Grade 12 learners' receptiveness to Siyavula Education Application in the context of learning of Mathematics

By

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A Dissertation submitted to the Faculty of Education

Department of Mathematics, Science and Technology Education

in partial fulfilment of the requirement for the

Master of Education Degree

(Technology Education)

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February 2023

DECLARATION

I, Ntuthuko S'bonelo Xulu (student number: 201406932), hereby declare that this dissertation entitled: **Grade 12 learners' receptiveness to Siyavula Education Application in the context of learning of Mathematics** submitted for the degree of Master of Education (M.Ed.). I have not submitted this dissertation to any other university for the qualification. This work is the product of my own work and effort. I have, to the best of my knowledge and belief, acknowledged all sources of information in line with normal academic conventions.

Signature: 

Date: February 2023

DEDICATION

I dedicate the accomplishment of this work to you, my star family. Thank you all for the support you have provided to me: Sithandwa Love Tembe, for giving me steadfast support to endure and complete this work despite the associated challenges; to my two lovely daughters, Zanokuhle Xulu and late Yandisokuhle Xulu, may your soul rest in peace, and to my son, Sukoluhle Xulu, for always understanding that daddy is doing his ‘homework’.

ACKNOWLEDGEMENTS

First of all, I thank God the Almighty for keeping me alive and for the protection, love, blessings and grace He gave me throughout the journey.

I wish to thank my supervisors, Dr A. Krishnannair and Dr A. Chibisa, for the invaluable support and academic guidance they have given me and, above all, the encouragement to fulfil my dream thank you. Your passion for supervising gives me the strength to pursue my purpose.

I appreciate the role played by my family for keeping me in their prayers throughout the journey of this research, I appreciate their presence in my life.

Many thanks to the circuit manager (Dr S.D. Sibeko) and the schools' principals under uMhlathuze circuits, for allowing me to use their Grade 12 learners to conduct research; without them, this study would have not been successful.

My thanks are also extended to Mrs M.G. Khumalo and staff at Nongweleza High school, for their emotional support during this journey.

Thank you to the KZN Department of Education, under the leadership of Dr M. J. B. Mthembu, for granting me the permission to conduct research at uMhlathuze circuits under King Cetshwayo District.

I sincerely appreciate the role played by Helen Bond of Impela Editing for proofreading this project.

Special thanks to Dr A. Chibisa and Dr D. Mutambara who kept motivating me and providing me with educational advice — that everything is possible if you keep the spirit of endless possibilities alive.

ABSTRACT

The purpose of this study was to examine the factors that affect Grade 12 learners' receptiveness of the Siyavula Education Application (SEA) in the learning of mathematics. The study was conducted at uMhlathuze circuits schools, King Cetshwayo District in South Africa. The research used a quantitative approach, in which quantitative data were collected using a questionnaire. To collect data, this study adopted stratified random sampling with equal allocation to select respondents. A representative sample was of 300 participants from a population of 673 Grade 12 learners. A total of 272 participants successfully completed and returned the questionnaires, yielding a response rate of 91%. The study employed the technology-acceptance model (TAM) as its theoretical framework. The study proposed and evaluated the SEATAM, that gives a wide overview of all the factors that affect the actual use of SEA. The SEATAM had eight constructs, namely perceived accessibility (PA), perceived social influence (PSI), perceived skills readiness (PSR), computer self-efficacy (CSE), perceived usefulness (PU), perceived ease of use (PEOU), attitudes towards using (ATT) and actual use (AU). The factor analysis was used to analyse the data generated from the survey, with the help of PLS-SEM, using smartPLS software version 3.0. The results indicated that, out of 15 hypotheses that were tested, only five path coefficients are not statistically significant; the rest of the 10 hypotheses were statistically significant, which indicates that most of the model variables were appropriate. To all identified construct for this study, the SEATAM model explained 74.6% of explanatory power, which indicates that the developed model is valid, robust, and suitable for use by stakeholders. The results also show that PU (61.6%) and ATT (61.95) constructs contributed more to actual usage of SEA.

Keywords: Technology acceptance model, Siyavula Educational Application, actual use of SEA.

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LIST OF ABBREVIATIONS

ATT	Attitude towards
AVE	Average variance extracted
AU	Actual use
CR	Composite reliability
CSE	Computer self-efficacy
DBE	Department of Basic Education
ICT	Information and communications technology
LMS	Learning management system
PA	Perceived accessibility
PEOU	Perceived ease of use
PLS	Partial least squares
PLS-SEM	Partial least squares structural equation modelling
PSI	Perceived social influence
PSR	Perceived skill readiness
PU	Perceived usefulness
SEA	Siyavula Educational Application
SEM	Structural equation modelling
SPSS	Statistical Package for Social Sciences
TAM	Technology acceptance model

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CHAPTER ONE

1.1 INTRODUCTION

Our daily life currently depends much on the use of technology in many, varied ways. Most people, especially Millennials and those from the Generation Z, cannot imagine their lives without a digital device. They can easily adapt to any device and are called “children of technology” (Panzabekovap et al., 2020). Because children, in general, are technologically savvy, it is appropriate think about teaching mathematics in technologically enhanced environments. One of the major problems that South Africa is facing is the closing of schools due to COVID-19, but learning has mostly resumed through online platforms.

According to Van den Berg and Spaull (2020) in this context point out the issues facing the education system, loss of school days, learners alternating in schools that disrupt the completion of the annual teaching plan (ATP). This presented an even more pressing need for the launch of software applications, such as the Siyavula Education Application (SEA), specifically in Grade 12.

SEA was proposed as a software solution for promoting independent study, and to help Grade 12 learners stay motivated and attain invaluable skills for their university studies. The South African Department of Education (DOE) supports the use of technology to transform the education system (Department of Education, 2020). It is known that the use of technology can improve the level of learners’ thinking in mathematics education, as mentioned by (Marbán & Mulenga, 2019). Using technology in the process of teaching and learning allows learners to move beyond focusing on basic information to more global issues, in cases where access to applications and tools are possible (Van Melle & Tomalty, 2000).

This study aimed to examine the factors that affect the receptiveness of Grade 12 learners at a school in uMhlathuze, South Africa, to SEA. Learners’ mindset in the direction of mathematics can influence their ordinary achievement. Value, self-confidence, enjoyment, motivation, and nervousness surrounding math are all mirrored in students’ attitude. Engaging learners in SEA may help in terms of improving their performance in mathematics.

The King Cetshwayo District of KwaZulu-Natal province is known to experience a high level of dropout and poor performance in mathematics. Such poor performance is often attributed to learners' mathematics-related misconceptions, which in turn is also related to their problem-solving competences (Ngoveni, 2018).

It is well documented in literature that teaching environments in schools can be changed by teachers, as argued by Hartsell et al. (2009). Teachers are the key agents who initiate changes in schools and in learners' education as they teach, mentor, and support learning in the classroom. Moreover, literature shows that technology can encourage active learning (Mhlanga & Moloi, 2020; Ntombela, 2011). It is interesting to see how technological tools, designed to enhance learning, constitute the learning experiences of learners in real classroom situations.

In this context, this study examined the factors that affect the receptiveness of the SEA amongst Grade 12 learners at UMhlathuze schools in the King Cetshwayo District. The Department of Basic Education (DoB) has collaborated with Sasol and Siyavula to provide professional development tools especially for mathematics and science education. Siyavula developed a software that enables learners to practice mathematics and science, from grades 8–12. However, this benefits teachers as well, as they can now minimize the paperwork in schools by engaging online. They are able to provide activities and set assignments using it. It is accessible to all South African schools and to all learners and teachers (Lambert, 2019).

This study also examines the extent to which these factors affect the receptiveness of SEA in the learning of mathematics and demographics influence in receptiveness of the application. Learners need to go beyond searching for information from different platforms and should be encouraged to use technology to increase their level of thinking and learning with regard to mathematics (Hartsell et al., 2009). The SEA aims at creating "a world in which learning is celebrated and pursued; education is accessible; curiosity is embraced; sharing is fundamental to our being; and technology is empowering, for each and every individual, each and every day" (Lambert, 2019, p. 287). It is in this context that this research sought learn more about the degree of receptiveness among learners to SEA, and its factors affecting the receptiveness of SEA.

1.2 LITERATURE REVIEW

The use of different devices during teaching and learning of mathematics is often associated with the assumption that such practices will improve the attainment of learning outcomes. If the present generation of learners can easily adapt to any technological device, a skill that can be tapped into for promoting mobile learning to use what they like the most and spend more time in it, surely it can improve their learning. If such affinity to technology is fostered it can improve performance in the learning of mathematics.

Regarding the use of mobile learning in rural areas, researchers have proposed and used the high school's acceptance of mobile learning model to check out the factors that predict behavioural intention to use cellular phones for learning (Mutambara & Bayaga, 2020a). Research has generated much new knowledge on the science, technology, engineering and mathematics (STEM) learning based on the technology acceptance model. Findings reveal that the high school acceptance of mobile learning model can be used to predict the acceptance of mobile learning.

The integration of technology in teaching and learning is intended to change the world, accommodate the way teachers and learners acquire knowledge and support schools to improve teaching and learning of mathematics (Tishkovskaya & Lancaster, 2012). Umugiraneza et al. (2018) conducted a study on how KwaZulu-Natal teachers use, access and integrate technology in teaching and learning of mathematics. Their findings suggested that almost 80% of teachers who used technology in teaching and learning stated that the use of technology does improve learners' understanding of mathematics. Furthermore, these authors indicated that teachers who have access to the internet have higher levels of confidence in teaching mathematics (Umugiraneza et al., 2018). Professional development workshops that were conducted to develop skills of teachers to teach mathematics via technology were seen to improve teachers' skills regarding the use of graphing calculators and other software (Hartsell et al., 2009). Hartsell et al. (2009) further noted that the workshops also developed confidence, a positive attitude towards technology and skills in using technology.

A research study carried out by Marbán and Mulenga (2019), investigated 163 Spanish pre-service primary teachers' teaching styles and their attitude towards the use of technology at the University of Valladolid (Level 1, Level 2 and Level 4). They

reported that 95% of female teachers showed a positive attitude towards the use of technology in mathematics classroom, which was more than the male teachers who showed such attitudes. At the level of professional training, Marbán and Mulenga (2019) pointed out that their study helped the University of Valladoid (Spain) to come up with programmes that intended to develop both trainee and in-service teachers' knowledge of integrating technology in the teaching and learning of mathematics.

While professional development is a significant factor that determines the efficiency with which teachers use technology, a study conducted in Ethiopia examined beliefs held by mathematics teachers and pre-service teachers about the usefulness and ease of use regarding computers in their teaching (Getenet, 2013). The author reported that both educators and pre-service teachers responded positively concerning the usefulness of technology in their teaching of mathematics. This author further reported that most teachers believe that technology can encourage active learning, and technology can help learners to understand the meaning of the content.

On learners' attitudes to the use of technology, Eyyam and Yaratan (2014) conducted a study to determine such attitudes and see whether the use of technology can improve their academic achievement. These authors found that the learners who participated showed positive attitude towards the use of technology in class, some were not sure of the change and if it was going to help them to become more successful in their classes, because it was their first time being exposed to that type of learning (Eyyam & Yaratan, 2014). Furthermore, they made it clear that the challenge to the use of technology in teaching was the lack of equipment in schools. Also, teachers were not well trained about integrating technology in their teaching.

Sabyr (2020) also conducted a survey to investigate what learners think about the new approach to learning and how it affects their academic performance (Sabyr, 2020). The study found that using technology was interesting to the learner and changed their attitude towards mathematics. The learners stated that mathematics was difficult to learn but, after the introduction of technology, they found mathematics easier to understand.

The South African Department of Education (2020) aims to ensure that children acquire and apply knowledge and skills in a way that is meaningful to their own lives. SchoolNetSA, together with the national DoE, stated that there are still schools

operating without computers (SchoolNetSA, 2016). Oke and Fernandes (2020) noted that the fourth Industrial Revolution (4IR) is beyond the use of computers as it has potential to impact the way we teach, learn and engage. However, the education sector in Africa is not prepared for the 4IR. A study on the readiness of the educational sector for 4IR shows that technology can facilitate learners' learning experience.

Mthethwa (2015) assessed learners' cognitive skills using GeoGebra App and to see whether the application helps learners in improving their performance in Euclidean geometry or circle geometry in the uMkhanyakude District. The author reported that learners showed an interest in the use of GeoGebra as a technological tool in the teaching and learning of Euclidean geometry. Additionally, the author stated that technology implementation remains a major problem because of the lack of sufficient technical support (Mthethwa, 2015, p. 68).

A study by Kok (2010) investigated the attitude of in-service teachers at the University of Zululand towards technology. The results of the study pointed out that the teachers showed a strong understanding of technology and showed interest in knowing more about technology. The author further stated that teachers showed low level of knowledge and understanding about technologies used in their daily lives. However, the study also showed that when talking about technology the teachers solely thought of computers, although it is a much broader concept.

This literature review focused on the receptiveness of the SEA, and the actual usage of the application in the context of learners having technologically enhanced learning environments. As indicated in this review, learners generally agree and have a positive influence towards the actual use of technology in learning situations. The literature, thus, has sufficient illustrations of positive learning experiences that were enhanced by the use of technology. The attitudes have been also noticeably positive towards the use of technology. However, there is insufficient understanding of how an application, such as SEA, evokes responses among learners in spite of a general positive inclination towards such applications as found elsewhere in the literature.

SEA is unique in that it is a comprehensive application package, while the extent to which it is experienced positively in and out of the classroom has significant implications for its perceived effectiveness in the advancement of learning. This aspect is insufficiently understood by researchers, educationists and practitioners in South

Africa. It is towards this end that this research is conceptualised and, hence, positioned, to generate an understanding of the factors that might affect the receptiveness of the application.

1.3 PROBLEM STATEMENT

This study addresses the lack of research on the receptiveness and usability of the SEA application among Grade 12 mathematics learners. While previous studies have highlighted the benefits of introducing the application, there is a notable gap in the literature concerning learners' perceptions and ease of use regarding SEA (Lambert, 2019). Understanding the learner experience with the application is crucial, especially in the context of the King Cetshwayo District, where schools face challenges such as poverty, high dropout rates, and overcrowded classrooms. By examining the factors that influence learners' engagement with the application, this research aims to promote its adoption as an alternative to traditional instructional methods, particularly considering the evolving landscape of learning driven by technological advancements.

Furthermore, the COVID-19 pandemic exacerbated the need for effective educational technology, particularly for Grade 12 students who had to prepare for their final exams amid school closures. Although some South African schools use the SEA application, its utility, ease of use, and impact on learner performance remain unassessed. Therefore, this study's significance lies in its contribution to understanding the reception and effectiveness of the Siyavula application, filling a crucial knowledge gap in the quest to enhance mathematics education in South African schools.

1.4 AIM, OBJECTIVES AND RESEARCH QUESTIONS

1.4.1 Aim

The aim of this study was to examine the factors that affect the receptiveness of the SEA in the learning of mathematics by Grade 12 Learners from uMhlathuze Circuit schools.

1.4.2 Research Objectives

- To examine the factors that affect Grade 12 learners’ receptiveness of SEA in the learning of mathematics.

- To investigate the extent to which these factors affect the receptiveness of SEA in the learning of mathematics.
- To explore the demographics effects of Grade 12 learners on the receptiveness of SEA in the learning of mathematics.

1.4.3 Research Questions

- What are the factors that affect Grade 12 learners' receptiveness of SEA in the learning of Mathematic?
- To what extent do these factors affect the receptiveness of SEA in the learning of mathematics?
- What effect does demographics have on Grade 12 learners' receptiveness of SEA in the learning of mathematics?

1.5 INTENDED CONTRIBUTION TO THE BODY OF KNOWLEDGE

Marbán and Mulenga (2019) discussed that integrating technology in teaching and learning will make Mathematics more accessible to learners and develop skills and high levels of thinking. This study will develop insights for the creators of SEA, as the results of the study can help make the application more effective for learning. The Department of Education (2020) believes that mathematics helps enhance intellectual approaches that underpin logical and fundamental thinking, accuracy, and hassle fixing, that will in turn in help decision-making. This study will explore the scientific knowledge that applications, such as Siyavula, help build as stipulated in curriculum assessment policy statement (CAPS) document (Department of Education, 2010). Such applications generally envisage that learners will be able to solve problems and come up with meaningful solutions to real life problems using decision making that makes use of critical and creative thinking.

This study will assist the DoE in terms of planning and providing learner support in the use of technology. This study will also help universities in preparing teachers to teach effectively and will assist to identify gaps in the field of integrating technology in the learning of mathematics. There is ample research done on software applications and their benefits, specifically in the context of mathematical learning. Siyavula remains a unique application that offers features to learners that are not commonly made available on other applications of a similar nature.

The sheer scope of varied types of learning that Siyavula offers and its benefits remain to be explored. This research, therefore, contributes to the existing knowledge in the sense that factors such as 'receptiveness' are explored at the level of the learner which makes this research potentially valuable. An extension of the current awareness with regard to the use of SEA thus stands to contribute to a quantitative improvement in instruction that depends on SEA as an instructional software.

1.6 THEORETICAL FRAMEWORK

This study aims to use the existing theory of technology acceptance model (TAM) developed by Davis (1989) as a framework. This framework is underpinned by the theory of reasoned action (TRA) which is popular in the field of psychology (Masrom, 2007). The TRA supports the idea that an individual behaviour is dictated by their behavioural intention. Behavioural intention can be described as a component of an individual's attitude towards the conduct and established rules regarding the carrying out of the behaviour (Masrom, 2007). This makes behaviour the component of attitude and beliefs. The technology acceptance model, alternatively, puts forward that perceived ease of use, as well as usefulness of technology, can be used to foretell the attitudes of users regarding technology. Additionally, it can be used to provide information on subsequent behaviour and the real usage of the technology. The perceived ease of use (PEOU) is also a factor in determining perceived usefulness (PU) of the technology in question (Masrom, 2007).

TAM is generally used to learn about elements that have an effect on the acceptance of learning. In this study, TAM has been chosen due to the fact it is viewed to be sturdy and it is ordinarily used model for the study of the adoption of technological know-how in educational contexts. Identifying these attitudes is vital for the effective implementation of SEA. Hence, this study uses the technology acceptance model proposed by Davis (1989) to examine the factors affecting Grade 12 learners' receptiveness of the SEA.

The TAM in this study will be used as a framework for examining factors affecting Grade 12 learners' receptiveness towards the actual usage of the SEA in the context of their learning of mathematics. The framework assists the study to gain insight on the adoption and use of the SEA in their schooling career. For this study, the TAM theorises that the intent to use can be referred to as the acceptance of technology,

while the usage behaviour indicates the actual use of the technology (Portz et al., 2019). This is influenced by the perception of the user about the technology's usefulness or how it functions in order to benefit them and how easy it is to use. Thus, Grade 12 learners considered in this study may have differing viewpoints on how the SEA benefits them and how easy it may be to use - which this study will explore.

Additionally, the creators of SEA can benefit from this study by understanding what the hindrances are for adopting this technology and what systemic, social or environmental conditions act to influence the adoption or non-adoption of this technology. This data can be used to improve the technology so that usability would increase and mathematical learning can be effective in producing quality matriculants. Figure 1.1 shows the technology acceptance model by Davis that this study aimed to extend by examine other external factors (Davis & Neitzel, 2011).

