Location: **Starting time:** **Date:**.....

Stopping time.....

9E instructional model in collaboration with the theory	Observed behavior
<p>1. Elicit phase</p> <p>How did the teacher use smart board to design interesting activities that elicit learner's prior knowledge?</p>	
<p>2. Elaboration phase</p> <p>How did the teacher use interesting online resources to build on learners existing knowledge through smart board?</p>	
<p>3. Explanation phase</p> <p>How did the teacher explain concepts for clear understanding in an effect way?</p>	
<p>4. Exploration Phase</p> <p>How did the teacher Introduce new concepts to learners in an interesting way?</p>	

<p>5. Enlightening Phase</p> <p>How did the teacher explain concepts using different and exciting online resources?</p>	
<p>6. Evaluation phase</p> <p>How did the teacher design assessment tasks that develop learner's creative thinking skill?</p>	
<p>7. Enclosure phase</p> <p>How did the teacher summarize concepts in an effective way for clear understanding?</p>	
<p>8. Engagement phase</p> <p>How did the teacher engage learners during the teaching and learning process to develop learners' creative thinking skill?</p>	
<p>9. Exchange phase</p> <p>How did the teacher used learner's ideas to create and rectify learners' misconception and develop their creative thinking skills?</p>	

ANNEXTURE C TOOL 3: SEMI-STRUCTURED INTERVIEW

SCHEDULE (LEARNERS' INTERVIEW)

Duration: 45 to 60min

Date: _____

During the presentation of lesson, smart board provide opportunities for creativity through teaching that is interesting, exciting, effective, and develop learner's creativity. However, we want to know the learners' perceptions towards the use of smart board in Technology classroom.

1. Elicit phase

1.1 Do you think the use of smart board made the lesson interesting when eliciting learners' prior knowledge? Why?

2. Elaboration phase

2.1 Do you think smart board has helped you to connect everyday experience with the topic in an interesting way? Explain how?

3. Exploration phase

3.1 Did the smart board assist your teacher to introduce new concept in an effective way? Explain how?

4. Enlightening phase

4.1 Do you think a smart board can assist your teacher to relate different concepts to the topic to make your learning more exciting? Why?

5. Engaging phase

5.1 Do you think smart board assisted your teacher to engage you during teaching and learning process and stimulate your creative thinking skills? How?

6. Evaluation phase

6.1 Do you think smart board assisted your teacher in evaluating your learning and develop creative thinking? How?

7. Explanation phase

7.1 Do you think smart board assisted your teacher to interestingly explain different concepts in order to improve your understanding? How?

8. Enclosure phase

2.2 Do you think smart board helped your teacher to summarize a lesson in an effective way? Why?

9. Exchange phase

9.1 Do you think smart board assisted your teacher to correct misconception in a way that develop your creative thinking? Why?

ANNEXURE D: LETTER TO REQUEST PERMISSION TO CONDUCT RESEARCH

TO: The Department of Basic Education

FROM: Researcher : Ndwandwe K.P

Email : khanyi.presh04@gmail.com

Contact : 0789832292/ 0713667564

Supervisor (S): Prof S.M Ramaligela & T.I Mtshali

Dear Sir/ Madam

REQUEST TO CONDUCT RESEARCH

I am Ndwandwe Khanyisile Precious, a teacher at Sekusile Primary School and a master's student at the University of Limpopo. I am requesting to conduct a research in Nkomazi East Circuit based on the Research Topic: **The effectiveness of smart board in enhancing Grade 6 Technology teachers' creativity at Nkomazi East Circuit in Mpumalanga Province.** The study requires only four teachers from any four Primary Schools that are using smart boards in their classrooms to participate on the research. Semi structured interviews and observations will be used to collect data. As a teacher, I have noticed that the smart boards that were provided to most of the schools in Mpumalanga, Nkomazi East Circuit are not utilised for teaching and learning Maths, Science and Technology. As a results, teachers lack opportunities for greater creativity in the classroom which can motivate learner's engagement and learning interest. The purpose of the research is to explore the effectiveness of smart board in enhancing teachers' creativity in Technology subject.

The study is important to the Department of Basic Education, learners and teachers. It will provide a good understanding on how a smart board enhances teachers' creativity and learner's engagement in Technology classroom. The study will introduce teachers to new teaching approach that will encourage and enhance creativity.

Yours sincerely

Ndwandwe K. P.



ANNEXURE E: LETTER TO REQUEST PERMISSION TO CONDUCT RESEARCH

Letter to Nkomazi East Circuit Manager.