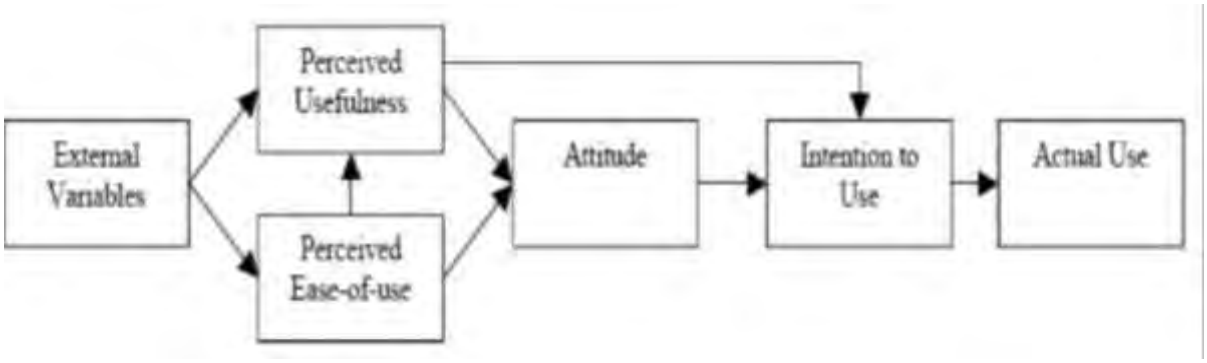

Figure 1.1: Technology acceptance model (TAM) (Davis, 1989)

The TAM in this study will be utilised for examining factors affecting Grade 12 learners' receptiveness of the SEA. The receptiveness of the learners may be influenced by other external variables, such as whether or not the application is promoted at schools or whether or not teachers use it in the classroom. The external variable will also indicate how useful the learners find the application. It can be said that if the application is seen to be easy to use, then the learners would be more likely to experience a positive attitude when using this application, as it would be useful to them (Portz et al., 2019).

1.7 RESEARCH METHODOLOGY

This study examines the factors that affect receptiveness of SEA in the learning of mathematics by Grade 12 Learners. This section includes a discussion of the

methodological framework that will be applied to answer the critical questions, paradigm and research strategy within which this study is located. Furthermore, the researcher explains how the paradigm that was used fits the study. This section also provides a detailed explanation of the approach used to generate and analyse data, and the research style that will be used; the sampling method and why the participants were chosen to participate in the study; and a discussion of the ethical issues that were considered in the conduction of the study.

The critical research questions examine the factors affecting receptiveness of SEA in the learning of mathematics by Grade 12 Learners. The research methodology that underpins this study is conceptualised in relation to the research questions indicated in section 1.4.3.

1.7.1 Target Population

Population refers to all possible units, elements or individuals that may form part of a study (Creswell, 2014b). The target populations of this study were Grade 12 learners from uMhlathuze circuit schools. The target population was not based on gender or race. Learners were chosen from six randomly selected schools in alignment with the methodological conventions found in the literature (Conroy, 2015). A population of 300 Grade 12 learners from six randomly selected schools were used for this study.

1.7.2 Positivism as Research Paradigm

There are different kinds of paradigms such as positivism (for quantitative research), interpretive (for qualitative research), critical (for civil actions) and pragmatic (for mixed methods)(Rane et al., 2018). Quantitative method research is usually associated with the positivism paradigm. This research study is based on positivism research paradigm. The positivist paradigm is described as the idea of gaining an understanding of human behaviour through observation and reason (Park et al., 2020).Sukamolson (2007) explains quantitative research that it is carried out by collecting data which is analysed using statistical methods or by collecting numerical data. Firmin and Injeti (2013) pointed out that the selected methods of research by the researcher must be driven by the research questions stated.

1.7.3 Research Design

According to McMillan and Schumacher (2006), research design is how the researcher will go about selecting subjects, research sites and data collection procedures to answer the research questions. Research design is a vision and plan that explains how research should be carried out (Kumar, 2018). This is a plan on how the researcher should systematically collect and analyse the data that is needed to answer the research questions (Creswell, 2014a).

This study used a descriptive design which involves the construction of a set of questions which are either asked by means of questionnaire or through an interview (Creswell, 2014b). Descriptive research design can be in the form of either a quantitative or qualitative study. In this case, it was used within the quantitative research approach. Descriptive research ascertains prevailing conditions of the study topic and allows comparison of characteristics of two or more groups to determine their similarities and differences (Creswell, 2014b).

A questionnaire was used in which, questions concerning perceived accessibility (PA), perceived social influence (PSI), perceived skills readiness (PSR), computer self-efficacy (CSE), perceived usefulness (PU), perceived ease of use (PEOU), attitudes towards using (ATT) and actual system use (AU) were included, along with questions on demographic data. The questionnaires were hand delivered to the schools after making appointments with the principals and were collected after the learners have completed these questionnaires.

1.7.4 Research Sampling

According to Creswell (2012), sampling strategy is a subgroup of a target population from which data is to be generated. In this study, probability sampling was used which ensured that each unit in the sample had a chance of being selected (Creswell, 2014a). There are 52 high schools that are actively using SEA in uMhlathuze circuit of King Cetshwayo District. From 52 high schools, 41 schools were from rural based and 11 schools were urban based. The researcher followed a simple random sampling to select three schools that were in rural areas and other three schools in the urban. This was done to understand the effect of geographical location in using SEA in learning mathematics.

Using simple random sampling, a representative sample of six schools were selected for the study, following a recommendation by Conroy (2015) that a representative sample should be at least 10% of the population. The selected six schools represented the sampling strata**.** The selected number of participants from the six randomly chosen schools at uMhlathuze made a total of 673 learners according to the requested statistics from mathematics subject advisor under uMhlathuze circuits.

Stratified simple random sampling was used to select learners' respondents from each stratum. The 'equal number' strategy from each stratum was employed in this study (Kumar, 2018). This means that an equal number of learners was selected from each of the selected schools because the goal is not to have proportional representation but to have representation from each school.

1.7.5 Data Collection Instrument

Data collection instruments are systematic approaches that researchers use to gather and measure information about a target population (Creswell, 2014a). In this study, a questionnaire was used to collect data. The questionnaire is a series of questions that is used by a researcher to gather information from respondents. Data were gathered using a five-point Likert scale questionnaire.

All ethical considerations were followed during and after the data gathering process, which was scheduled to take place when learners were on school breaks and/or after school, in order to minimise disturbances in the schools. The responses were measured using a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the mid-point 3 representing the state of being uncertain or neutral. A questionnaire is considered to be a valid, accurate and time saving method of data collection.

The questionnaire was administered by the researcher in person, by first making an appointment with the schools. This were done by contacting the principals of each school and explaining the study and the target population. Permission was obtained from the relevant departments and stakeholders such as the School Governing Body. Once this was obtained, the researcher visited the school and administered the questionnaire to Grade 12s. They were given, at most, half an hour to complete the questionnaire. The questions that were asked were divided into the categories based on the three research questions.

1.7.6 Data Analysis

In this study, the quantitative data were analysed with the assistance of Statistical Package for the Social Sciences (SPSS). The data were also analysed by the structural equation modelling-partial least squares (SEM-PLS) using SmartPLS (structural) which was able to provide information on latent variables, which are variables that are not directly observed. In this case, it was inferred from the results of the study. The learners' determinants of receptiveness or external factors affecting actual use of the application can be inferred from this study. This will have implication on the steps that were taken to increase the actual use of the SEA. This method of data analysis is also useful for multivariate data analysis and provides visuals on relationships that exist with regard to the variables under study (Wong, 2019). The data were also presented by appropriate graphs and tables.

1.7.7 Reliability and Validity

Reliability is the extent to which results are consistent over time regarding an accurate representation of total population in a study. Should the results of the study be produced through similar methodology, then the research instrument is reliable (Collins et al., 2006). Validity refers to whether the measurement obtained truly depicts what the researcher intended to measure (Babbie & Mouton, 2001). In setting the questionnaire for this study, the researcher took into consideration the technique, format and methodology which were used by various researchers (Bansilal, 2015).

The SPSS and SmartPLS software were used in the analysis of data. The test of reliability of the items/indicators on the instrument were done using the Cronbach's alpha coefficient. To test for validity of the instrument, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy Kaiser (1970) and the Bartlett's test of sphericity were used.

1.7.8 Confidentiality and Anonymity

According to Creswell (2014a), anonymity and confidentiality of the participants must be guaranteed as this is among the ethical concerns in a research. In conducting this study, the researcher explained to the participants that their personal details, such as names, phone numbers, identity numbers, and physical addresses, were not required and would not be disclosed. The researcher of this study also assured the respondents

that the information collected would be solely kept by the researcher and would not be disclosed to any third party.

1.8 ETHICAL AND SAFETY ISSUES

Research requires ethical considerations, guaranteeing that there was no harm done to participants. The researcher requested permission, through a formal letter of request, from the KwaZulu-Natal Department of Education to use six high schools at uMhlathuze circuit under the King Cetshwayo District. Ethical consideration includes ensuring that participants of a study provide a researcher with their informed consent,; ensuring no harm is experienced by the participants; ensuring confidentiality and anonymity; and ensuring that permission is obtained from the organisation used for the study (Parkes, 1995).

The participants were informed that they would not be forced to participate in the study, that their participation was voluntary, and that they could withdraw at any time if they felt like doing so. Moreover, the researcher was also aware that the participants must be told to be on time and be reminded beforehand.

The schools and teachers were given assurance that the core business of the school (teaching and learning) was not going to be disturbed during the process of collecting data from learners. In addition, regulations of COVID-19 were considered throughout the course of the study, especially during data collection (Mhlanga & Moloi, 2020). The researcher maintained the ethical research principles of:

- The right to participant privacy.
- The right to maintain self-respect and human dignity.
- Confidentiality.
- Anonymity and protection from the potential misuse of research findings.

1.9 FEASIBILITY OF THE STUDY

The study examined the factors that affect the actual use of SEA in learning mathematics at Grade 12 level. It was conducted in six King Cetshwayo schools at uMhlathuze circuit. The researcher is employed in the Department of Basic Education (DBE) in the King Cetshwayo District and works in the circuit of uMhlathuze as a

qualified educator, teaching grades 10–12 mathematics in High school. Financial support was required from the University of Zululand to carry out the study successfully.

The first factor to be considered is the capability of the study to be carried out. This requires a feasible plan that considers whether the researcher has access to the target population (Orsmond & Cohn, 2015). In this case, the researcher had access to the participants, albeit when the correct permissions were obtained and institutional and departmental clearance had been received.

The second factor concerns itself with the participants and if the study method is suitable (Orsmond & Cohn, 2015). In this case, the Grade 12 learners knew how to read and write and were capable of completing the questionnaire under no obligation and of their will. The timeframe for the questionnaire was reasonable seeing as it did not take more than half an hour to complete. It was not mentally or emotionally draining for the Grade 12 learners.

1.10 PRELIMINARY TABLE OF CONTENTS

Chapter One included the introduction, problem statement, aim of the study, research questions and objectives, as well as plan of the study.

Chapter Two consists of the review of the literature on learning management system, SEA and theoretical framework underpinning this study as well as the conceptual framework is discussed.

Chapter Three outlines in details the designs and methodology of this study. Also, the data collection instrument and how data were collected and data analyses techniques used are discussed.

Chapter Four covers the statistical analysis, data analysis and interpretation.

Chapter Five summarises the research, concludes the discussion and findings of this study, and makes recommendation for future research.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 INTRODUCTION

The chapter examines the existing literature on the receptiveness of Siyavula Educational Application in the context of learning mathematics. The subsequent discussion is a review of literature organised into four sections. The first section presents an analysis of learning management systems (LMS), the SEA, as a software used in the learning and teaching of mathematics and science.

The second section addresses the lens through which this study is framed: the technology acceptance model (TAM). The section elucidates on how the TAM will be used in this study. Furthermore, the factors that affect Grade 12 learners' receptiveness of SEA in the learning of mathematics will be discussed.

The third section looks at the extent to which these factors affect the receptiveness of SEA in the learning of mathematics. And the last section looks at demographic effects of Grade 12 learners on the receptiveness of SEA in the learning of mathematics.

2.2 LEARNING MANAGEMENT SYSTEMS (LMS)

Learning management systems (LMSs) furnish educators and learners with a web-based learning environment that facilitates teaching and learning (Bradley, 2021). In web-based learning conditions, LMS sustain a comprehensive learning climate for scholastic advancement with intervening frameworks that advance internet based cooperative groupings, proficient preparation, conversations, and correspondence among different LMS users (Bradley, 2021; Dias & Diniz, 2014). Nasser et al. (2011) notes that LMS utilisation gives online learners predictable data with respect to their academic endeavours and results. Additionally, Nasser et al. (2011) and Wood et al. (2011) argued that LMS use aids learners to become autonomous by engaging themselves in the use of technology.

2.2.1 LMSs for Teaching and Learning

The differentiations of LMSs sway the advancing requirements of current learners (Watson & Watson, 2007). There is a critical change among learners in the current

time since there has been a shift from industry-focused learning to the 21st-century age of information (Kimmons et al., 2019; Toffler, 1984). In a LMS setting, educators are facilitators, fostering a learning climate where learners can direct research and draw in with innovative assets to become information age experts (Kehrwald & Parker, 2019; Toffler, 1984). Progress among learners utilising a LMS changes, where low-accomplishing learners might battle in fulfilling time constraints with submitting tasks, and successful learners may have issues with time constraints (Bradley, 2021). Al-Fraihat et al. (2020) accepts that LMS educators have trouble in making administrative and instructive changes from a homogenous plane of lack to a characterization of progress, to help all learners.

Online teachers can use LMSs to convey exact requirements to learners (Kehrwald & Parker, 2019). A LMS supports learners by checking learning progress, constantly giving fundamental information, and executing appraisals (Bradley, 2021). However, SEA was proposed as a software solution for promoting independent study, to help Grade 12 learners stay motivated and attain invaluable skills for their tertiary studies. The LMS can assess a learners' present degree of achievement (Branch, 2015). Educators can likewise refer to a record of accomplishment, support arrangements, and produce portrayals to administer knowledge that amplifies the achievement of learners in a web-based climate (Kehrwald & Parker, 2019). LMSs permits learners to really look at their instructive advancement, evaluate their learning, gain online help from educators, and access materials and specific functions (Bradley, 2021).

LMSs permit online educators to set up constructivist courses of action with versatile instructive goals (Al-Fraihat et al., 2020). LMSs permit online learners to partake in team discussions, screen their grades and progress, take an interest in web-based conversations, and complete evaluations (Bradley, 2021; Reigeluth & Garfinkle, 1994). Additionally, LMSs permit online teachers to develop an instructive climate for learning and consistent improvement, and it is also versatile for particular leaner needs (Bradley, 2021). As a learning management system, the SEA aims to help learners in preparing for their examination with guidance by their teachers and parents, who are there to monitor the progress of learners. Moreover, engaging learners in the SEA LMS may help strengthen teaching and learning in terms of improving learners' performance in Mathematics.

2.2.2 LMS for Supporting Learners' Achievement

Learners can submit and utilise LMSs to work cooperatively on instructive learning tasks. In a review directed by Dias and Diniz (2014), as cited by Bradley (2021), zeroing in on student profiles, teachers gave learners remarks on their tasks through their student profiles. The examination included 36 learners from an advanced education organisation and utilised web and in-person tasks. The review incorporated a mix of subjective and quantitative information techniques, including semi-organised meetings and normalised multivariate content examinations.

Dias and Diniz (2014) demonstrated three student profiles adjusted to a proportional learning condition, information and communication technologies (ICT) educators' confirmations, and learners' readiness. The results from the review showed that leaners profiles can correspond with internet learning societies, ICT educators' hopes, and student readiness.

Dias and Diniz (2014) and Islam (2016) stated that supporting learners with readiness is advantageous towards cultivating joint effort and discussions on the web. Islam (2016) urged learners to utilise LMS highlights to upgrade participation with leaners conversations that will likewise expand learners' inherent inspiration and learning. Through enrolling into the Siyavula Educational Application and creating profiles, teachers gain an efficient system towards supporting student capacities (Bradley, 2021; Dias & Diniz, 2014).

Learners who use applications such as SEA will start to develop deeper understanding of mathematics will improve their advancement. You (2016), as cited by Bradley (2021), led a review utilising a LMS to track down recognisable ways to deal with course learning achievement. The review incorporated determinations for accumulating data for self-controlled information with LMS particulars and student achievement. There were 530 college-level students who formed part of the study that took a web-based course. Like Dias and Diniz (2014), You (2016) incorporated Howell (2001) promotion for teachers to utilise LMS fundamental assets, including tasks, prospectuses, plans, tips, conversation discussions, important connections, and backing from the educator. Howell (2001) examination showed that learners would go to the course site assuming they thought it was valuable.

Online educators decide how a LMS can give learners an instructive learning climate that draws them in and permits learners self-control (You, 2016). Gašević et al. (2016) led a review that investigated the impact of learning conditions on student achievement. The review examines the distinction in predictive power and indicators between course-explicit models like arithmetic and summed up prescient models (Bradley, 2021). It showed extensive ramifications for students who were recognised as being in danger of failing scholastically. This suggests that educational conditions, prior to allocating the utilisation of extra features, should be thoroughly assessed so that students can take full advantage of the online platform, according to their individual needs (Bradley, 2021).

Table 2.1: LMS in supporting teaching and learning.

Aspect	Critique	Author
LMS in teaching and learning	• Offers defensive outcomes for learners. • Permits learners to view their progress consistently. • Teachers can create tailored lessons for students that have specific difficulties. • Acts as a learning resource. • Different forms of media can be integrated as part of the study material.	Bradley (2021)
Enhancing the LMS	• Learners respond to interactional learning conditions. • LMS is able to provide information to correct learning areas that are difficult and increase learner achievement.	Dias and Diniz (2014) You (2016)
Current LMS findings	• Learners engage more with LMS when incentives are offered by the teacher. • Middle school learners used LMS to view progress and ask questions. • Students can independently complete assignments and projects devoid of influence from their teacher.	Nasser, Cherif, and Romanowski (2011) Zhang (2013) Selwyn et al. (2011) Moreno-Murcia (2016) Shukla and Verma (2019)

Source: Adapted from (Bradley, 2021, p. 73)

2.2.3 The Current Online Learning Climate

As focal and constructivist internet learning conditions advance, learners figure out how to deal with their scholastics freely (Al-Fraihat et al., 2020). Constructivist approaches permit learners to build mindfulness through dynamic cooperation and allot worth to the learners' independence (Moreno-Murcia, 2016). In web-based conditions, educators work with and model conversations, design online exercises,

outline learning requirements, furnish learners with decisions and choices, and help learners take care of issues (Jung & Huh, 2019).

According to Moreno-Murcia (2016), online facilitators give learners chances to pose inquiries and use their past information to make new ideas. Facilitators permit learners to hold their independence, excitement, and inspiration. Online educators are meant to support student commitment through keeping up with their involvement in the LMS. Models incorporate reacting to inquiries from individuals, taking part in the LMS course conversations, and giving learners criticism on their tasks(Bradley, 2021).

LMS coordination into various types of exercises advances student learning and self-guidance (Al-Fraihat et al., 2020). A few adventurous internet-based educators are supporting LMS use to advance web-based learning conditions, that use an assortment of media and specialized apparatuses, that advance students decisions in the choice and utilisation of web-based learning implements (Kehrwald & Parker, 2019).

Additionally, the innovative foundation develops with quicker web associations, such as the current 4G and 5G network connections. The innovation framework additionally creates complementary opportunities for the use of affluent media in instruction and moves the focal point from the online text, in conjunction with media bundles, towards more useful, incorporated web-based learning materials with text, sound, symbolism and intuitive learning objects (Kehrwald & Parker, 2019).

2.2.3.1 Online Learning in the Pandemic

The COVID-19 pandemic, which impacted the entire world in the previous few years, has equally impacted on schooling. The remarkable circumstance of a global shutdown has driven the educational sector to embrace remote learning instead of personal instruction (Saygili & Çetin, 2021). With the advantages of creative instructive innovations, the limits of instructive exercises have extended (Chang et al., 2014). One of the apparatuses in which distance instruction exercises are effectively introduced is through LMSs. It has been proposed that internet learning conditions have expanded the adequacy of virtual learning with online correspondences, for example, email and live round table discussions (Lee, 2019; Saygili & Çetin, 2021). Online learning is viewed as significant in that it incorporates teaching and learning without the

constraints of time and venues, and presents prospects that cannot be given in conventional face-to-face learning environments (Saygili & Çetin, 2021).

2.2.4.1 E-Learning

Electronic learning (e-learning) is the utilisation of ICTs (for example Web, PC, phone, radio, video, and others) to help instruction and learning exercises. A number of public and private colleges are utilising e-learning techniques, either to offer scholastic projects by means of distance or to help their full-time contact learners (Masrom, 2007). E-learning is also called web-based learning or online learning. The academic thinking around e-learning is firmly connected with digital hardware training. The point is to convey courses for learners. E-learning can be created in different ways, relying upon the necessity of the educational curriculum (Masrom, 2007). Some curricula or departments restrict this to course materials conveyance only through the web, and others have had fundamental structures for their e-learning framework to be utilised for contact learners and distance learners. Subsequently, learners can now utilise innovation to get class notes or data, take examinations, and ask questions at whatever time the need arises (Masrom, 2007). Learning with an application like Siyavula aims to provide opportunities to learners through an online platform which will develop skills.

2.2.4.2 M-Learning

According to (Chibisa & Mutambara, 2022) mobile learning is “learning that takes place through wireless devices such as iPods, laptops, smartphones, USBs, cameras, and personal digital assistants (PDAs)”. As indicated by Herring et al. (2016), mobile learning (m-learning) changes an instructor-focused conceptualisation to a student-focused one, which can invigorate an all-encompassing opportunity for growth. Moreover, m-learning furnishes educators with various teaching methods, for example, instructive games, test and team work, which can be used to meet learners’ different learning inclinations (Yeop et al., 2019). M-learning makes learning and appraisal materials accessible to learners whenever they need it regardless of time and place (Criollo-C et al., 2018). However, the future of m-learning depends on its acceptance (Ayris, 2021).

M-learning is very much comparable to the level of receptiveness that an application, such as SEA, and it may be accessible to all learners in high school from grades 8–

12. M-learning empowers the utilisation of envisioned science tests, which have prospects to upgrade how learners interpret science construct, and empower them to give logical clarifications (Mutambara & Bayaga, 2021; Prestridge, 2012).

As indicated by Kong (2018), m-learning works on parental association in their youngsters' learning process, which further develops learners' inspiration and execution in STEM-related topics. Considering these investigations, it can be reasoned that, despite the fact that STEM instruction is confronting many difficulties, m-learning can reduce the effect of difficulties in rural secondary schools (Mutambara & Bayaga, 2021; Yeop et al., 2019).

Sánchez-Prieto et al. (2019) revealed that learners who appreciate utilising cellular phones see m-learning as helpful and simple to aid their learning. Moreover, the investigation uncovered that perceived satisfaction predicts learners' behavioural intention to utilise m-learning better, than when compared to their discernment that m-learning will increase their scholarly execution.

Be that as it may, this discovery by Sánchez-Prieto et al. (2019) is conflicting when compared to other investigations (Iqbal & Bhatti, 2017; Mutambara & Bayaga, 2021) that put forward learners' demeanour towards use is the best indicator of their goal to utilise m-learning, followed by its value. Sivo *et al.* (2018) discovered that the accessibility of assets positively affected learners' apparent usefulness, similar to the pre-test outcomes of the investigation by Ku (2009). However, the outcomes conflicted with the post-test results of Ku (2009), who announced that apparent resources had no critical impact on apparent helpfulness.

2.2.4 Online Learning and Acceptance

Investigations concerning online learning have an extraordinary commitment to the education sector adding to a comprehension of data practices prompting compelling learning (Ajijola et al., 2021). To gauge the productivity and adequacy of utilising LMS, users' attitudes are a fundamental boundary of accomplishment and disappointment. The acknowledgment of LMS depends on the view of its users, and when users have a negative attitude, it can result in not using the application (Ajijola et al., 2021; Venkatesh & Davis). It was proposed that associating insight with real use is difficult, as discussed by Hanson and Robson (2004) in a review where they analysed the

utilisation of two business-interest LMS called WebCT and Blackboard. It was clear that the learners believed that the functionality further developed their learning.

Liyanagunawardena (2008) stated that there was no important connection between the insight learners had about the LMS and its genuine use. Almarashdeh et al. (2010) showed that the capacity of LMS to permit learners and teachers to achieve their learning task, improve adequacy in learning and increment learning effectiveness is more important than simple-to-get-to data, simplicity in utilisation and easy cooperation from the LMS. The investigation additionally affirmed that receiving the LMS is crucial in deciding if the functionality is working and utilised by learners and teachers in Malaysian colleges.

Trayek and Hassan (2013) additionally analysed the impression of learners at the Defence University on the use of LMSs. The outcomes revealed that users had a good attitude towards the utilisation of the LMS (Ajijola et al., 2021). However, there were a few specialised issues that should be addressed to ensure that the LMS can work phenomenally.

None of the previously mentioned investigations uncovered whether there is positive or negative disposition of learners towards LMS in an open and distance learning setting, as prompted by the health regulations of COVID-19. The subsequent discussion elaborates on the ICT in mathematics education in other less developed countries.

For a long time, mathematics teachers have been investigating various procedures and ways to deal with the nature of schooling and to further develop learning processes (Marban & Mulenga, 2019). Albeit numerous features have been investigated with regards to mathematics instruction, for example, learners accomplishment, parental inclusion, learning conditions, instructor preparation, school educational programmes and state sanctioned testing, among others, it appears to be that more consideration is needed by a few different factors, such as the mix of ICT in teaching mathematics and the consolidated elements of learning and instructing styles (Marbán & Mulenga, 2019).

The instruction in Spain has been going through a few changes, including mathematical teaching. Specifically, the latest strategy proposition has included, as a central issue, the comprehensiveness of ICTs in fulfilling a need that is normal for the

present emphasis on technology (Marbán & Mulenga, 2019). It is critical to understand that in these innovative directions educators truly do matter, but what is perplexing, is that there is no agreement about a solid or objective method of distinguishing great educators. Subsequently, despite the fact that educators are arranged as inexperienced, experienced and specialists in their calling, what makes an instructor decent, a specialist or a superb instructor is not explicitly comprehended (Fan & Ye, 2007; Marbán & Mulenga, 2019).

One of the most fundamental required abilities for either an instructor or student in the 21st century is innovation. It is accepted that ICT can be utilised as an incredible asset to help its incorporation (Bagon et al., 2018).

Salam et al. (2018) specified that change is difficult. It requires overcoming the obstructions that prevent the beneficial combination of ICT in government-funded schools. However, natural boundaries are not difficult to overcome when outward hindrances have been quelled effectively (Marbán & Mulenga, 2019).

2.2.5 The Role of Teaching Styles in Adopting ICT in the Teaching and Learning of Mathematics Using SEA

Grasha (1996), studying instructional styles, stated that such styles differ and are frequently mixed together practically. The most often employed apparatus has been the Teaching Style Survey created by (Grasha & Riechmann-Hruska, 1996). This overview is a 40-item Likert scale that categorises respondents into one of five instructing style types, which Grasha distinguished in his 1996 book *Teaching with Style*.

According to Marbán and Mulenga (2019), the five styles are:

1. **Master**: This educator is a transmitter of data who has information that leaners need and endeavours to keep up with his/her status as a specialist among learners by showing itemized information and by encouraging learners to improve their skill. Specialists are concerned about putting forth data and guaranteeing that learners are prepared. The benefits of this style are that the educator possesses data, information, and abilities. An inconvenience of this style is that an unmistakable showcase of information can be alarming to unpractised learners, and the hidden thoughts that created the data may not be obvious to learners.

2. **Formal Power**: This methodology centres around content and can be solely educator focused. The teacher characterises the hypotheses, standards, ideas or terms that the learners need to learn and sorts out them into a sequence and creates objectives or targets. Assessments are a vital piece of arranging the course as they permit the teacher to find out how much learning has occurred.
3. **Demonstrator**: This methodology focuses on the exhibition of scholastic technique. The educator characterises the means a specialist in the field would use to achieve essential assignments and characterises the norms, which would demonstrate dominance in applying these techniques. The educator then, at that point, creates circumstances in which these means can be carried out and the results detected. The teacher might be the person who shows the strategies; learners might be the ones rehearsing the techniques, or a mix of both.
4. **Facilitator**: Educators who have a facilitator style of teaching will generally focus on exercises. This style emphasises learners focused learning and there is substantially more obligation set on the learners to take responsibility for fulfilling the needs of different learning undertakings. Educators ordinarily configure team exercises, which require dynamic learning, learners-to-leaners joint effort and critical thinking.
5. **Delegator**: Educators who practice a delegator style of teaching will generally put control and obligation regarding learning on the leaners or gatherings of learners. This instructor will regularly give learners a role in planning and carrying out their own learning tasks and will take on a consultative function.

Grasha (1996) proposed a coordinated instructing model that recommends that each instructor has every one of the five styles to a fluctuating degree and mixes of educating styles. The need for each style in the cluster shows the apparent significance of that style and demonstrates that all styles have various benefits and detriments, and can possibly cause uneasiness for the student and restrain learning.

According to (González et al., 2018) proposed that educators' teaching styles in advanced education is an issue that is critical because these connections influence learners' self-insights, contribution, and accomplishments. The investigation uncovered the requirements for various mediations to improve educators' teaching

styles and to cultivate capabilities, introductory self-viability, and a decent degree of obligation to their calling (Marbán & Mulenga, 2019).

According to Li et al. (2017) stated that the commonness of online e-teaching has a learning environment that merges into the recent trend of computerised learning (Li et al., 2017). With changing data innovation and interactive media, computerised instructing is continually affecting unique teaching styles; numerous informational points can be introduced through texts, images, and clear sound (Marbán & Mulenga, 2019). Learning conditions and learning materials are recreated to prompt learners' learning involvement and improve the impact of teaching (Wu & Tai, 2016). Van Braak et al. (2004) researched the solid connection between ICT related mentalities and its use in class for instructive purposes.

Many examinations in the field of ICT in schooling have shown that mentalities towards ICTs impact educators' acknowledgment of the accessibility of ICTs in the illustrations, and furthermore impact whether or not educators incorporate ICTs into their classes (Marbán & Mulenga, 2019). It is proposed that a suitable mix of ICT will affect each part of mathematics instruction; this includes what sort of mathematics is to be introduced and the way in which mathematics is delivered (Leung, 2013; Marbán & Mulenga, 2019).

The proper usage of ICT in mathematics instruction could prompt a more student-focused teaching method, since the incorporation of ICT, in a general sense, changes the educator-learners connection and the manner in which mathematics is being introduced to learners (Marbán & Mulenga, 2019; Pierce & Ball, 2009). These progressions have been generally accepted to have a constructive outcome on mathematics teaching and learning. For instance, the utilisation of ICT can advance learners' mathematic opportunities for growth to develop further learners' inclinations in learning mathematics, and alter their perspectives towards mathematics (Marbán & Mulenga, 2019; Pierce & Ball, 2009).

In spite of the fact that ICT is accepted to have positive advantages on mathematical training, as a general rule, at times educators do not involve ICT by any means or use it in an extremely customary manner, such as utilising ICT to support direct instructing (Goos & Bennison, 2008; Marbán & Mulenga, 2019). Educators' mentalities and convictions about the use of ICT have been contended as a hindrance to take on and

utilise ICT practically (Prestridge, 2012). Significantly, the successful coordination of ICT can make mathematics (and other conceptual ideas) more open to learners and further develop learners' interpretation of mathematics ideas, foster learners' critical thinking abilities, further develop learners' levels of numerical reasoning, and even develop learners' mathematics accomplishment (Li & Ma, 2010; Marbán & Mulenga, 2019).

Scholars have observed that educators' perspectives toward ICT were a prominent sign of their expectation to utilise the innovation than their convictions, similar to self-viability convictions (Marbán & Mulenga, 2019). For the most part, more positive perspectives towards ICT will support higher learning environment ICT combination, while negative mentalities halt its use (Sangcap, 2010). In mathematics training, it was observed that when educators accept the utilisation of ICT, only then will learners learning improve or increment learners' inspiration, satisfaction and certainty (Marbán & Mulenga, 2019). Assuming educators believe that to show a comprehension of mathematics, leaners should have the option to take care of issues without the help of ICT, or even accept that the use of ICT will block the improvement of learners' capacity, for example, the capacity of estimation, they will not incorporate ICT in mathematical training, or use it in an extremely conventional information transmission way (Goos & Bennison, 2008).

2.3 SIYAVULA EDUCATIONAL APPLICATION

"*Siyavula*" is a Nguni phrase that means "we are opening", which is core to Siyavula's mission to open up education in South Africa. It means something to the many people who Siyavula aim to reach. Siyavula claimed that every learner and teacher should have access to quality educational resources for long term development. Siyavula have faith in time and research for building technology to facilitate profound learning mathematics and science experiences. Siyavula members are working together in making sure of the good foundation on learning in all South African schools. Siyavula focuses more on mathematics and science education for grades 4–12; it is aligned with the South African national curriculum. Siyavula migrated its profitable open educational resources (OER) concept-mapping and textbook to work with other African nations, such as Nigeria (Lambert, 2019).

2.3.1 The Evolution of Siyavula Company

Siyavula evolved from high school science texts to a project with an open mission, where Siyavula technology company was developed.

2.3.1.1 Free High School Science Texts

This company started with a project of free high school science texts in March 2002, by Mark Horner, who graduated at the University of Cape Town (Petrides & Jimes, 2008). A group of students asked Horner to demonstrate, step by step, the textbook (covering grades 10–12) including physics, chemistry, life science and mathematics, and make it free and sharable, so they could share notes with their classmates and teachers. The Free High School Science Texts (FHSST) began publishing OER. OER is an educational resources that includes curriculum mapping, textbook, videos, applications and all other materials designed for teaching and learning (Butcher, 2015).

2.3.1.2 A Project with an Open Mission

With the support from the Shuttleworth Foundation, the aim was to make licensed content available for all learners in all grades. This project intention was to build better a knowledgeable society with limitless possibilities, FHSST become Siyavula an educational technology company in 2007. Siyavula educational technology was tasked to develop and improve education (De los Arcos et al., 2016). The government distributed millions of printed textbooks to all learners in South African schools at no cost to schools. Moon and Villet (2016) pointed out that Siyavula's mission is to make everyone has access to all resources and support in learning.

2.3.1.3 Transition to a Technology Company

Siyavula was able to transform creating learning resources to learning opportunities in South Africa and developed a digital catalogue of OER, textbooks and other online resources which provide learners with quizzes and feedback (Lambert, 2019). Siyavula partnered with, and was sponsored by, the Sasol Inzalo Foundation to produce textbooks for grades 4–6 natural sciences and technology workbooks, and grades 10–12 textbooks which was printed in both English and Afrikaans.

SEA was proposed as a software solution for promoting independent study, and to help Grade 12 learners stay motivated and attain invaluable skills to prepare them for

university studies. The South African Department of Basic Education (DOE) supports the use of technology to transform the education system (Department of Education, 2020). Siyavula is an organisation with a mission to create and engage, integrate, high quality learning in mathematics and science and helping young minds to master and develop skills for their future needs. Siyavula aims to deliver good standards throughout South Africa, and beyond. Siyavula has developed progressive software programs that permit learners to learn mathematics and science. In the SEA, parents and teachers can also enrol to track learners' work; for parents they need a learner's identity link which is obtained in the application and each learner has a unique identity.

The software application presently covers grade 8–12 mathematics and grades 10–12 physical sciences. If a leaner is registered on the SEA he or she can work independently and with assistance from others. Figure 2.1 shows the logo currently used by SEA, with a compony slogan (Technology-powered learning).

Figure 2.1: Siyavula as a learning institute (Lambert, 2019)

This study examines the factors affecting Grade 12 learners' receptiveness in using SEA in the learning of mathematics. The Department of Education (2020) points out that mathematics helps enhance intellectual approaches that underpin logical and fundamental thinking, accuracy problem solving that will, in turn, help decision-making. This study emphasises the creation of scientific knowledge that applications such as Siyavula help build, as stipulated in the curriculum assessment policy statement CAPS document (Department of Education, 2010). The subsequent literature elaborates on the theoretical framework that underpins this study, the technology acceptance model (TAM).

2.4 THEORETICAL FRAMEWORK: TECHNOLOGY ACCEPTANCE MODEL (TAM)

In this study the technology acceptance model (TAM) was chosen because it is considered robust, and because it is the most commonly used model for studying the acceptance of technology in many fields, education included. This framework was an improvement of the theory of reasoned action (TRA) which started in the field of psychology (Hale et al., 2002). The TRA was the first theory to be examined. The TRA postulates that an individual's behaviour is determined by their behavioural intentions, which is a component of an individual's attitude towards conducting and identifying rules about carrying the behaviour (Ibrahim et al., 2017; Masrom, 2007).

Figure 2.2 shows the TRA where beliefs and evaluations had a direct influence on attitude towards one's behaviour, and these influences one's behavioural intentions. Normative beliefs had direct effects on subjective norms that in turn influence behavioural intentions. Actual behaviour is therefore a result of individual behavioural intentions.

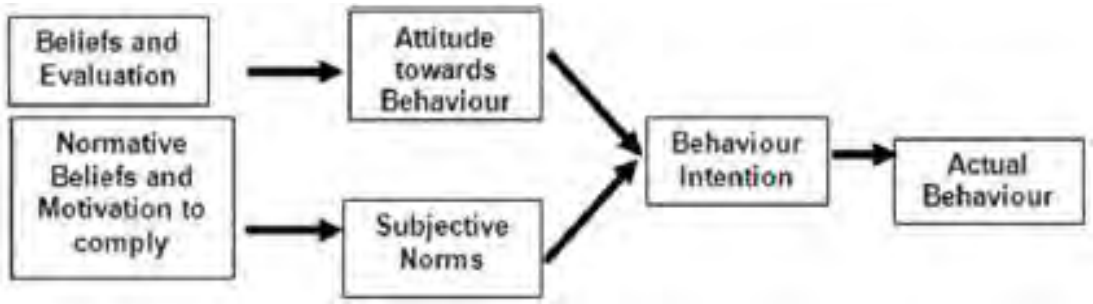

Figure 2.2: Theory of reasoned action (Adapted from (Al-Adwan et al., 2013)

According to Terry et al. (1993), the shortcoming of TRA is the inability to demonstrate the relationships between individuals and the larger social structures that influence social behaviour. The other weakness of TRA is that it just considers attitude and subjective norm as the two latent variables of behavioural intentions. Schwartz and Tessler (1972) noted that there are other constructs, beside attitudes towards and behavioural intentions, that include a sense of right or wrong in an individual.

As a means of closing the gaps in the TRA, the TAM was proposed by Davis (1989). It was reviewed and improved by many authors over the years (Chibisa et al., 2021; Fathema et al., 2015; Kamal et al., 2020; Mutambara & Bayaga, 2021). TAM was presented by Fred Davis in 1986 for his doctorate proposition, as shown in Figure 2.3.

An improvement on the TRA, the TAM is used for assessing individuals' acceptance of information system technology (Tshabalala et al., 2019).

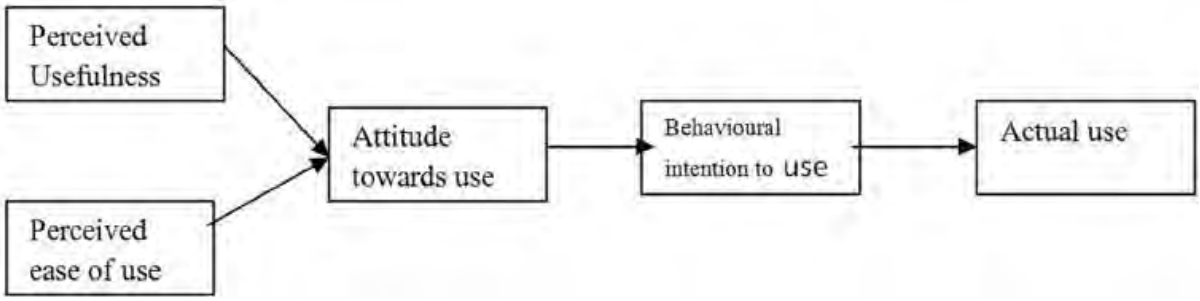

Figure 2.3: Technology acceptance model (Davis, 1989)

In 1989, Davis utilised the TAM to clarify computer-use conduct, as displayed in Figure 2.4. Davis elucidated the overall determinants of computer acknowledgment that clarify users conduct across an expansive scope of end-user computing innovations and user populaces. The fundamental TAM model tried two explicit convictions which were perceived usefulness (PU) and perceived ease of use (PEU) (Lai, 2017). PU is characterised as the potential user's abstract probability that the utilisation of a specific framework will further develop users' activity. PEU alludes to how much the potential user anticipates that the objective framework should be easy (Davis, 1989). The conviction of the individual towards a framework might be impacted by different elements, alluded to as external variable in TAM (Lai, 2017).