From:

Researcher : Ndwandwe K.P

Email : khanyi.presh04@gmail.com

Contact : 0789832292/ 0713667564

Supervisor: Prof
Ramaligela S.M

Dear Sir/ Madam

REQUEST TO CONDUCT RESEARCH

I am Ndwandwe Khanyisile Precious, a teacher at Sekusile Primary School and a master's student at the University of Limpopo. I am requesting to conduct research in your Circuit based on the Research Topic: The effectiveness of smart board in enhancing Grade 6 Technology teachers' creativity at Nkomazi East Circuit in Mpumalanga Province. The study will require only four teachers from any four primary schools that are using smart boards in their classrooms to participate in the research. Semi-structured interviews and observations will be used to collect data.

As a teacher, I have noticed that the smart boards that were provided to most of the schools in Mpumalanga, Nkomazi East Circuit are not utilised for teaching and learning Mathematics, Science and Technology. As a result, teachers lack opportunities for greater creativity in the classroom which can motivate learner's engagement and learning interest. The purpose of the research is to explore the effectiveness of smart board in enhancing teachers' creativity in Technology subject.

The study is important to the Department of Basic Education, learners and teachers. It will provide a good understanding on how a smart board multimedia enhances teachers' creativity and learner's engagement in Technology classrooms. The study will introduce teachers to new teaching approach that will encourage and enhance creativity.

Yours sincerely



Ndwandwe K. P.

Student

ANNEXURE F: LETTER TO THE PRINCIPAL

From:

Researcher : Ndwandwe K.P

Email : khanyi.presh04@gmail.com

Contact : 0789832292/ 0713667564

Supervisor : Prof Ramaligela MS

To: The Principal

REQUEST TO CONDUCT RESEARCH WITH TECHNOLOGY TEACHERS AT YOUR SCHOOL.

The above matter has reference, I Ndwandwe K.P, Student number 201010625 hereby request to conduct research with your Technology teachers as requested by the Department of Mathematics, Science and Technology Education (University of Limpopo) as part of my research project. The title of the research says: The effectiveness of smart board in enhancing Grade 6 Technology teachers' creativity at Nkomazi East Circuit in Mpumalanga Province. The study will take place at the following date (s).....

I am pleading for a positive response, as my contribution will be beneficial in the learning area stated.

Yours faithfully

Ndwandwe K. P.



.....
Signature

APPENDIX A: ETHICAL CLEARANCE CERTIFICATE



University of Limpopo
Department of Research Administration and Development
Private Bag X1106, Sovenga, 0727, South Africa
Tel: (015) 268 3935, Fax: (015) 268 2306, Email: anastasia.ngobe@ul.ac.za

TURFLOOP RESEARCH ETHICS COMMITTEE
ETHICS CLEARANCE CERTIFICATE

MEETING: 22 August 2022

PROJECT NUMBER: TREC/381/2022: PG

PROJECT:

Title: The effectiveness of smart board in enhancing Grade 6 Technology teachers' creativity at Nkomazi East Circuit in Mpumalanga Province.
Researcher: KP Ndwandwe
Supervisor: Prof. MS Ramaligela
Co-Supervisor/s: Mr. TI Mtshali
School: Education
Degree: Master of Education in Technology

PROF D MAPOSA
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: REC-0310111-031

Note:

- i) This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.
- ii) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.
- iii) PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

Finding solutions for Africa

APPENDIX B: APPROVAL LETTER FROM THE MPUMALANGA DEPARTMENT OF BASIC EDUCATION



education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

Ikhemenge B Bldg, Government Arts Centre, Rivierhof Park, Mpumalanga Province
Private Bag 211341, Mbombela, 1200.
Tel: 013 766 5552/115 Toll Free Line: 0800 203 118

Litoko le Tsoelikeho Umgangano wa Fajiso

Departement van Onderwys

Ntsoelikeho ya Etyondze

Enq: Ndwadwe KP
University of Limpopo
Cell No. 0789832292/0713667564
Email: khani.presh01@gmail.com

RE: "THE EFFECTIVENESS OF SMART BOARD IN ENHANCING GRADE 6 TECHNOLOGY TEACHERS CREATIVITY AT NKOMAZI EAST CIRCUIT IN MPUMALANGA PROVINCE".

Your application to conduct research study was received and is therefore acknowledged. The title of your research project reads: **"The effectiveness of smart board in enhancing grade 6 technology teachers creativity at Nkomazi East Circuit in Mpumalanga province"**. I trust that the aims and the objectives of the study will benefit the whole department especially the beneficiaries. Your request is approved subject to you observing the provisions of the departmental research policy which is available in the department website. You are requested to adhere to your university's research ethics as spelt out in your research ethics.