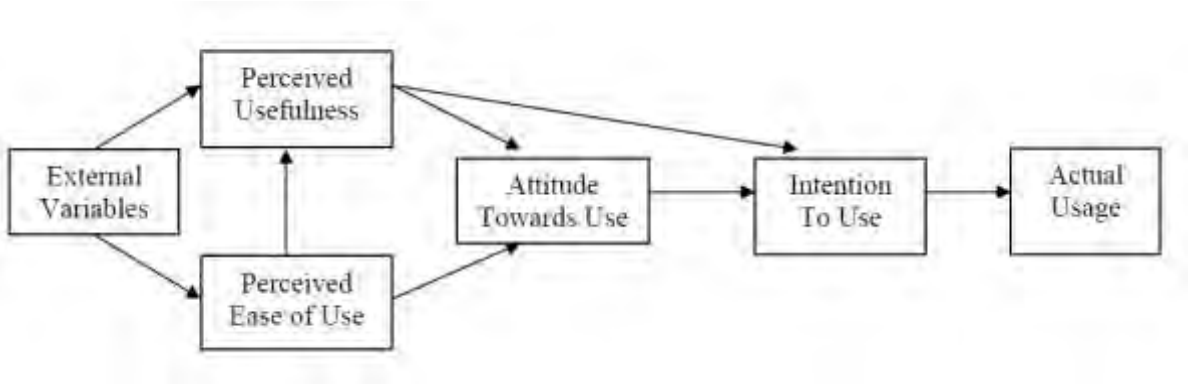

Figure 2.4: First modified version of technology acceptance model (TAM) (Davis et al., 1989)

The last form of TAM was framed by Venkatesh and Davis (2000), as displayed in Figure 2.5, after the fundamental finding of both PU and PEOU were found to impact behavioural intention, subsequently ending the requirement for the attitude element (Lai, 2017). There is little or no difference between the behaviour of Grade 12 learners.

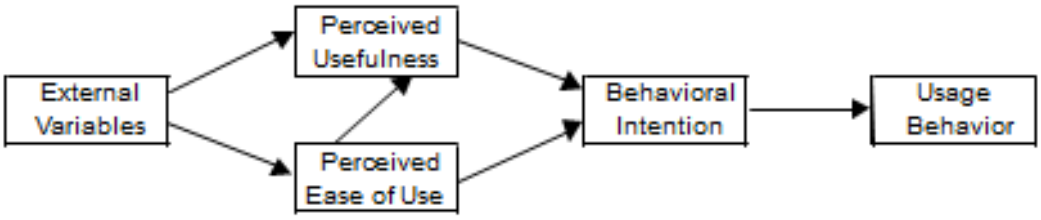

Figure 2.5: Last form of TAM (Venkatesh & Davis, 1996).

A number of studies were conducted after a study by Davis (1989), to validate TAM. Van Raaij and Schepers (2008) used TAM to identify the acceptance of virtual learning environments on students, who reported that their model explained 31% of virtual learning acceptance. Also the findings of Davis (1989) used original TAM — the results of the explanatory power was 40% of the variance in individuals' behavioural intentions to use information system.

The purpose of this study is to examine the factors affecting receptiveness of the SEA in the learning of mathematics. This study used the extended technology acceptance model initially developed by (Davis, 1989). Some of the external factors identified by this study, PA, PSI, PSR, and CSE, affect the actual use the SEA, which are all not identified by original TAM. This means that the researcher used the extended TAM to examine Grade 12 learners' receptiveness of SEA because it has limited constructs, following the suggestion by Davis (1989), that researchers should continue to find other variables that are context related.

Shankar and Kumari (2019) explored the factors affecting the intention to adopt mobile governance (mGov). The result shows that PU, PEOU, perceived security, and perceived compatibility were strong determinants factors that affecting the adoption of mGov. Damnjanovic et al. (2015) identified eight other factors that affect the effectiveness of modular object-orientated dynamic learning environment (Moodle),

from students' perspective. The results show that communicativeness as one of the constructs had a strong influence on the effectiveness of Moodle, with the explanatory power of 68.4%

2.5 FACTORS THAT AFFECT GRADE 12 LEARNERS' RECEPTIVENESS OF SEA IN THE LEARNING OF MATHEMATICS

This study sought to investigate factors affecting Grade 12 learners' receptiveness of SEA in the learning of mathematics using the extend TAM. Davis (1989) noted convergence of usefulness and attitude towards the system on a person's behaviour. Davis (1998) suggested that PU and PEOU are the main determinants of users' attitudes towards the application. PEOU refers to individual perception on how easy to use technology and PU is individuals' beliefs on how useful technology is (Davis, 1989).

A study conducted by Šumak et al. (2011) examined the factors that have an impact on students' perceptions about the acceptance and the use of e-learning system (Moodle). The results of the study indicated that PU and PEOU are factors that directly affect students' attitudes toward using Moodle, the study further revealed that PU is the most significant and the strongest determinant of students' attitudes toward using Moodle. That means that students like to use Moodle.

2.5.1 Proposed Conceptual Model

This study used the extended TAM initially developed by Davis (1989), to establish the factors that affect Grade 12 learners' receptiveness to SEA (SEA) in the context of learning. The reason for using the extended TAM was to take advantage of the suggestion by Davis that researchers should continue to find other variables that are context related (Davis, 1989). As a result, the researcher used TAM because it allows the addition of the following content variables: perceived accessibility (PA), perceived social influence (PSI), perceived skill readiness (PSR) and computer self-efficiency (CSE). These constructs are critical in this study, However, this is an original integrated model (SEATAM) designed by the researcher, to understand the actual use of SEA in the content of learning mathematics by grade 12 learners.

The conceptual framework is shown in Figure 2.6, which has eight construct that are explained thereafter, starting with PA, PSI, PSR, and CSE external factors feeding to

original TAM by Davis (1989), followed by the four original TAM factors (PU, PEOU, ATT and AU). This study had hypotheses towards each construct. Furthermore, Venkatesh and Davis (2000), noted that it is necessary to hypothesise the relationship between the model variables in order to assess the impact of external variables on TAM constructs.

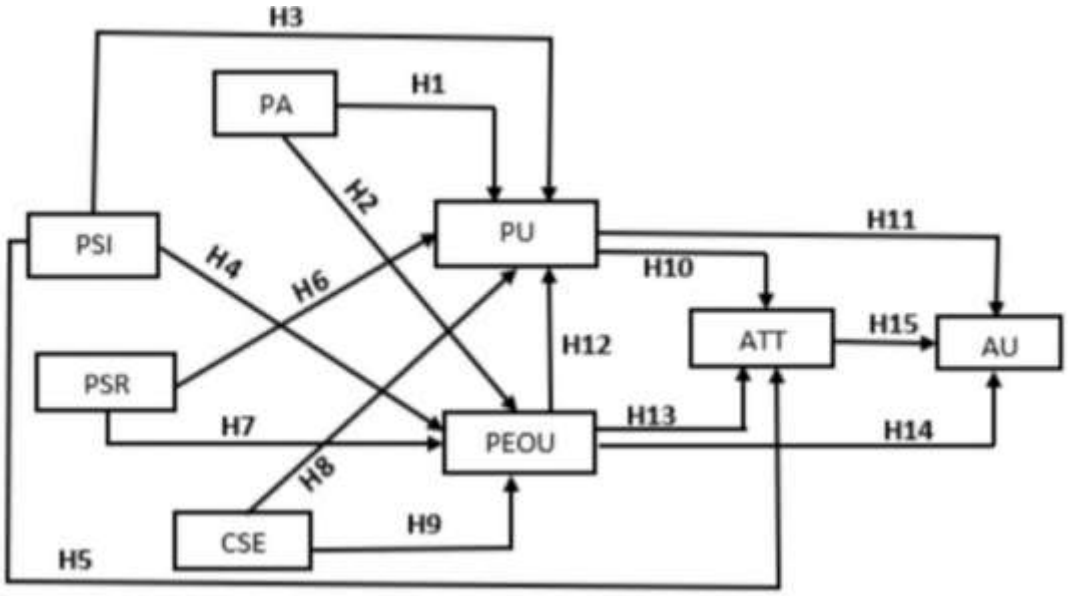

Figure 2.6: Proposed SEA technology acceptance model (SEATAM)

2.5.1.1 Perceived Accessibility (PA)

Perceived accessibility refers to “the degree of easy of how a user can access and use the given information system” (Salloum et al., 2019). In this study, PA is how Grade 12 leaners access and use SEA. Past investigations demonstrated that PA has a positive relationship with PU and PEOU (Rafique et al., 2020; Salloum et al., 2019; Salloum, 2018; Saroia & Gao, 2019; Shankar & Kumari, 2019).

Salloum (2018) defined PA as one of the factors to influence the acceptance of e-learning in higher education. It was found that the result supported the hypothesis that PA had a positive influence on PEOU and PU. If Grade 12 leaners consider SEA accessible, then there is a more prominent chance that the usefulness and ease of use of SEA would increase. Therefore, the following were hypothesised:

H1: Perceived accessibility has a positive effect on perceived usefulness.

H2: Perceived accessibility has a positive effect on perceived ease of use.

2.5.1.2 Perceived Social Influence (PSI)

Perceived social influence (PSI) refers to how other individuals impact an individual's perception, beliefs, and states of mind towards using the given information system (Chibisa et al., 2021). Mutambara and Bayaga (2020b) supported the idea that PSI is regarded as the perception that most of individuals who are important to them, should influence others to use or not use the information system. In this study PSI is when Grade 12 learners think that they can be influenced by others to use or not use SEA. Leaners get motivated or demotivated by others to use or not use the SEA system (Mutambara & Bayaga, 2020a). In a study conducted by Chibisa and Mutambara (2022) about the acceptance of mobile learning by educators and students, PSI was found to be a good determinant of high school educators and students to use m-learning as an educational tool. A number of studies prove that social influence has a positive influence on PU, PEOU and ATT (Chibisa et al., 2021; Lee et al., 2003; Mutambara & Bayaga, 2021; Scherer et al., 2019; Tayo, 2015; Zhang et al., 2020). This implies that Grade 12 learners may consider PSI as an important factor in considering the use of SEA in their learning of mathematics, since their significant other think that they can use SEA in the learning of mathematics. As a result, the following hypotheses were made:

H3: Social influence has a positive effect on perceived useful.

H4: Social influence has a positive effect on perceived ease of use.

H5: Social influence has a positive effect on attitude towards using.

2.5.1.3 Perceived Skill Readiness (PSR)

According to Mutambara and Bayaga (2021), perceived skill readiness is one's perception of capability to use a mobile devise, for the achievement of a learning task. A study conducted in Gulf by Al-Maroof et al. (2021) examined the factors that have an impact on the use of 5G in the Gulf area. The research reported a positive effect on perceived skill readiness which indicated competence in using technology. Iqbal and Ahmed Bhatti (2015) stated that students with technical skills will easily engage themselves in a new technology than those who do not have technical skills. In this study, skill readiness implies that if most learners have the required technical skills when using any devise for the implementation of SEA. It will be easy for them to

engage with SEA than those without the technical skills. Consequently, the hypotheses are:

H6: Perceived skill readiness has a positive effect on perceived usefulness.

H7: Perceived skill readiness has a positive effect on the perceived ease of use.

2.5.1.4 Computer Self-Efficacy (CSE)

Self-efficacy (SE) alludes to users' capacity and inspiration to perform explicit assignments (Agarwal et al., 2000). Computer self-efficacy (CSE) is centred around the idea of judgment of one's capacity to utilise an innovation to achieve a specific task or assignment (Johnson et al., 2017). Fathema et al. (2015, p. 214) defines self-efficacy as "an individual's judgment of his or her capability to organize and execute the courses of action required to attain designated types of performances".

The term 'computer' in this study refers to computers such as a desktop, tablet, cell phone and laptop, and learning software, such as educational websites and applications, such as SEA. Compeau and Higgins (1995) have characterised self-efficacy as appraisal of a person's capacity to utilise a computer. The emphasis is on what they can accomplish in the approaching years rather than on what they have effectively accomplished (Hatlevik et al., 2018). Ajzen (1991) has portrayed CSE as a self-assessment on one's capacity to use computer.

In computer use, consolation and backing from others, particularly administrators, and gaining from others, can likewise positively influence CSE. With higher CSE, users will have better understanding, invest more energy on the computer, and have a more uplifting outlook about it. Simultaneously, they will have lower nervousness about using the computer (Liao et al., 2018). He further reported that CSE have a positive effect on PU and PEOU. In this study, if Grade 12 learners are able to use computer technologies, they are more likely to use SEA. The following hypotheses were proposed, to test the impact of CSE on Grade 12 leaners to use SEA:

H8: Computer self-efficacy has a positive effect on perceived usefulness.

H9: Computer self-efficacy has a positive effect on perceived ease of use.

2.5.1.5 Perceived Usefulness (PU)

Perceived usefulness (PU) is one of the pillars of the TAM, as described by Davis (1989), as the degree to which a person believes that when using any information

system they would perform better. PU in this study examines learners' perceptions as to whether the use of SEA will improve their grades in the learning of mathematics. Research confirms the strong impact of PU in the TAM. For instance, a study conducted by Mutambara and Bayaga (2020b) about understanding parents' behavioural intention in allowing their children to use mobile learning, the result showed that parents in rural areas are not aware of the usefulness of m-learning. A study by Šumak et al. (2011) found that PU had a positive effect on ATT and BI. Another study conducted by Masrom (2007) found that PU has a significant effect on intention to use e-learning in universities as an effective learning tool. However, if Grade 12 leaners believe that using SEA is useful to them, then they will use it and perform better in mathematics. Thus, researcher tested the following hypotheses:

H10: Perceived usefulness has a positive effect on attitude towards using SEA.

H11: Perceived usefulness has a positive effect on actual use of SEA.

2.5.1.6 Perceived Ease of Use (PEOU)

Perceived ease of use (PEOU) affect both PU and intention to use (Davis, 1989). Moreover, the two elements have been viewed as beliefs of users in the technology improving intention to use and real use of the technology (Mutahar et al. (2018), and PEOU has a positive influence in ATT. Davis et al. (1989), stated that PEOU influences PU, which means if someone believes that technology is easy to use then they will consider technology useful to use. This study investigated that if Grade 12 learners perceive SEA easy to use, they will consider it useful in the learning of mathematics.

PEOU is the level to which an individual accepts that the utilisation of a framework is simple. PU is the level to which an individual accepts that the use of a framework further develops their knowledge of the subject (Chibisa et al., 2021). PEOU and PU can impact a person's demeanour towards involving innovation in their personal limits. In any case, PEOU and PU are additionally interrelated and the PEOU of data innovation can straightforwardly influence the PU of a similar data framework. Outside factors additionally impact the PEOU and the PU of a data set. The outside factors, thus, impact the mentality towards utilising a data set, prompting the real use of the data set, or a choice not to utilise it (Chibisa et al., 2021). The study conducted by Al-

Adwan et al. (2013) found that PEOU has positive influence on intention to continue use e-learning system. Therefore, the hypotheses are:

H12: Perceived ease of use has a positive effect on perceived usefulness.

H13: Perceived ease of use has a positive effect on attitude towards use.

H14: Perceived ease of use has a positive effect on actual use of SEA.

2.5.1.7 Attitudes Towards Using (ATT)

Attitudes towards a behaviour is defined by Chen and Tsai (2019, p. 96) as “the degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour studied”. According to Escobar-Rodriguez and Monge-Lozano (2012), attitude refers to the degree to which an individual has a positive or negative feeling towards a learning management system. Previous studies have shown that attitude towards something has a positive effect on actual system use, as Salloum (2018) found that ATT has a positive influence on AU. The study will determine the attitude of Grade 12 learners in using SEA in the learning of mathematics. Hence, the hypothesis is:

H15: Attitude towards use has a positive effect on actual use of SEA.

2.5.1.8 Actual Use of SEA

Actual use of SEA in this study means Grade 12 leaners exposed to the application. Additionally, is the resultant construct which measures the extent to which Grade 12 learners actually use the SEA to learn mathematics. A number of studies conducted, such as Hernandez et al. (2011), who found 45.6% of the actual use of the learners’ attitude and usage behaviour of ICT.

2.6 THE EXTENT TO WHICH THESE FACTORS AFFECT THE RECEPTIVENESS OF SIYAVULA EDUCATIONAL APPLICATION (SEA) IN THE LEARNING OF MATHEMATICS

Mutambara and Chibisa (2022) studied the extent to which the following factors explain the actual use of virtual learning (VL) by rural STEM preservice teachers: computer self-efficacy (CSE), perceived enjoyment (PEN), social influence (SI), facilitating conditions (PR), perceived ease of use (PEOU), perceived usefulness (PU)

and perceived attitude towards (ATU) ICT. Their explained variable was 74.6% of the actual usage of VL.

Tshabalala et al. (2019) reviewed the extent to which pre-service teachers use Moodle to enhance learning; the conceptual model had seven constructs which examined pre-service teachers' use of Moodle: subjective norm (SN), perceived resources (PR), perceived enjoyment (EN), PEOU, PU, attitude towards use (ATT), and actual use (AU). The explained variance of AU of Moodle by preservice teachers was a substantial 69.8%. Based on these results with high explained variances as shown, it means that the identified constructs were the best determinants of actual use of the intended information systems (Tshabalala et al., 2019).

The proposed conceptual model of this study has eight constructs which were examined for their important to the Siyavula Educational Application: PA, PSI, PSR, CSE, PU, PEOU, ATT and AU of SEA. The intention was to find out how far these factors explain the actual usage of SEA in the learning of mathematics.

2.7 EFFECTS OF DEMOGRAPHIC FACTORS OF GRADE 12 LEARNERS ON THE RECEPTIVENESS OF SEA IN THE LEARNING OF MATHEMATICS.

Chibisa (2021, p. 83) defined demographics as "the collection and analysis of broad characteristics about groups of people and population". In a study conducted by Tshabalala et al. (2019), demographic factors, namely gender, level of study, and age, do not influence pre-service teachers' use of Moodle to enhance learning. In this study, the focus has been on two demographic factors: residential location and gender of Grade 12 learners on SEA. Age was not considered because the age difference of Grade 12 learners is generally too small.

2.7.1 Residential Location

The residential location in this study was included to find out how Grade 12 learners in various locations receive SEA in the learning of mathematics. The study explored two distinct school contexts: rural and urban based school contexts in King Cetshwayo District, uMhlathuze circuit. The question was whether Grade 12 leaners in rural and urban schools, when using the SEA, would study mathematics differently depending on where they are located in relation to one another.

A number of studies were conducted to determine the effect of geographical location around the world. Syahruddin et al. (2021) examined the role of geographical location in Indonesian sport science students. The study was based on the acceptance of distance learning during COVID-19. However, the result shows a huge difference when it comes to the acceptance of distance learning such as learning behaviour patterns and access to technology was revealed to be different according to different location. Cooper et al. (2021) argued that geographical location has positive effect on Google search returns when understating a web-search. Based on the findings of research that was undertaken in 12 different countries, 43 items were identified, and concluded that geographical location have positive influence on Google returns.