In terms of the research policy, data or any research activity can be conducted after school hours as per appointment with affected participants. You are also requested to share your findings with the relevant sections of the department so that we may consider implementing your findings if that will be in the best interest of the department. To this effect, your final approved research report (both soft and hard copy) should be submitted to the department so that your recommendations could be implemented. You may be required to prepare a presentation and present at the departments' annual research dialogue.

For more information kindly liaise with the department's research unit @ 013 766 5124 / 5015 Or c.maphanga@mpuedu.gov.za

The department wishes you well in this important project and pledges to give you the necessary support you may need.


MRS LH MOYANE
HEAD: EDUCATION

05 / 10 / 2022
DATE



APPENDIX C: APPROVAL LETTER FROM THE CIRCUIT MANAGER



Ikhanga Building, Government Boulevard, Riverside Park, Mpumalanga Province
Private Bag X11341, Mbombela, 1200
Tel: 013 766 5552/5115 Toll Free Line 0800 203 116

Libko le Temfundvo Umnyango we Fundo

Departement van Onderwys

Ndzawulo ya Dyondzo

ENQ: Shabangu P
Tel No. 013 782 0210
Email : nkomazieast@gmail.com
Contact: 082 575 1127

03 OCTOBER 2022

TO: Ms. KHANYI NDWANDWE

**REQUEST TO CONDUCT A RESEARCH FOR YOUR MASTER'S WORK AT
NKOMAZI EAST CIRCUIT SCHOOLS**

1. Nkomazi East Circuit is in receipt of your request to conduct a research regarding your Masters studies at Nkomazi East schools.
2. Please note and be advised that the Circuit has no objection to the request as we hope it is aimed at enhancing the use of technology gadgets or instruments in our schools. We also strongly believe the research will make recommendations that will improve love for teaching and learning the subject in the Circuit in particular and Mpumalanga Province in general.
3. Should you encounter any challenges do not hesitate to contact our office.
4. Wishing you all the best in your research.



SHABANGU P
CIRCUIT MANAGER

03/10/2022
DATE

DEPARTMENT OF EDUCATION
NIKOMAZI EAST CIRCUIT
2022 -10- 03
PRIVATE BAG X4043 KOPPELSPLANE TEL 013
MPUMALANGA PROVINCE

APPENDIX D: ACCEPTANCE LETTER FROM THE PRINCIPALS



Khula-Mshika Primary School
Private Bag X 4028
Kwa – Lusedlane
1341
Emis no: 800007807
Enquiries To:
Principal- Sibande SS
ContantNo .082 0897 886
Email address: khulamshika@gmail.com



To: K.P Ndwandwe
Research Candidate
Student no: 201010625
UNIVERSITY OF LIMPOPO

From: The Principal
Khula-Mshika Primary School
Nkomazi East Circuit
Mpumalanga Province

Date: 17 October 2022

SUBJECT: ACKNOWLEDGEMENT OF RECEIPT OF REQUEST TO CONDUCT A RESEARCH WITH TECHNOLOGY EDUCATORS AND AN APPROVAL THEREOF.

The above subject has reference to

Your interest to use the school as your research subject, for the period 18 to 21 October 2022

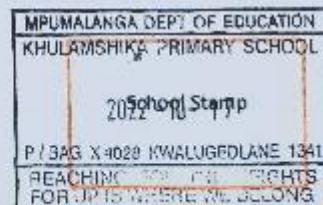
The school has pleasure in informing you that your request has been approved with all indicated specifications. We thus, looking forward to a positive interaction with you.

Regards!

Principal

17-10-2022

Date



SEKUSILE P. SCHOOL

ENQ : NKUNA S.E
CELL : 082 5567510
FAX : 079 7484 743
EMAIL : sekusilepschool70@gmail.com

PRIVATE BAG X 4041
KWALUGEDLANE
1341



To: K.P Ndwandwe

Research Candidate

Student no: 201010525

UNIVERSITY OF LIMPOPO

From: The Principal

Khula-Mshika Primary School

Nkomazi East Circuit

Mpumalanga Province

Date: 2022/10/11

**SUBJECT: ACKNOWLEDGEMENT OF RECEIPT OF REQUEST TO CONDUCT A
RESEARCH WITH TECHNOLOGY EDUCATORS AND AN APPROVAL THEREOF.**

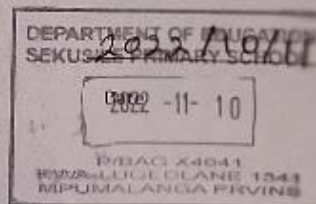
The above subject has reference to:

Your interest to use the school as your research subject, for the period of 04 days

The school has pleasure in information you that your request has been approved with all
Indicated specifications. We thus, looking forward to a positive interaction with you.