Another study was conducted by Panizzon (2015) in Australia about the impact of geographical location on student achievement in mathematics, comparing students in rural schools and students in metropolitan schools. He stated that student diversity must be considered in order to ensure greater access to mathematics. However, the result of the study showed that students at metropolitan schools achieve better than students in rural schools. Therefore, there will be effect of geographical location to learners in rural and learners in urban location when it come to the receptiveness of SEA.

2.7.2 Gender

Tshabalala et al. (2019) conducted a study about the extent to which pre-service teachers use Moodle to enhance learning. They explored the effect of demographic influence which was measured on gender, age and level of the study. They reported that gender has no effect on the relationship between pre-service teacher's use of Moodle to enhance learning. In this study, gender will have no effect when it comes to the receptiveness of SEA.

2.8 SUMMARY OF THE CHAPTER

The aim of the study was to investigate the receptiveness of the SEA in the learning of mathematics by Grade 12 Learners from uMhlathuze Circuit schools. The literature was organised in four sections: conceptual analysis of learning management systems (LMs); the SEA as an academic software; the rationale for choosing to focus on the SEA and the theory govern this study which is technology acceptance model. It then

focused on the factors that affect Grade 12 learners' receptiveness of the SEA in line with the theory governs the study, TAM by Davis et al. (1989). The conceptual framework of the study and its hypotheses were presented and discussed. The chapter concluded by looking at the effects of demographic factors of Grade 12 learners on the receptiveness of the SEA in the learning of mathematics where the study examined gender and geographical location. The subsequent chapter focuses on the methodology used to examine Grade 12 receptiveness of SEA in the learning of mathematics.

CHAPTER THREE METHODOLOGY

3.1 INTRODUCTION

The previous chapter outlined the literature review and the theoretical framework which underpins this study. This chapter elucidates the methodology used to examine Grade 12 receptiveness of SEA in the learning of mathematics. This chapter includes the research paradigm, research design, population, sampling approach, instrument used, data collection methods, and data analysis. The research methodology that underpins this study is conceptualised in relation to the following research questions:

- What are the factors that affect Grade 12 learners' receptiveness of SEA in the learning of Mathematic?
- To what extent do these factors affect the receptiveness of SEA in the learning of mathematics?
- What effect does demographics have on Grade 12 learners' receptiveness of SEA in the learning of mathematics?

According to Kumar (2018), research covers two key stages: the stage of planning, where the researcher aims to construct a design, and appropriate plan of the research and the stage of implementation, where data are collected and analysed. In the current study, the researcher investigated the factors that affect Grade 12 leaners' receptiveness of SEA in the context of learning mathematics.

3.2 RESEARCH PARADIGM

A paradigm, according to Shuttleworth and Wilson (2008), as cited by (Mthethwa, 2015, p. 51), "is a framework containing all of the commonly acceptable views about the structure of which direction research should take and how it should be formed". There are different kinds of paradigms, such as positivism for quantitative research, interpretivism for qualitative research, criticism for civil actions, and pragmatism for mixed methods (Rane et al., 2018). Quantitative research methods are usually associated with the positivism paradigm.

The paradigm that will be employed in this prospectus study to comprehend the factors that affect Grade 12 learners' responsiveness to SEA in the content of learning mathematics is explained in the following subtopic.

3.2.1 Positivist Paradigm

The researcher employed a positivist research paradigm to understand the factors that affect Grade 12 learners' receptiveness of SEA in the context of learning of mathematics. The positivist paradigm is associated with the idea of gaining an understanding of human behaviour through observation and reason (Park et al., 2020). Park et al. (2020) explained that a paradigm the standpoint from which one views the world, and such views assume one's own reality. Moreover, positivism is in line with the current study, where the researcher determined the factors that affect Grade 12 leaners' receptiveness of SEA in the context of learning mathematics at uMhlathuze circuits under King Cetshwayo District.

3.3 RESEARCH DESIGN

A research design is the framework of methods and procedures with which a researcher merges various components to make sure that a research problem is effectively studied (Mngomezulu et al., 2022). However, a research design can also be considered a blueprint or plan of how the researcher intends to collect and analyse data that aim to answer the research questions (Kumar, 2018). A research design is a vision and plan that explains how research should be carried out.

The study applied a quantitative approach because the researcher wished to understand the factors that affect Grade 12 learners' receptiveness of SEA in the context of learning mathematics and the actual use of the application. In addition, the researcher also investigated the role played by Grade 12 learners' demographic characteristics in their receptiveness of SEA.

Huang (2014) suggested that the quantitative approach helps to examine the factors that affect the users' acceptance of technology and in analysing survey data. A quantitative study can be a systematic and fair strategy that uses measurable data from a chosen sample of the population to generalise to the target populace that is being examined (Bellhouse, 2005; Creswell & Creswell, 2017; Mthethwa, 2015). This definition harmonises with Alharahsheh and Pius (2020), who pointed out that quantitative research is related to observations which create numerical evidence. A quantitative research is used mostly to test existing theories (Creswell & Creswell, 2017).

This study used a descriptive design, which involves the construction of a set of questions which are either asked by means of a questionnaire or through an interview (Creswell, 2014a). Descriptive research designs can be either a quantitative or qualitative study. In this case, it will be used within the quantitative research approach. Descriptive research ascertains the prevailing conditions of the study topic and allows comparison of characteristics of two or more groups to determine their similarities and differences (Creswell, 2014a). In agreement with Bhattacherjee (2012), the study by Chibisa (2021) posited that quantitative research is mostly in line with positivism and deductive research.

A survey design was used in this research. According to Creswell (2012), as cited by Mutambara and Bayaga (2020a, p. 57), a "survey design provides a quantitative description of opinions of a population by studying a sample of population". In this study, a survey design was conducted in order to have quantitative description of Grade 12 learners' receptiveness of SEA. A survey was chosen because it has prospects to collect large amount of data from Grade 12 leaners at uMhlathuze schools. A descriptive, cross-sectional survey design was used to collect quantitative data through questionnaires (Creswell & Creswell, 2017).

A questionnaire, in which questions concerning perceived accessibility (PA), perceived social influence (PSI), perceived skills readiness (PSR), computer self-efficacy (CSE), perceived usefulness (PU), perceived ease of use (PEOU), attitudes towards using (ATT) and actual system use (AU) were included, was used along with questions on demographic data.

3.4 TARGET POPULATION

A target population is the entire group of people or things that have one extra comparable factor in common from which the data can be collected. According to Creswell and Creswell (2017), population is the group of individuals or items sharing common characteristics. Some researchers have postulated it refers to all possible units, elements or individuals that may form part of a study (Bhattacherjee, 2012; Chibisa, 2021; Creswell, 2014a; DRAINE, 2001; Kumar, 2018). In this study, the researcher focussed on Grade 12 learners from uMhlathuze circuit schools under the King Cetshwayo District.

Learners were chosen from six randomly selected schools in alignment with the methodological conventions found in the literature (Conroy, 2015). A population of 673 learners from the six schools, according to requested statistics from subject advisors, was used for this study. Bhattacherjee (2012), together with Creswell (2011), pointed out that, before sampling the targeted population where the data is to be collected, sampling methods and sampling size need to be considered. The following discussion alludes to sampling methods and sample size of the population.

3.5 SAMPLING AND SAMPLE SIZE

Sampling refers to a process of selecting a subgroup of items from a defined population for inclusion in the study (Kumar et al., 2019). However, Creswell (2012) defined sampling as a subgroup of a target population from which data are to be generated. The definitions above posit that sampling is the selection of the participants in the study. To collect data, this study adopted stratified random sampling with equal allocation to select participants. To have all Grade 12 learners represented in the survey, a stratified random sampling was used. In this study, and it ensured that each unit in the sample had a chance of being selected to participate in the study (Creswell, 2014a).

A total of 52 high schools were actively using SEA in uMhlathuze circuit of King Cetshwayo District. From 52 high schools, of which 41 schools are rural and 11 schools are urban, the researcher followed a simple random sampling to select three schools from the rural areas and other three urban schools. This was done to understand the effect of geographical location in using SEA in learning mathematics.

Using simple random sampling, a representative sample of six schools was used for the study, following a recommendation by Conroy (2015), that a representative sample should be at least 10% of the population. To collect data, stratified sampling was used with equal allocation of participants for this study. In all the selected six schools in uMhlathuze circuit that were actively using SEA, each school was used as a strata. There were six strata altogether, which made a population of 300 learners.

Simple random sampling was used to select respondents from each stratum. The ‘equal number’ strategy of seven-step procedure, suggested by Kumar (2018), as cited by Chibisa (2021, p. 121), was used. The sample size calculation was done by dividing the number of respondents (300) by the number of strata (6), which makes 50

respondents from each stratum. The researcher used numbered class lists to sample 50 Grade 12 leaners in each stratum. This means that an equal number of learners was selected from each of the selected schools because the goal was not to have proportional representation but to have representation from each school.

Following the recommendation by Hair Jr et al. (2017) as cited by Mutambara and Chibisa (2022), that a sample size should be at least 10 times larger than the number of indicators of the construct with the most indicators, the suggested minimum sample size is 50. For this study, the perceived usefulness (PU), perceived ease of use (PEOU) and perceived social influence (PSI) have the most indicators, of five in each, and therefore data were collected from 300 respondents in this study which exceeded the minimum recommended 50.

3.6 DATA COLLECTION

McMillan and Schumacher (2010) argued that the data collection stage of the research study describes accurately how the researcher goes about collecting the data. The researcher details steps that are followed when collecting the data. McMillan and Schumacher (2010) further mentioned that explaining step-by-step process of collecting data is important for the study in order to ensure reliability and validity of the study.

In order to collect data that were intended to answer the research questions, the researcher adapted questionnaires used in similar studies (Mutambara & Chibisa, 2022; Tshabalala et al., 2022). The responses were measured using a five-point Likert scale questionnaire which was self-administered. Data were collected from Grade 12 learners at uMhlathuze circuit schools under king Cetshwayo District in South Africa. A total of 300 questionnaires were administered randomly; 291 questionnaires were returned, giving a response rate of 97%.

3.7 QUESTIONNAIRE DESIGN

A questionnaire is defined by Creswell (2012) as the series of questions that is used by a researcher to gather information from respondents. The responses were measured using a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the mid-point (3) representing the state of being uncertain or neutral. The questionnaire was designed to collect data on the factors that affect

Grade 12 learners' receptiveness of SEA in the context of learning mathematics and actual use of the application, and to investigate the role played by demographic characteristics in Grade 12 leaners receptiveness of SEA.

According to Kumar (2018) and Husain and Farooq (2013), this instrument should be made simple to use, by paying more attention to appropriateness of its design. Moreover, the instrument instructions should be easy for the respondents to make certain it is filled successfully and without any difficulty. A questionnaire is considered to be a valid, accurate and time saving method of data collection (Salloum, 2018). Following the suggestion made by Husain and Farooq (2013), that all answers should be direct and accurate, indicators/items should describe precisely and correctly; the language used in the questionnaire should be easy and simple; the length should be a proper one; answers should be relevant to the topic and indicators/items aligned with the research question of the study.

The questionnaire comprised of two sections: Section A and Section B. The questionnaire was intended to collect data on the receptiveness SEA in the context of learning of mathematics by Grade 12 learners. The collected information was solely kept by the researcher and was not disclosed to any third party and used for academic purpose only. Section A had three items intended to collect the respondents' biographical data: gender, residential demographics and how many hours they spent using SEA per week. However, age was not a factor that was taken into consideration because the researcher intended no exclusivity of participants based on their age but grade. In addition, the researcher did not consider age because the age of Grade 12 learners is too close, which was ranging from 17 to 19. The questionnaire was used keeping leaners' responses anonymous.

Section B was meant to answer the research question, "What are the factors that affect Grade 12 learners' receptiveness of SEA in the learning of mathematics?". Eight constructs were measured with no more than 5 indicators per construct which were measured on a five-point Likert scale with the alternatives ranging from 1 – strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – strongly agree. These indicators or items were intended to measure the Grade 12 leaners' receptiveness of SEA in the context of learning of mathematics. The questionnaire was constructed and written in simple language for all respondents to understand. The aim of the study was clearly written in the first page and it was clear to the respondents that the information was

not going to be disclosed to any third party besides that it would be used for academic purposes only. Instructions were clearly indicated on how to respond to every question. Then the questionnaire was administered to 300 Grade 12 mathematics learners at uMhlathuze circuit schools under king Cetshwayo District in South Africa. The questionnaires were delivered and collected after they were filled in.

3.8 PILOT STUDY

To confirm the instrument developed for data collection for this study, a pilot study was conducted. The pilot study is an important stage before conducting the final study of the research (Sekaran & Bougie, 2010). In addition, the main aim of piloting the study was for the researcher to prepare the actual study using similar items and phrasing to test the instrument so that it could provide advance warning about how effective the instruments will be in measuring what they are intended to measure. The pilot study also helped the researcher check if the instruments were realistic or effective and also to determine whether the proposed data is good enough for the study. However, a pilot study can also be used as a starting point to try out a particular research instrument.

Sekaran and Bougie (2010, p. 164) stated that when piloting a study “the researcher should provide brief details about where the study will be conducted, who the participants of the study are, and how the survey will reach the participants”. In this study, the participants involved in this pilot study were 30 Grade 12 learners. Following a recommendation from Hunt et al. (1982, p. 271), that the minimum number of participants in the pilot study is 30 participants, the questionnaire was distributed to a sample of 30 Grade 12 learners from the same targeted population that the researcher found easy to reach for participation in a pilot study. This sample of leaners did not form part of the actual study. This was done for the purpose of improving dependability and validity of the instrument.

A pilot study has some boundaries, such as contamination (Holloway, 1997). When data are collected using the same participants in the pilot and in the main study, the contamination occurs. Holloway (1997) claimed that contaminated data are unfair and thus it becomes unreliable. In this study Grade 12 learners who participated in the pilot study did not form part of the actual study. Therefore, contamination was not an issue,

and the researcher then collected and stored all questionnaires used for the pilot study from the school.

3.9 RELIABILITY AND VALIDITY OF THE INSTRUMENT

SPSS software was used in the analysis of data. A test of reliability of the items/indicators on the instrument was done using the Cronbach's alpha coefficient. To test for validity of the instrument, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity were used (Kaiser, 1970).

Reliability is the extent to which results are consistent over time regarding an accurate representation of total population in a study. Should the results of the study be produced through similar methodology, then the research instrument is reliable (Collins et al., 2006). Validity refers to whether the measurement obtained truly depicts what the researcher intended to measure (Babbie & Mouton, 2001). According to Cohen et al. (2018, p. 267), "reliability is basically an umbrella term for dependability, consistency and replicability over time, over instruments and over groups of respondents" and is "concerned with precision and accuracy". They further indicated that the main types of reliability are "stability, equivalence and internal consistency". With the conception of reliability, Kumar (2018, p. 35) also concurred, indicating that "if a research tool is consistent and stable, hence predictable and accurate, it is said to be reliable".

The present study has considered reliability, as internal consistency, called Cronbach's alpha, which is often called alpha coefficient of reliability or just alpha. Alpha is suitable for scales with many indicators/items amongst which it gauges internal consistency (Cohen et al., 2018). Besides, it is a popularly used quantification in research writings (Morgan et al., 2004). According to Salloum et al. (2019), a reliability coefficient of 0.7 or above is deemed to be acceptable. In this study, the Cronbach's alpha value 0.878, as shown in the Table 3.1, which reflect a significant reliability of the constructs (Hair et al., 2019). Therefore, all the construct indicators were reliable, and hence, they could be used in the final study.

Table 3.1: Cronbach's alpha values for the pilot study (N=30)

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.867	.878	35

As defined by Morgan et al. (2004, p. 214), validity is "the extent to which a data collection or measurement technique measures what it is supposed to measure". This conception of validity harmonises with that of Opie (2004, p. 24) that "a valid measure is one which measures what it is intended to measure". To test for validity of the instrument, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity were used (Kaiser, 1970). The adequacy of the sample is measured by KMO in SPSS. The sampling is adequate or sufficient if the KMO value is larger than 0.5 (Hadi et al., 2016).

Kaiser (1974) recommends a bare minimum of 0.5 is acceptable, while the Bartlett's test of sphericity value of less than 0.05 is adequate. In this study, as shown in Table 3.2, the KMO measure of sampling adequacy is greater than 0.5, while the significance level which is measured by the Bartlett's test of sphericity were less than 0.05. The overall validity of the instrument was 0.872, which indicates that the instrument was valid (see Table 3.2).

Table 3.2: Kaiser-Meyer-Olkin (KMO) and Bartlett's Test (N=30)

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.872
Bartlett's Test of Sphericity	Approx. Chi-Square	3356.831
	df	595
	Sig.	.000

After considering the statistical reliability and validity of the instrument, some changes were made to the instrument, guided by the research's supervisor:

- Instructions on the instrument were clearly stated, but research topic was not included on the instructions, then it was included.

- Some repetition of the indicators was removed from some constructs, PEOU, PA and AU of the instrument.
- Numbers were assigned in the codes, so that it easy for the respondents to reference, for example, PU1, PA1, and PSI2, etc.

3.10 DATA ANALYSIS

In this study, the Statistical Package for the Social Sciences (SPSS) was used for the analysis of descriptive statistics focussing mostly on demographic data. For the main model data were analysed using partial least squares-structural equation modelling (PLS-SEM) applying SmartPLS version 3.0. This methodology was chosen because of its ability to provide a comprehensive analysis of latent variables that are not directly observable. This speaks directly to the determinants of Grade 12 learners' receptiveness of SEA in learning mathematics.

3.11 STRUCTURAL EQUATION MODELING

Structural equation modelling (SEM) is a statistical techniques that is used to examine theoretical models and was developed to address the shortcomings of the SPSS and Amos programs (Hair et al., 2019). SEM has become more valuable for a huge number of research studies because of its ability to model latent variables simultaneously., and to test the complete theories (Al-Emran et al., 2018). PLS-SEM was appropriate in this study because it predict the factors that affect Grade 12 learners' receptiveness to SEA in the context of learning mathematics. In addition, the study aimed to develop and evaluate a new model (SEA technology acceptance model) to predict the factors that might affect the receptiveness of SEA to Grade 12 learners, that can be used by extending TAM.

According to Hair Jr et al. (2017), the main function of PLS-SEM, is to predict the target variable, in this study, the actual usage of SEA by Grade 12 learners. In this study to examine the proposed research model (SEA technology acceptance), partial least squares structural equation modelling (PLS-SEM) was used, as previous researchers done the same such as (Chibisa, 2021; Fishbein & Ajzen, 1980; Gess-Newsome, 2015; Hair Jr et al., 2014; Mutambara & Bayaga, 2021). PLS-SEM is a good strategy for models with many latent variables, items, and hypotheses (Mutambara & Chibisa, 2022).

3.12 ETHICAL CONSIDERATION

Researchers McMillan and Schumacher (2010) discussed the significance of ethical considerations — that the quantitative researcher must be delicate, informed and consider carefully the ethical standards according to the nature of the research topic. Permission was sought from all the other stakeholders before embarking on collecting data and gaining official permission to undertake research with the target population. Cohen et al. (2000) stated that getting permission to conduct research means contacting relevant people in writing. To that effect the researcher did the following:

- A letter requesting authorization to conduct research was sent to the KwaZulu-Natal provincial head of the Department of Basic Education asking for consent to conduct research in chosen schools.
- A letter was also sent to the Circuit manager of uMhlathuze under King Cetshwayo District asking for permission to conduct research in high schools.
- A letter was forwarded to the principals of the target schools at uMhlathuze circuits seeking permission to conduct the research.
- Permission to conduct the research was sought from the University of Zululand ethics committee.
- Thereafter, permission was sought from the relevant Grade 12 leaners and parents using a detailed informed consent declaration which was given to learners to seek permission from their parents/guardian to participate in the study.

The researcher's application for ethical clearance was endorsed on 21 January 2022 and the ethical clearance number is UZREC 171110-030 PGM/283.

The respondents were given a workshop and asked to read and sign their consent form and those who were below 18 had to take parents informed consent declaration. However, parental permission was essential as most of the learners were minors. The respondents were assured that they would not be exposed to any harm which and the information they shared would remain private and would not be utilised for purposes outside the study. The respondents were informed and it was clear to them that the information was not going to be disclosed to any third party besides for academic purposes only. Hence, the researcher gave all the respondents the informed consent

forms, guaranteeing that were made mindful of the type of data that the researcher looked for from them, why the data were being collected from them and what were the reasons for collecting the information. Moreover, respondents had the right to know in advance how they anticipated to take an interest within the study and how it would influence them. In all these ways the respondents were informed appropriately earlier to the data collection. In addition, the researcher treated all respondents with respect and regulations of COVID-19 were considered throughout the course of the study, especially during data collection (Mhlanga & Moloi, 2020). The researcher maintained ethical research principles which are:

- The right to participant privacy.
- The right to maintain self-respect and human dignity.
- Confidentiality.
- Anonymity and protection from the potential misuse of research findings.

Lastly, the researcher stated to the participants that their participation in the study was voluntary, meaning that those who took part in this study understood that they were doing it willingly and no compensation would be provided. It was explained to the participants that they could withdraw any time, should they wish to do so. The participants in this study were informed of the valuable and meaningful contribution in their learning of mathematics and science education.

3.13 CHAPTER SUMMARY

The chapter mainly dealt with the research method followed in this study. It also has provided a detailed description of the research paradigm, research design and the context of the study. The chapter then dealt with the sampling technique, the research instrument and the step process followed when collecting the data. The analytical techniques used in the research were subsequently discussed. Thereafter the reliability, validity as well as ethical considerations were also discussed. The upcoming chapter will focus on the presentation and an analysis of the results of the study.

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

The previous chapter discussed the methodology used to examine Grade 12 receptiveness of SEA in the learning of mathematics. However, this chapter focuses on the presentation and analysis of the results. The research statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) and SmartPLS 3. The presentation and analysis is divided into three steps. The first step deal with data screening to ensure the collected data is clean and can be used for analysis. The second step is to assess measurement model and structural model is then presented. The third step focuses on interpretation of the results and the chapter summary.

4.2 DATA SCREENING

In all research studies, data screening is essential for ensuring that collected data is analysed accurately. If the step of data screening was ignored, the quality and accuracy of the analysis would be low (Cooper et al., 2021). The following sections describe the coding and editing of the data.

4.2.1 Coding

According to Chibisa (2021), coding is the process of allocating numbers to the responses of respondents. Pre-coding and post-coding were employed in this study. In this study, pre-coding was done to assign codes on the questionnaire, codes allocation was done during the questionnaire design stage. During the questionnaire design stage, each construct indicators were coded for example, construct perceived accessibility was assigned PA1, PA2, depending to the number of indicators per construct. The questions in an instrument were measured using a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the mid-point (3) representing the state of being uncertain or neutral. The response from demographics information in the questionnaire were post-coded, which is done after data collection.

4.2.2 Missing Data

According to Hair Jr et al. (2014), missing data happens when any respondent fail to answer one or more questions in the provided questionnaire. In this study, a questionnaire was administered to 300 Grade 12 mathematics learners at uMhlathuze circuit schools under king Cetshwayo District in South Africa. A total of 300 questionnaires were administered randomly, and only 291 questionnaires were returned. From the 291 collected responses there were 19 questionnaires with missing data and they were removed. Following suggestion by Hair et al. (2012), that “if one response fails to answer 50% of the questionnaire’s questions, then the response should be deleted”, as such 19 respondents failed to answer all the questions, and those were deleted.

4.3 DEMOGRAPHICS

In this section, an analysis of demographic data is given. The three demographic items are gender, residential location, and hours spent using the SEA application.

4.3.1 Gender

Out of 272 Grade 12 leaners who took part in the survey, both genders were fairly represented in the survey, as evidenced by the outcome as shown in Table 4.1. In all, 161(59.2%) respondents were females, while111 (40.8%) were males. In other words, females made up a marginal majority of the study participants.

Table 4.1: Gender distribution (N=272)

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	111	40.8	40.8	40.8
	Female	161	59.2	59.2	100.0
	Total	272	100.0	100.0	

4.3.2 Residential Demographics

The residential demographics of the respondents is shown in the Table 4.2, where the result 182 (66.9%) were respondents that were coming from rural Schools and 90 (33.1%) were from urban.

Table 4.2: Residential demographics distribution (N=272)

Residential demographics					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rural	182	66.9	66.9	66.9
	Urban	90	33.1	33.1	100.0
	Total	272	100.0	100.0	

4.3.3 Hours They Spend

The respondents were asked about the number of hours they spend using SEA per week. The results shown in Table 4.3 reveal that 83 (30.5%) of the respondents indicated that they spend 1–2 hours per week, followed by 99 (36.4%) who indicated that they spend 3–4 hours per week, 54 (19.9%) indicated that they spend 5–6 hours per week, and 36 (13.2%) learners said they spend more than 7 hours per week on the application. A conclusion can therefore be drawn that most respondents who participated in this study spend an average of 3–4 hours per week using SEA to practice mathematics.

Table 4.3: Hours spent using SEA (N=272)

Hours spent on SEA					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 – 2 hrs	83	30.5	30.5	30.5
	3 – 4 hrs	99	36.4	36.4	66.9
	5 – 6 hrs	54	19.9	19.9	86.8
	7 or more hrs	36	13.2	13.2	100.0
	Total	272	100.0	100.0	

4.4 DESCRIPTIVE STATISTICS OF THE INSTRUMENT

All eight constructs of the model for this study were measured with no more than 5 indicators per construct which were measured on a five-point Likert scale with the alternatives; ranging from 1 – strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – strongly agree. Moreover, these indicators or items were intended to measure the Grade 12 leaners' receptiveness of SEA in the context of learning of mathematics.

4.4.1 Perceived Usefulness

In this study, PU is learners' perceptions as to whether the use of SEA will improve their grades in the learning of mathematics. The results in Table 4.4 show that the mean values of all the items of this construct were greater than 3, indicating that the majority of respondents agreed that SEA will improve their grades in the learning of mathematics. In addition, most of Grade 12 leaners who participated in this study believe that the use of SEA will improve their grades in the learning of mathematics.

In this study, PU had five indicators; during the factor analysis only one (PU5) was discarded because of the outer loading of less than 0.70 (Garson, 2016). Each of these indicators had average mean response of greater than 3 (see Table 4.4) from a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the mid-point (3) representing the state of being uncertain or neutral. The average responses of greater than 3 in this study means that Grade 12 learners agreed with the indicators construct. Which indicate that most of Grade 12 leaners who participated

in this study believe that the use of SEA will improve their grades in the learning of mathematics.

Table 4.4: Perceived usefulness (N=272)

Perceived Usefulness	N	Mean	Std
Using SEA will improve my mathematics result	272	3.96	.886
I think SEA will help me to understand mathematics better	272	4.04	.839
I believe using SEA in learning mathematics is a good idea	272	4.21	.813
I can use SEA anywhere, anytime	272	3.95	1.044
By using SEA, I find it easy to answer questions in mathematics	272	3.67	1.014

4.4.2 Perceived Ease of Use

Perceived ease of use is the extent to which users believe that adopting a new information system technology will be effortless. The result for the construct perceived of use are shown in Table 4.5. the result shows that the mean values of all indicators are greater than 3. In this study, this implies that, Grade 12 learners who participated in this study agreed that they found using SEA for learning mathematics to be effortless. In this study, PEOU refers as perception of Grade 12 learners on how ease the SEA to them, then they will consider the application useful to them for learning mathematics.

This construct had five indicators, but PEOU5 was discarded during factor analysis, because the outer loading was less than a recommendation of above 0.70 (Garson, 2016). The average mean of al the five indicators was greater than 3 (see Table 4.5) from a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the mid-point (3) representing the state of being uncertain or neutral. This implies that, Grade 12 learners who participated in this study agreed that they found using SEA for learning mathematics influenced by their belief that the use of SEA would be effortless.

Table 4.5: Perceived ease of use (N=272)

Perceived Ease of Use	N	Mean	Std
It is easy to log in to SAE	272	4.02	1.025
It is easy to navigate through relevant mathematics sections on the SEA	272	3.74	.623
SEA is a significant addition to my mathematical learning	272	3.80	.937
It is easy to access my assignments using SEA	272	3.79	1.054
It is easy to write assignments on SEA	272	3.78	1.046

4.4.3 Attitude Towards Using

In this study, the attitude towards construct measures the attitude of Grade 12 learners in using SEA in the learning of mathematics. The results in Table 4.6 show that the range of the mean values from 3.96 to 4.19, indicating that the majority of Grade 12 learners have positive attitude towards using SEA. In this study, attitude towards construct measures the attitude of Grade 12 learners in using SEA in the learning of mathematics.

This construct had four indicators, all accepted during the factor analysis with outer loading of greater than 0.70 (Garson, 2016). These indicators in this construct had an average response of greater than 3 (see Table 4.6), where the responses were measured using a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the mid-point (3) representing the state of being uncertain or neutral. The response of greater than 3 in this study, means that Grade 12 learners agreed with all the indicators in the construct, indicating that their actual use of SEA was influenced by their attitude towards.

Table 4.6: Attitude towards using (N=272)

Attitude Towards using	N	Mean	Std
I am happy to use SEA to learn mathematics	272	4.14	.916
I will continue to use the SEA to learn mathematics	272	4.19	.872
Using SEA helps me to improve my mathematics grades	272	3.96	.858
I have positive attitude learning mathematics using SEA	272	3.97	.977

4.4.4 Perceived Accessibility

In this study, perceived accessibility is how Grade 12 leaners access and use SEA. The results in Table 4.7 show that all the questions had mean values greater than 3. The result indicates that majority of Grade 12 learners consider SEA accessible. In this study, PA had four indicators and none of the four indicators were discarded during the factor analysis, but all indicators of this construct had outer loading above a recommendation by Garson (2016) of 0.5 threshold. These indicators in this construct had an average response of greater than 3 (see Table 4.7), where the responses were measured using a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the mid-point (3) representing the state of being uncertain or neutral. This only implies that most learners were agreeing that SEA is accessible.

Table 4.7: Perceived accessibility (N=272)

Perceived Accessibility	N	Mean	Std
It is easy to download SEA onto any device	272	3.79	1.118
I can log in to SEA using my smartphone/laptop	272	4.20	.951
I can log in to SEA without downloading it on my device	272	3.62	1.254
SEA is free to access when using MTN, Vodacom & Telkom	272	4.00	1.184

4.4.5 Perceived Social Influence

Perceived social influence is when Grade 12 learners think that they can be influenced by others to use or not use SEA. The result in Table 4.8, all the mean where greater than 3, except 2.96, which indicates that Grade 12 learners were not influenced by their family members to use SEA. Others agreed that social influence played an important role in considering the use of SEA in the learning of mathematics.

In this study, PSI construct had five indicators, but only one (PSI1) was discarded during the process of factor analysis because PSI1 had outer loading of less than 0.70 (Garson, 2016). These indicators in this construct had an average response of greater than 3 (see Table 4.8), where the responses were measured using a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the mid-point (3)

representing the state of being uncertain or neutral. The responses of greater than 3 means that Grade 12 learners agreed with all the indicators in the construct, indicating that their actual usage of SEA was influenced by social influence.

Table 4.8: Perceived social influence (N=272)

Perceived Social Influence	N	Mean	Std
I was encouraged by other learners' beliefs who are using SEA	272	3.36	1.321
My family encourage me to use SEA in my studies	272	2.96	1.355
My teacher's beliefs about SEA influence me to use SEA	272	4.05	1.087
All my friends in my school are using SEA	272	3.16	1327
During study groups outside my school, they encourage the use of SEA	272	3.16	1.338

4.4.6 Perceived Skills Readiness

In this study, perceived skill readiness is one's perception of his or her capability to use SEA. The results of this construct are shown in Table 4.9, which indicate that all the mean values were greater than 3, indicating that most learners have the required technical skills to use any device for the implementation of SEA. This construct had four indicators, but only one (PSR1) was discarded during the process of factor analysis because it had outer loading of less than 0.70 (Garson, 2016). Each of these indicators had mean values of greater than 3 (see Table 4.9) from a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the mid-point (3) representing the state of being uncertain or neutral. Which means that their actual usage of the application was influenced by their skills readiness.

Table 4.9: Perceived skills readiness (N=272)

Perceived Skills Readiness	N	Mean	Std
I have the skills to work on SEA	272	3.44	1.138
I have a skill of using any device	272	3.63	1.090
I understand better when learning using my device	272	3.79	1.089
I have the ability to use the SEA interface	272	3.47	1.062

4.4.7 Computer Self Efficacy

The computer self-efficacy construct in this study measures the personal belief that Grade 12 learners are able to use computer technologies to perform any tasks. The results in Table 4.10 show that all the mean values range from 3.83 to 4.08, meaning that respondents believe in their ability to use computer technologies, then are more likely to use SEA.

In this study, this construct had four indicators, all were accepted during factor analysis. Their outer loading was greater than 0.70 (Garson, 2016). Each of these indicators had average mean response of greater than 3 (see Table 4.10) from a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the mid-point (3) representing the state of being uncertain or neutral. The average response of greater than 3 means that Grade 12 leaners agreed with the indicators construct, which indicates that the use of SEA was influenced by knowledge of using any device.

Table 4.10: Computer self-efficacy (N=272)

Computer Self Efficacy	N	Mean	Std
I believe that I can follow instructions on SEA	272	4.08	.969
I believe I know how to use SEA on my phone	272	4.03	1.025
I believe I can use SEA if someone showed me how to use it	272	4.06	1.020
I believe I know how to use SEA on my tablet	272	3.83	1.066

4.4.8 Actual System Use

In this study, actual use is the resultant construct which measures the extent to which Grade 12 learners actually use the SEA to learn mathematics. The results of this construct are shown in Table 4.11, which shows that all the mean values were greater than 3, indicating that the respondents agreed to use SEA. This construct had four indicators, all accepted during the factor analysis with outer loading of greater than 0.70 (Garson, 2016). These indicators in this construct had an average response of greater than 3 (see Table 4.11), where the responses were measured using a five-point Likert scale, ranging from 1 – strongly disagree to 5 – strongly agree, with the

mid-point (3) representing the state of being uncertain or neutral. The response of greater than 3 in this study, means that Grade 12 learners agreed with all the indicators in the construct. This means that the factors identified in this model (SEA technology acceptance model) explain the actual usage of the application by Grade 12 leaners.

Table 4.11: Actual system use (N=272)

Actual System Use	1	2	3
Practising using SEA is more interesting	272	4.07	.992
I frequently use SEA to write my assessments	272	3.45	1.142
I use SEA in learning most of my mathematics	272	3.74	1.108
I frequently use SEA for practicing mathematics	272	3.86	1.090

4.5 PRESENTATION AND ANALYSIS OF RESULTS

Partial least squares structural equation modelling (PLS-SEM) was used to analyse the data by making use of the software SmartPLS. This study adopted a two-step model analysis procedure suggested by (Hair Jr et al., 2016). The structural model was assessed after the measurement model.

4.5.1 Measurement Model

According to Hair Jr et al. (2017), the measurement model establishes the link between latent variables and the corresponding items. To examine statistical relationships between each construct's element and other constructs, the software PLS-SEM could be utilised. Paudyal (2020), stated that the researchers can model, estimate, and estimate the model with Smart PLS to describe the relationship between the constructive interest with a wide range of indicators and latent constructions. The validity and reliability of the measurement model is established by testing/assessing internal consistency reliability, indicator reliability, convergent validity, and discriminant validity. The following section presents the result for evaluating the validity and reliability of the measurement model.

4.5.1.1 Outer Model Measurement Loading

According to Garson (2016, p. 60), the outer model "is the measurement model which consist of the indicators and the paths connecting them to their respective constructs".

Garson (2016) further pointed out that the outer model loading focuses on the reflective model. The reflective model represents the paths from construct to indicator variables (Garson, 2016). Path loading should be above a minimum measurement criterion of 0.7 (Garson, 2016, p. 61). However, Harks et al. (2014, p. 103) proposed a rule of thumb that the indicator with a measurement loading between 0.40 to 0.70 should be dropped. Eliminating one indicator may not have much of an impact, but, other indications are also representative. In this case, all the final model indicator loadings of the SEA technology acceptance model are all above 0.70 (see Figure 4.4), which means that they are all reliable. Indicators PU5, PSI1, PSR1 and PEOU5 were discarded during factor analysis because their outer loadings were less than 0.7 threshold and did not improve the composite reliability of the model (Harks et al., 2014).

4.5.1.2 Internal Consistency Reliability

To assess the internal consistency reliability of the measurement model, Cronbach's alpha and composite reliability were used. When the composite reliability and Cronbach's alpha test results for each latent variable exceed or are equal to the threshold value of 0,7, the measurement model is said to have sufficient internal consistency reliability(Hair Jr et al., 2014). Figure 4.1 and Figure 4.2 show the result of Cronbach's alpha and the composite reliability test. The results indicating acceptable internal consistency reliability, because the results were greater 0.7.

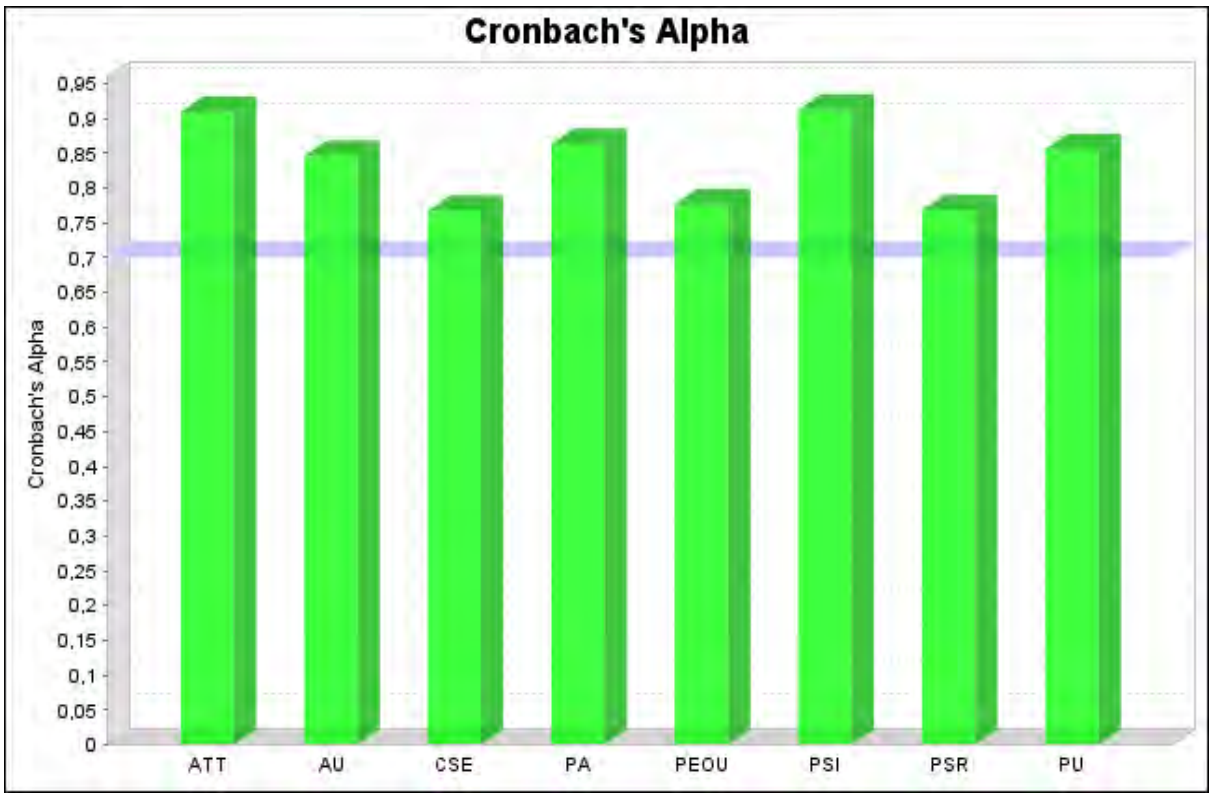

Figure 4.1: Cronbach's Alpha

Composite reliability values in Figure 4.2 are above 0.7 which indicating acceptable internal consistency reliability.