Regards!

Principal



Stand No. 8 Block B
Tel: 013-7807358
Fax: 086 226 0969
Cell: 082 0695 0740
Email: ematholeni8@gmail.com



Education is the key to success

Ematholeni Primary School
Private Bag X4016
KWALUGEDLANE
1341

To: Ndwandwe KP

Research Candidate

Student no: 201010625

UNIVERSITY OF LIMPOPO

From: The Principal

Ematholeni Primary School

Nkomazi East Circuit

Mpumalanga Province

DATE: 26 August 2022

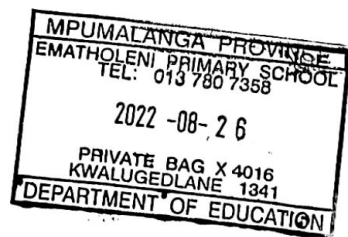
SUBJECT: ACCEPTANCE LETTER TO CONDUCT RESEARCH WITH GRADE 6 NS/TECH TEACHERS IN THE SCHOOL.

This is to inform you that your request to conduct research has been approved. Tittle of the research study: The effectiveness of smart board in enhancing Grade 6 Technology teachers' creativity at Nkomazi East Circuit in Mpumalanga Province. We are looking forward to work with you.

Regards

School Principal

Date: 26/08/2022



ANNEXURE G: PARENTS CONSENT FORM

Title of the study: The effectiveness of smart board in enhancing Grade 6 Technology teachers' creativity at Nkomazi East Circuit primary schools in Mpumalanga province. This serves as a request for permission to conduct a research on your child while he/she will be participating on the study. Ndwandwe K. P. (researcher) is a teacher at the school and a registered University of Limpopo Student at Masters level.

"Parent/guardian

I agree that my child (Surname and name)will participate in a programme of research conducted by Ndwandwe KP atPrimary School.

I understand that my daughter/son's name will be false name to maintain confidentiality.

I understand that upon request, I may have a full description of the results study after its completion.

I understand that the data from this study may be published.

I understand that I am free to withdraw from this study at any time without negative consequences."

I HAVE READ AND UNDERSTOOD THIS CONSENT FORM AND I THEREFORE, GRANT PERMISSION FOR MY CHILD TO PARTICIPATE IN THE STUDY.

Signatures

Learner's signature:

Signature of parent/guardian:

Date:

Cell/Telephone number:"

ANNEXURE H: LEARNERS CONSENT FORM

Title of the study: The effectiveness of smart board in enhancing Grade 6 Technology teachers' creativity at Nkomazi East Circuit primary schools in Mpumalanga province.

This serves as a request for permission to conduct a research on your class where you will be participating on the study. Ndwandwe KP (researcher) is a teacher at the school and a registered University of Limpopo Student at Honours level.

“Participants

- I agree to participate in a programme of research conducted by Ndwandwe KP atPrimary School.
- I understand that my name will be hidden to maintain confidentiality.
- I understand that upon request, I may have a full description of the results study after its completion.
- I understand that the data from this study may be published.
- I understand that I am free to withdraw from this study at any time without negative consequences.”

I HAVE READ AND UNDERSTOOD THIS CONSENT FORM AND I AGREE TO PARTICIPATE IN THE STUDY.

Signature of learner:

Date:

Phone number:

ANNEXURE I: LEARNERS' LETTER OF ASSENT

Title of study: "THE EFFECTIVENESS OF SMART BOARD IN ENHANCING GRADE 6 TECHNOLOGY TEACHERS' CREATIVITY AT NKOMAZI EAST CIRCUIT IN MPUMALANGA PROVINCE"

You are invited to be part of the classroom where a research study will be conducted by Ndwandwe KP. The purpose of this research is to explore the effectiveness of smart board technology to enhance teacher's creativity in Technology classroom. This research will give insight to the Department of Basic Education on how smart board enhance teacher's creativity.

There are no known risks associated with this research and there are no known benefits to your child that would result from your participation in this research.

The researcher will do everything she can to protect your privacy and his or her identity will not be revealed in any publication resulting from this study.

Your participation in this research study is voluntary. You may choose not to participate, and you may withdraw your consent for him/her to participate at any time. If you have any questions or concerns about this study or if any problems arise, please contact me via email: Khanyi.presh04@gmail.com. Please sign below to give your consent and give the page to your child to return it back to me. By giving consent, your child is also giving consent to participate in the study.