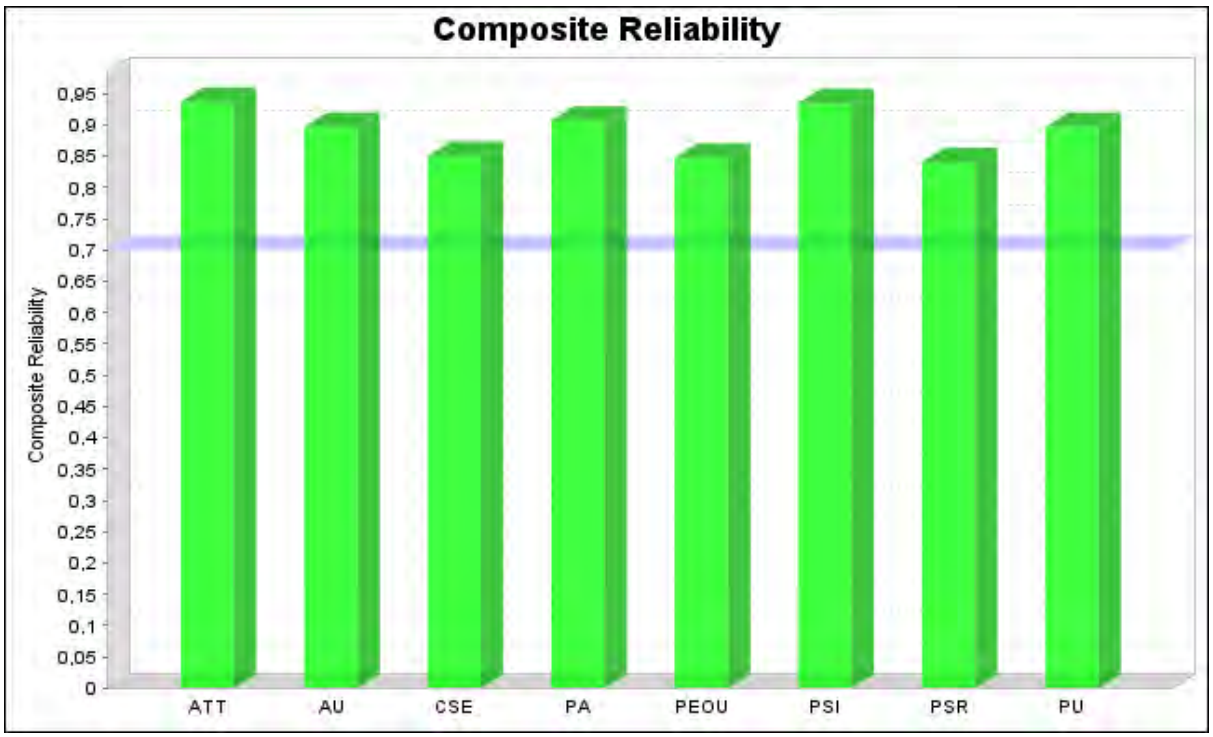

Figure 4.2: Composite reliability (CR)

4.5.1.3 Indicator Reliability

The indicator reliability describes the proportion of an indicator's variance for which the underlying latent variable can account (Hair Jr et al., 2017). According to Sarstedt and Cheah (2019), more than 50% of an indicator's variance should be explained by the latent construct. According to Hair Jr et al. (2017), an accepted threshold value for the outer loadings of 0.7, indicators whose outer loading are below 0.7 should be removed (Hair Jr et al., 2014). The outer loadings were assessed using SmartPLS 3 software. Table 4.12 shows that all of the indicators had outer loadings greater than the threshold value of 0.7 that were used in this study, excepts PEOU5 (0.642), PSI1 (0.652), PSR1 (0.683), and PU5 (0.617) which were removed from the model because their out loading were below 0.7.

Table 4.12: Indicator reliability (N=272)

Construct	Indicator	Outer Loading	Construct	Indicator	Outer Loading
Attitude towards	ATT1	0,847	Perceived Social Influence	PSI2	0,825
	ATT2	0,877		PSI3	0,762
	ATT3	0,918		PSI4	0,789
	ATT4	0,910		PSI5	0,783
Actual Usage	AU1	0,934	Perceived Skill Readiness	PSR2	0,745
	AU2	0,715		PSR3	0,833
	AU3	0,924		PSR4	0,839
	AU4	0,903	Perceived Usefulness	PU1	0,850
Computer Self-Efficacy	CSE1	0,764		PU2	0,841
	CSE2	0,788		PU3	0,871
	CSE3	0,810		PU4	0,718
	CSE4	0,795			
Perceived Accessibility	PA1	0,816			
	PA2	0,864			
	PA3	0,892			
	PA4	0,831			
Perceived Ease of Use	PEOU1	0,772			
	PEOU2	0,810			
	PEOU3	0,872			
	PEOU4	0,861			

4.5.1.4 Convergent Validity

Convergent and discriminant analysis must be evaluated for validity. The average variance extracted (AVE) was used to assess the convergent validity of the measurement mode l(Fauzi, 2022). In order to assess if the items are converged to a desired construct or variable, the average variance extracted serves as a measure of variable convergence (Hair Jr et al., 2017). It is the degree to which each item firmly agrees with the others, in how well they represent the construct that were used to assess the model. The average variance extracted values, according to Hair Jr et al. (2014), should be 0.5 and above, for the convergent validity to be established. The result in Figure 4.3 shows that all the average variance extracted values were greater than 0.5.

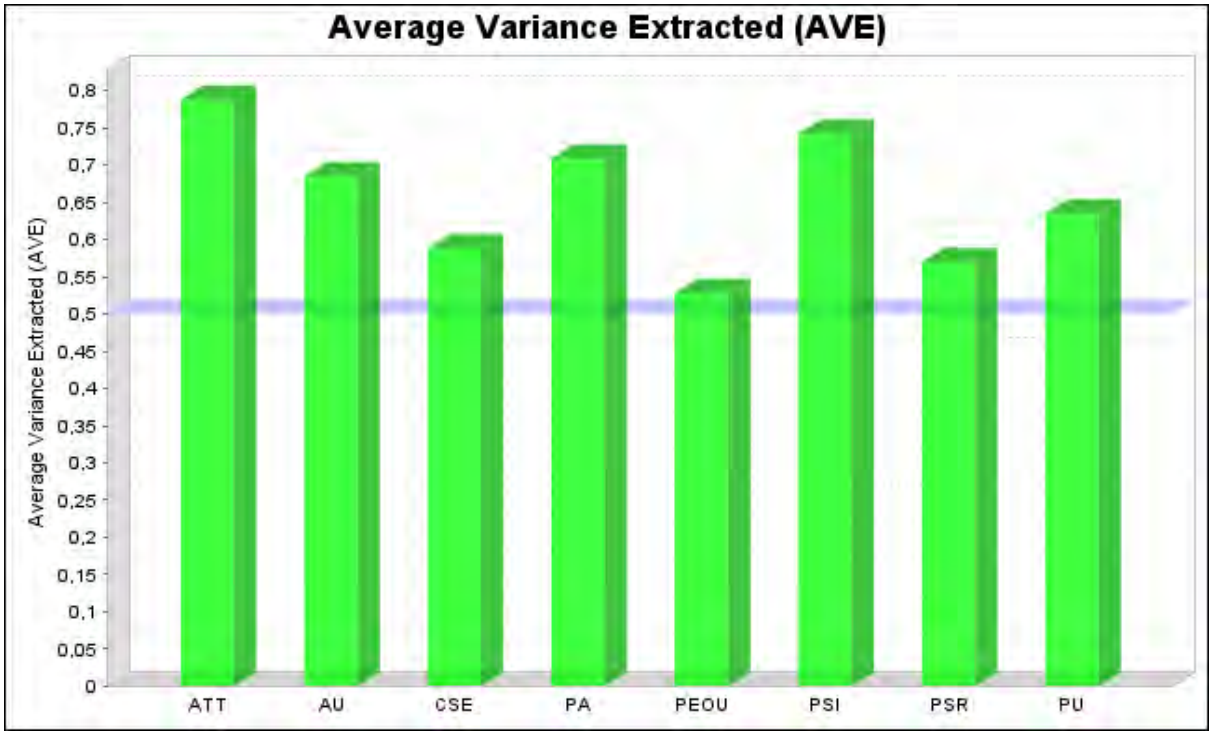

Figure 4.3: Average Variance Extracted

4.5.1.5 Discriminant Validity

According to Hair et al. (2012, p. 423), discriminant validity "measures the extent to which a latent variable differs from other latent variables in the model". This study used cross-loading, heterotrait-monotrait ratio (HTMT) and Fornell-Larcker criterion to assess discriminant validity, as suggested by Hair Jr et al. (2016).

4.5.1.6 Cross Loadings

The constructs' loadings are shaded as shown in Table 4.13. Each item loads higher on its own construct than on any other construct, as seen by moving across the rows. Moving down a column shows that a construct loads best with its own component. The intended loadings in cross-loading output between the latent variables and items should be greater than 0.7 (Garson, 2016). The result shown in Table 4.12, indicate that the measurement model demonstrated the acceptable discriminant validity, except CSE4.

Table 4.13: Cross loadings (N=272)

	ATT	AU	CSE	PA	PEOU	PSI	PSR	PU
ATT1	**0,886**	0,511	0,552	0,627	0,513	0,591	0,575	0,485
ATT2	**0,829**	0,452	0,463	0,611	0,530	0,552	0,496	0,439
ATT3	**0,927**	0,498	0,453	0,679	0,638	0,595	0,538	0,517
ATT4	**0,904**	0,483	0,477	0,693	0,626	0,603	0,526	0,483
AU1	0,508	**0,837**	0,431	0,414	0,392	0,379	0,472	0,282
AU2	0,486	**0,810**	0,424	0,334	0,305	0,469	0,542	0,272
AU3	0,441	**0,891**	0,398	0,394	0,414	0,372	0,515	0,316
AU4	0,360	**0,766**	0,287	0,367	0,352	0,166	0,336	0,238
CSE1	0,353	0,336	**0,725**	0,279	0,260	0,437	0,529	0,346
CSE2	0,498	0,311	**0,823**	0,470	0,498	0,447	0,473	0,377
CSE3	0,433	0,278	**0,830**	0,370	0,373	0,444	0,473	0,342
CSE4	0,369	0,596	**0,678**	0,335	0,318	0,315	0,481	0,229
PA1	0,681	0,383	0,373	**0,807**	0,658	0,330	0,306	0,463
PA2	0,522	0,402	0,426	**0,839**	0,598	0,371	0,372	0,464
PA3	0,629	0,360	0,405	**0,865**	0,520	0,439	0,437	0,406
PA4	0,640	0,385	0,427	**0,855**	0,559	0,491	0,472	0,437
PEOU1	0,364	0,275	0,195	0,357	**0,616**	0,251	0,244	0,611
PEOU2	0,393	0,270	0,248	0,489	**0,713**	0,302	0,275	0,329
PEOU3	0,415	0,285	0,262	0,483	**0,776**	0,444	0,311	0,348
PEOU4	0,518	0,321	0,478	0,552	**0,773**	0,635	0,514	0,483
PEOU5	0,609	0,417	0,493	0,611	**0,742**	0,432	0,464	0,576
PSI1	0,599	0,435	0,473	0,458	0,544	**0,887**	0,606	0,412
PSI2	0,523	0,334	0,419	0,415	0,505	**0,793**	0,553	0,362
PSI3	0,525	0,353	0,492	0,354	0,418	**0,854**	0,601	0,349
PSI4	0,612	0,363	0,462	0,425	0,532	**0,876**	0,613	0,406
PSI5	0,574	0,358	0,478	0,411	0,509	**0,892**	0,585	0,415
PSR1	0,544	0,386	0,467	0,464	0,609	0,640	**0,806**	0,428
PSR2	0,457	0,385	0,530	0,306	0,304	0,528	**0,813**	0,340
PSR3	0,350	0,661	0,463	0,288	0,250	0,384	**0,689**	0,250
PSR4	0,401	0,384	0,473	0,269	0,206	0,424	**0,702**	0,255
PU1	0,414	0,232	0,325	0,438	0,658	0,524	0,389	**0,758**
PU2	0,495	0,277	0,363	0,463	0,564	0,385	0,396	**0,826**
PU3	0,506	0,265	0,343	0,496	0,525	0,315	0,277	**0,820**
PU4	0,408	0,310	0,377	0,411	0,480	0,282	0,377	**0,862**
PU5	0,303	0,261	0,292	0,249	0,347	0,265	0,344	**0,708**

4.5.1.7 Heterotrait-Monotrait Ratio (HTMT)

According to Garson (2016, p. 69), “In a well-fitting model, heterotrait correlations should be smaller than monotrait correlations, meaning that the HTMT ratio should be below 1.0”. According to Henseler et al. (2015, p. 121), if the HTMT value are below 0.90, then discriminant validity has been established between a given pair of reflective

constructs. The results in Table 4.13 show that all the HTMT values were below 0.9 (Hair et al., 2017). The results confirmed discriminant validity. The resulted showed that the constructs were truly distinct from each other.

Table 4.14: Heterotrait-monotrait ratio (HTMT) (N=272)

	ATT	AU	CSE	PA	PEOU	PSI	PSR	PU
ATT								
AU	0,619							
CSE	0,646	0,608						
PA	0,828	0,531	0,582					
PEOU	0,751	0,533	0,578	0,830				
PSI	0,723	0,476	0,641	0,544	0,671			
PSR	0,683	0,726	0,836	0,537	0,546	0,769		
PU	0,605	0,396	0,519	0,598	0,777	0,502	0,515	

4.5.1.8 Fornell-Larcker Criterion

The result shown in Table 4.14 represent the analysis of Fornell-Larcker Criterion. The bold values in the diagonal cells represent the square root of average variance extracted (AVE) and values that are not in bold represents the inter-correlation value between latent variables. Therefore, if the top number (which is the square root of AVE) is higher than the values below it, there is discriminant validity.

Table 4.15: Fornell-Larcker criterion (N=272)

	ATT	AU	CSE	PA	PEOU	PSI	PSR	PU
ATT	**0,887**							
AU	0,548	**0,827**						
CSE	0,547	0,471	**0,767**					
PA	0,736	0,456	0,484	**0,842**				
PEOU	0,651	0,443	0,487	0,699	**0,726**			
PSI	0,660	0,429	0,539	0,481	0,585	**0,861**		
PSR	0,602	0,570	0,629	0,468	0,518	0,687	**0,755**	
PU	0,543	0,336	0,428	0,529	0,659	0,453	0,447	**0,797**

4.5.2 Analysis of Results

This section focuses on the analysis of results of the structural model. After the verification of the measurement model's validity and reliability, the next step was to assess collinearity and variation inflation factor (VIF) values in the process of evaluating structural model.

4.5.2.1 Multicollinearity Assessment

According to Garson (2016, p. 81), in order "to assess multicollinearity in the inner (structural) model, variation inflation factor (VIF)criteria may be applied". Garson (2016) further pointed out that problematic multicollinearity may exist if variance inflation factor (VIF) exceeds 4. Multicollinearity is not a problem if VIF is less than 4. The result in Table 4.16 shows that the variation inflation factor (VIF) values were less than 5, indicating the absence of collinearity between the latent variables of the study.

Table 4.16: Variance inflation factor values (N=272)

	ATT	AU	CSE	PA	PEOU	PSI	PSR	PU
ATT		1,808						
AU								
CSE					1,822			1,829
PA					1,449			2,077
PEOU	2,166	2,257						2,354
PSI	1,540				2,052			2,219
PSR					2,326			2,334
PU	1,791	1,842						

4.5.2.2 Structural Model Path Coefficients

To assess the statistical significance of each path coefficients, using a recommendation by (Chin, 1998), a full bootstrapping (with 5000 subsamples) was performed using t-tests. The result are shown in Table 4.17.

Table 4.17: Path coefficients (N=272)

Hypothesis	Path	Std Beta	T Statistics	P Values	Decision
H15	ATT -> AU	0,590	13,054	0,000	Accepted
H9	CSE -> PEOU	0,082	1,103	0,271	Rejected
H8	CSE -> PU	-0,037	0,557	0,578	Rejected
H2	PA -> PEOU	0,125	1,638	0,102	Rejected
H1	PA -> PU	0,311	5,191	0,000	Accepted
H13	PEOU -> ATT	0,225	4,397	0,000	Accepted
H14	PEOU -> AU	-0,070	1,713	0,087	Rejected
H12	PEOU -> PU	0,162	2,504	0,013	Accepted
H5	PSI -> ATT	0,252	5,322	0,000	Accepted
H4	PSI -> PEOU	0,008	0,101	0,919	Rejected
H3	PSI -> PU	0,307	4,350	0,000	Accepted
H7	PSR -> PEOU	0,547	8,218	0,000	Accepted
H6	PSR -> PU	0,199	3,088	0,002	Accepted
H10	PU -> ATT	0,442	7,939	0,000	Accepted
H11	PU -> AU	0,378	6,806	0,000	Accepted

The result given in Table 4.17, indicates that out of 15 hypotheses that were tested, only five path coefficients are not statistically significant H9 ($\beta = 0.082$, $p > 0.05$), H8 ($\beta = -0.037$, $p > 0.05$), H2 ($\beta = 0.125$, $p > 0.05$), H14 ($\beta = -0.070$, $p > 0.05$), andH4 ($\beta = 0.008$, $p > 0.05$) were the non-significant pathways. The rest of the 10 hypotheses were statistically significant, which indicate that most of the model variables were appropriate.

The SEA technology acceptance model R-squared and the paths coefficients are shown in Figure 4.4, is made up of eight constructs (PA, PSI, PSR, CSE, PEOU, PU, ATT, and AU). PA, PSI, PSR, CSE, and PEOU, all predict PU. POEU is predicted by PA, PSI, PSR, and CSE. PEOU predicts PU, and they are both predictors of ATT and PSI. AU is predicted by PU, PEOU, and ATT. All the indicators loaded well.