Consent form

This consent form confirms that I have read and understood the scope of this study. In addition, it confirms that I have understood the terms of this study.

I _____ understand that:

Participation in this interview is voluntary.

That I can withdraw myself from the study at any time.

That no risks or benefits are anticipated, and my responses will be kept confidential.

Signature of learner _____

Date: _____

ANNEXURE J: LETTER OF ASSENT TRANSLATED TO SISWATI LANGUAGE

Sihloko: “THE EFFECTIVENESS OF SMART BOARD IN ENHANCING GRADE 6 TECHNOLOGY TEACHERS’ CREATIVITY AT NKOMAZI EAST CIRCUIT IN MPUMALANGA PROVINCE”

Uyamenywa kutsi ube yincenye yelikilasi lapho lucwaningo lutokwentiwa khona ngu-Ndwandwe KP. Inhloso yalolu cwaningo kuhlola kusetjentiswa kwebuchwepheshe bebhodi lehlakaniphile yokutfufukisa buhlakani babothishela ekilasini Lekufundzela. Lolucwaningo lutonika uMnyango weteMfundvo tindlela tekusebentisa lebhodi lehlakaniphile kute kutfufukiswe buhlakani babothishela.

Kute tingoti letatiwako letingahle tivelele makwentiwa lolucwaningo, kantsi futsi akukho lokunganani lokutawutfolakala ngaphandle kwelwati lolutawutfolakala kulolucwaningo.

Umcwaningi utowenta konkhe lokusemandleni akhe kute avikele bumfihlo bakho kantsi futsi buwena angeke buvetwe kunoma ngubani nanoba ngukuphi.

Kuhlanganyela kwakho kulolucwaningo kungekutitsandzela. Ungakhetsa kungenti lutfo nekuhocisa imvumo yakho.

Uma unemibuto mayelana nalolucwaningo ungangitfoli ku-imeyili: Khanyi.presh04@gmail.com. Ngicela usayine ngentasi lokusho kutsi unginiketa imvumo yakho.

Lifomu lemvumo

Leli fomu lemvume liqinisekisa kutsi ngifundzile futsi ngicodzile lekubaluleka kwalolucwaningo. Kungeta, kucinisekisa kutsi ngiyivisisile imigomo yalolucwaningo.

Mine _____ ngiyacondza kutsi:

Kuphumelela kulolucwaningo kungekutsandza kwakho.

Kutsi ngingakwati kutikhipha kulelucwaningo noma kunini.

Kutsi kute ingoti nemihlomelo letotfolakala nekutsi yonkhe imininigwane yami iyoba yimfihlo.

Kusayina umfundzi _____

APPENDIX E: EDITING PROOF



You Write. We Edit. You Love it.

20 June 2023

TO WHOM IT MAY CONCERN

RE: CONFIRMATION OF LANGUAGE EDITING SERVICES: KHANYISILE NDWANDWE

I confirm that I have done language editing for Khanyisile Ndwandwe's dissertation titled:



THE EFFECTIVENESS OF THE SMARTBOARD IN ENHANCING THE GRADE 6 TECHNOLOGY TEACHERS' CREATIVITY AT NKOMAZI EAST CIRCUIT IN MPUMALANGA PROVINCE

The dissertation now conforms to the University of Limpopo's language editing standards.

Yours sincerely



Lynn

Lynn N. Sibanda Moyo

Tel: 011 050 0376

Mobile: 071 989 0983

Email: lynn@lovetoedit.co.za

Member of the [Professional Editors Guild](#)



Address: 16 Countesses Ave, Randburg, South Africa, 2194 | **Telephone:** +27 11 050 0376 | **Email:** info@lovetoedit.co.za
Website: www.lovetoedit.co.za | **Registration Number:** 2016/ 425723/ 07



507 Caledon village, Email: kubayijoe@gmail.com, Cell 0794848449

25 October 2023

Dear Sir/Madam

SUBJECT: EDITING OF DISSERTATION – ABSTRACT AND CHAPTERS 1-3

This is to certify that the abstract and chapters 1-3 of the dissertation entitled 'The effectiveness of the smart board in enhancing the Grade 6 Technology teachers' creativity at Nkomazi East Circuit in Mpumalanga Province, South Africa' by Ms K.P. Ndwandwe has been copy-edited, and that unless further tampered with, I am content with the quality of the three chapters in terms of editorial principles of consistency, cohesion, clarity of thought and precision.

Kind regards

Prof. SJ Kubayi (DLitt et Phil)