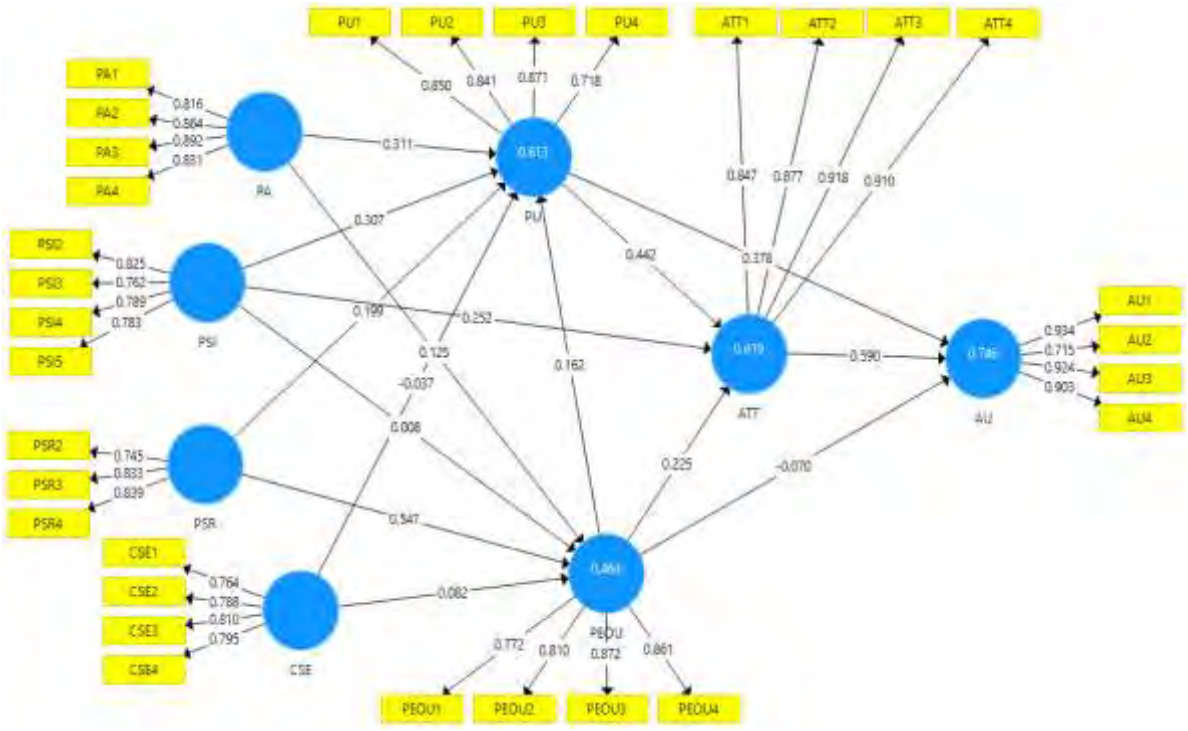

Figure 4.4: SEA technology acceptance model (SEATAM)

PA — perceived accessibility
PSI — perceived social Influence
PSR — perceived skill readiness
CSE — computer self-efficiency
PU — perceived usefulness
PEOU — perceived ease of use
ATT — attitude towards
AU — actual usage.

4.5.2.3 Coefficient of Determination (R-Square)

According to Hair Jr et al. (2017), the R-squared value shows the overall contribution of all the independent variables on the explained variance of the dependent variable. As supported by Chibisa and Mutambara (2022, p. 12), the "R-squared value is the sum of all the predictors' contributions to the explained variance of the exogenous variable".

The R-squared value measures the variance, which is explained in each of the endogenous constructs and is therefore a measure of the model's explanatory power(Garson, 2016). According to Cohen (2013), the R-squared value of 0.02, 0.13, 0.26, respectively, describes weak, moderate, or substantial in prediction. Figure 4.4 shows the R-square of the model. According to the suggestion by Cohen (2013), the R-square values of PU (0.613), ATT (0.619), and PEOU (0.464) are all considered substantial. These results imply that the external variables to TAM (PA, PSI, PSR, and

CSE) together explain 46.4% of the variance in PEOU and 61.3% of the variance in PU. The R-squared value of the model in this study was 0.746, as shown in Figure 4.4. According to the findings, all model predictors account for 74.6% of the actual use of SEA by Grade 12 learners. In addition, this model, therefore, is deemed a good fit for explaining the receptiveness of SEA by Grade 12 learners.

4.5.2.4 Effect Size (F-Square)

The f-square value measures the strength of the relationship between the constructs (Chibisa et al., 2021). The f-square value is the effect size between the contracts. According to Cohen (2013), f-square values of 0.02, 0.15, and 0.35 indicate small, medium, and substantial levels of effect size, respectively. The results in Table 4.18 indicate the F-square. In this study, the results shown in Table 4.18 indicate that only one hypothesis H2out of fifteen hypotheses had a high effect on actual usage of the SEA; but only four hypotheses (H5, H10, H12, and H15) had a medium effect; while the rest had a low effect on AU.

Table 4.18: F-squared value (N=272)

Hypothesis	Path	Std Beta	T Statistics	P Values	Decision	f^2
H15	ATT -> AU	0,590	13,054	0,000	Accepted	0.165
H9	CSE -> PEOU	0,082	1,103	0,271	Rejected	0.004
H8	CSE -> PU	-0,037	0,557	0,578	Rejected	0.006
H2	PA -> PEOU	0,125	1,638	0,102	Rejected	0.434
H1	PA -> PU	0,311	5,191	0,000	Accepted	0.007
H13	PEOU -> ATT	0,225	4,397	0,000	Accepted	0.101
H14	PEOU -> AU	-0,070	1,713	0,087	Rejected	0.016
H12	PEOU -> PU	0,162	2,504	0,013	Accepted	0.202
H5	PSI -> ATT	0,252	5,322	0,000	Accepted	0.244
H4	PSI -> PEOU	0,008	0,101	0,919	Rejected	0.081
H3	PSI -> PU	0,307	4,350	0,000	Accepted	0.000
H7	PSR -> PEOU	0,547	8,218	0,000	Accepted	0.003
H6	PSR -> PU	0,199	3,088	0,002	Accepted	0.006
H10	PU -> ATT	0,442	7,939	0,000	Accepted	0.029
H11	PU -> AU	0,378	6,806	0,000	Accepted	0.000

Before focusing on answering blindfolding and predictive relevance of the model, the mediation and moderation effects of variables were considered.

4.5.2.5 Mediation

According to Hair Jr et al. (2022), in SmartPLS mediation takes place when a third mediator variable steps in between two related constructs. This means that in a PLS path model, a change in the exogenous construct causes a change in the mediator variable. The mediator variable results in a change in the endogenous construct. The mediator variable is the one that govern the relationship between two constructs (Nitzl et al., 2016). Hair Jr et al. (2022, p. 140) stated that a direct effect represents the relationship between two constructs joined with a single arrow. While an indirect mediating effect involve a sequence of two or more direct effects, it is represented by multiple arrows in a model. Table 4.19 shows the total indirect effect of the explanatory variables.

Table 4.19: Total indirect effect (N=272)

Path	Std Beta	t-values	p-values	Decision
ATT -> AU	0,590	13,054	0,000	Accepted
CSE -> ATT	0,008	0,199	0,842	Rejected
CSE -> AU	-0,010	0,216	0,829	Rejected
CSE -> PEOU	0,082	1,103	0,271	Rejected
CSE -> PU	-0,023	0,347	0,729	Rejected
PA -> ATT	0,175	4,234	0,000	Accepted
PA -> AU	0,220	5,381	0,000	Accepted
PA -> PEOU	0,125	1,638	0,102	Rejected
PA -> PU	0,331	5,439	0,000	Accepted
PEOU -> ATT	0,297	5,296	0,000	Accepted
PEOU -> AU	0,166	3,254	0,001	Accepted
PEOU -> PU	0,162	2,504	0,013	Accepted
PSI -> ATT	0,390	8,076	0,000	Accepted
PSI -> AU	0,346	7,507	0,000	Accepted
PSI -> PEOU	0,008	0,101	0,919	Rejected
PSI -> PU	0,308	4,430	0,000	Accepted
PSR -> ATT	0,250	6,168	0,000	Accepted
PSR -> AU	0,218	5,837	0,000	Accepted
PSR -> PEOU	0,547	8,218	0,000	Accepted
PSR -> PU	0,287	5,711	0,000	Accepted
PU -> ATT	0,442	7,939	0,000	Accepted
PU -> AU	0,639	14,144	0,000	Accepted

The explained variable is the receptiveness of SEA actual use (AU). The results in Table 4.19 indicate the total indirect effect of each of the constructs' indirect to actual

usage of SEA (PA, PSI, PSR, PU, PEOU and ATT were accepted). Only CSE indirect mediator effect AU was not supported by the result of the model.

4.5.2.6 Blindfolding and Predictive Relevance (Q-Squared)

The study used the blindfolding rules suggested by Hair Jr et al. (2014) to evaluate the predictive relevance of the postulated SEA technology acceptance model. The predictive relevance of the SEA technology acceptance model was evaluated using a cross-validated redundancy predictor Q-squared(Garson, 2016).

In this study, the results shown in Table 4.20 indicate that that all Q-squared values ranged from 0.307 to 0.631. All the Q-squared values were greater than zero, and therefore, meaning that the SEA Technology Acceptance model can be used to explain Grade 12 learners' receptiveness of the SEA in the context of learning mathematics. The results also mean that the factors (PA, PSI, PSR, CSE, PEOU, PU, and ATT) are good predictors of AU.

Table 4.20: Predictive relevance (Q-squared) (N=272)

	SSO	SSE	Q^2 (=1-SSE/SSO)
ATT	1088,000	401,477	0,631
AU	1088,000	431,213	0,604
CSE	1088,000	686,326	0,369
PA	1088,000	511,689	0,530
PEOU	1088,000	571,372	0,475
PSI	1088,000	693,397	0,363
PSR	816,000	565,384	0,307
PU	1088,000	593,018	0,455

Before focusing on answering research questions, the next step of the model evaluation was hypothesis testing.

4.6 EFFECTS OF DEMOGRAPHIC VARIABLES TO RECEPTIVENES OF SEA

To determine the role played by demographic variables (gender, residential, and hours spent using SEA), in this study, multigroup analysis was used. This was done to understand whether demographics influence the actual use of SEA by Grade 12

learners. This study used a two-tailed t-test to assess the effect of demographics on the actual use of SEA. Therefore, the cut-off t-value was 1.96 (Klesel et al., 2022).

4.6.1 Effect of the Gender Variable on Receptiveness of SEA

The results of the multigroup analysis of the gender variable are presented in Table 4.21. They indicate that only three paths were accepted. These are: ATT to AU (t >1.96, p < 0.05), PSI to ATT (t >1.96, p < 0.05) and PU to AU (t >1.96, p < 0.05). The rest of the paths was not supported.

Table 4.21: Multigroup analysis of gender variable (N=272)

Path	Path Coefficients-diff (Female - Male)	t-Value (Female vs Male)	p-Value (Female vs Male)	Decision
ATT -> AU	0,224	2,339	0,020	Accepted
CSE -> PEOU	-0,199	1,333	0,184	Rejected
CSE -> PU	0,035	0,260	0,795	Rejected
PA -> PEOU	0,105	0,663	0,508	Rejected
PA -> PU	-0,025	0,208	0,835	Rejected
PEOU -> ATT	-0,176	1,826	0,069	Rejected
PEOU -> AU	0,056	0,657	0,512	Rejected
PEOU -> PU	0,009	0,063	0,950	Rejected
PSI -> ATT	0,210	2,079	0,039	Accepted
PSI -> PEOU	0,025	0,141	0,888	Rejected
PSI -> PU	-0,021	0,139	0,890	Rejected
PSR -> PEOU	-0,073	0,509	0,611	Rejected
PSR -> PU	0,000	0,002	0,999	Rejected
PU -> ATT	-0,002	0,020	0,984	Rejected
PU -> AU	-0,306	2,719	0,007	Accepted

4.6.2 Effect of the Residential Location Variable on Receptiveness of SEA

This study used rural- and urban-based school contexts to examine the significant influence on receptiveness of SEA. The results of the multigroup analysis effect of the residential location variable are presented in Table 4.22 — a two-tailed t-test result between rural and urban locations. The results showed that two paths were accepted. These are ATT to AU (t >1.96, p < 0.05) and PU to AU (t >1.96, p < 0.05). The rest of the paths were not supported.

Table 4.22: Multigroup analysis effect of residential location variable (N=272)

Path	Path Coefficients-diff (Rural-Urban)	t-Value (Rural vs Urban)	p-Value (Rural vs Urban)	Decision
ATT -> AU	0,215	2,045	0,042	Accepted
CSE -> PEOU	-0,131	0,903	0,367	Rejected
CSE -> PU	0,010	0,075	0,940	Rejected
PA -> PEOU	-0,030	0,195	0,845	Rejected
PA -> PU	-0,125	0,973	0,332	Rejected
PEOU -> ATT	-0,196	1,885	0,061	Rejected
PEOU -> AU	0,099	1,210	0,227	Rejected
PEOU -> PU	0,042	0,293	0,770	Rejected
PSI -> ATT	-0,116	1,059	0,291	Rejected
PSI -> PEOU	0,327	1,827	0,069	Rejected
PSI -> PU	0,003	0,017	0,987	Rejected
PSR -> PEOU	-0,202	1,398	0,163	Rejected
PSR -> PU	0,095	0,657	0,512	Rejected
PU -> ATT	0,159	1,397	0,164	Rejected
PU -> AU	-0,281	2,531	0,012	Accepted

4.6.3 Effect of the Hours Spent Variable on Receptiveness of SEA

In this study, a comparison of leaners that spent maximum hours using SEA (five hours or more) versus those that spent minimum hours using SEA (less than five hours) per week were considered. The results in Table 4.23 show the multigroup analysis effect of hours that Grade 12 learners spent using SEA to learn mathematics. They show that all paths were not supported by the results.

Table 4.23: Multigroup analysis effect of hours spent using SEA variable (N=272)

Path	Coefficients-diff (Maximum - Minimum hours)	t-Value (Maximum vs Minimum hours)	p-Value (Maximum vs Minimum hours)	Decision
ATT -> AU	-0,010	0,091	0,927	Rejected
CSE -> PEOU	0,124	0,835	0,405	Rejected
CSE -> PU	0,133	1,029	0,304	Rejected
PA -> PEOU	-0,274	1,633	0,104	Rejected
PA -> PU	-0,061	0,438	0,662	Rejected
PEOU -> ATT	0,043	0,394	0,694	Rejected
PEOU -> AU	-0,106	1,200	0,231	Rejected
PEOU -> PU	0,087	0,580	0,562	Rejected
PSI -> ATT	-0,069	0,691	0,490	Rejected
PSI -> PEOU	-0,052	0,296	0,768	Rejected
PSI -> PU	-0,123	0,817	0,414	Rejected
PSR -> PEOU	0,260	1,624	0,106	Rejected
PSR -> PU	0,079	0,528	0,598	Rejected
PU -> ATT	0,164	1,330	0,185	Rejected
PU -> AU	0,031	0,251	0,802	Rejected

4.7 HYPOTHESIS TESTING

In this study, 15 hypotheses were tested analysis in order to investigate the relationships hypothesized in the research model.

4.7.1 Perceived Accessibility (PA)

The first hypothesis (H1) stated that perceived accessibility has a positive effect on PU. However, the result in Table 4.17 indicates that (β =0.311, $p < 0.05$) which suggest a positive relationship exists. Second hypothesis (H2) stated that perceived accessibility has a positive effect on perceived ease of use. The result in Table 4.17 did not support the stated hypothesis (β = 0.125, $p > 0.05$). Therefore, hypothesis one (H1) is supported while (H2) is not supported. The results mean that the SEA accessible influence PU but not PEOU. SEA accessible contribute 31.1% to PU (61.3%), while 12.5% is contributed to PEOU (46.4%)

4.7.2 Perceived Social Influence (PSI)

The third hypothesis (H3) stated that social influence has a positive effect on perceived useful. The result in Table 4.17 shows that H3 was accepted which implies that Grade 12 learners consider social influence a good factor that encourages them to use the application. The fourth hypothesis (H4) was rejected (see Table 4.17) which was stated “social influence has a positive effect on perceived ease of use” indicating that being influence by social does not affect ease of use of the application. The fifth hypothesis (H5) stated that social influence has a positive effect on attitude towards using the application; the result in Table 4.17 indicate that it is accepted, which means that social influence does affect the attitude of using the application.

4.7.3 Perceived Skill Readiness (PSR)

Hypothesis number six (H6) stated that PSR has a positive effect on PU, and hypothesis number seven (H7) stated that PSR has a positive effect on the PEU. The result in Table 4.17 shows that both hypotheses were accepted. In this study it implies that Grade 12 learners have the technical skills to use any device and that also influence positive on the usefulness and ease of use of the application.

4.7.4 Computer Self-Efficacy (CSE)

The eighth hypothesis (H8) stated that CSE has a positive effect on PU and the ninth hypothesis (H9) stated that CSE has a positive effect on PEU. In the result, shown in Table 4.17, both these hypotheses were rejected which indicate that CSE does not have any influence on usefulness and ease of use of the application.

4.7.5 Perceived Usefulness (PU)

The tenth hypothesis (H10) stated that PU has a positive effect on attitude towards using SEA and eleventh hypothesis (H11) stated PU has a positive effect on actual use of SEA. The result supported the stated hypotheses, as shown in Table 4.17, and hypotheses 10 and 11 was accepted. This study implies that Grade 12 learners believe that using SEA is useful to them, and that improves the attitude towards using the application ATT (61.9%). ATT contribute 59% to actual use of SEA AU (74.6%).

4.7.6 Perceived Ease of Use (PEOU)

Hypothesis number 12 (H12) stated that PEOU has a positive effect on PU and hypothesis number thirteen (H13) stated that PEOU has a positive effect on attitude towards use of the application. There two hypotheses were accepted, as seen in Table 4.17. This indicates that Grade 12 learners perceive that SEA is easy to use and that affects the attitude towards using the application and usefulness of the application to learn mathematics. However, the result indicated that hypothesis number 14 (H14) “perceived ease of use has a positive effect on actual use of SEA”, was rejected, which means that Grade 12 learners believe that knowing how to use the application does not mean that they will use the application to learn mathematics.

4.7.7 Attitude Towards Using (ATT)

The last hypothesis for this study (H15) stated that attitude towards use has a positive effect on actual use of SEA. The result in Table 4.17 shows that H15 was accepted, which indicate that Grade 12 learners have a positive attitude and they will use the application to learn mathematics.

4.8 CHAPTER SUMMARY

This chapter focussed on the presentation and analysis of the results of the study. First step in this chapter involved data screening to ensure the collected data is clean and valid for testing. The second step focused on assessing the measurement model and the structural model. The third stage focused on hypotheses testing of the proposed SEA technology acceptance model of this study. The upcoming chapter focuses on discussion, conclusions and recommendations that could be beneficial for further research within the field of technology education.

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The purpose of this study was to examine the factors that affect Grade 12 learners' receptiveness of the SEA in the learning of mathematics. Moreover, the researcher developed the SEA technological model to explain the factors that affect receptiveness of the application by Grade 12 learners (see Figure 4.4).

This chapter is divided into three sections. The first section comprises the discussion of the findings articulated based on the research objectives included in this study.

- To examine the factors that affect Grade 12 learners' receptiveness of SEA in the learning of mathematics.
- To investigate the extent to which these factors affect the receptiveness of SEA in the learning of mathematics.
- To explore the demographics effects of Grade 12 learners on the receptiveness of SEA in the learning of mathematics.

The second section highlights recommendations that could be beneficial for further research within the field of technology education. This chapter, therefore, presents the summary and conclusion on the key research findings of this study.

5.2 DISCUSSION

The developed model (SEA technology acceptance) has eight constructs (PA, PSI, PSR, CSE, PU, PEOU, ATT, and AU), which were identified to be critical towards Grade 12 learners' receptiveness of the application. In this study, the discussion of results followed the sequence of the three research objectives.

5.2.1 Factors Affecting Grade 12 Learners' Receptiveness of SEA in the Learning of Mathematics

This research objective one aimed to examine the factors affecting Grade 12 learners' receptiveness of SEA in the context of learning mathematics. The researcher used the original TAM variables by Davis (1989): perceived usefulness (PU), perceived ease of use (PEOU), attitude towards (ATT), and actual use (AU). In addition to TAM variables the researcher identified four external factors that were added to the original TAM:

perceived accessibility (PA), perceived social influence (PSI), perceived skill readiness (PSR), and computer self-efficacy (CSE).

Altogether, these seven factors, PA, PSI, PSR, CSE, PU, PEOU, and ATT, explained a substantial 74.6% of the variance in the AU of SEA by Grade 12 learners in the context of learning mathematics.

5.2.1.1 Perceived Accessibility (PA)

In SEATAM model (figure 4.4), the construct had two hypotheses that were tested: perceived accessibility has a positive effect on perceived usefulness (H1) and perceived accessibility has a positive effect on perceived ease of use (H2). The result in Table 4.18 showed that the H1 was accepted ($\beta = 0.311$, $p<0.05$) and the H2 was rejected ($\beta = 0.125$, $p>0.05$). This means that PA had an insignificant effect on PEOU, while having a significant positive influence on PU. These results for the PA contradict with that of the researchers (Rafique et al., 2020; Salloum et al., 2019; Salloum, 2018; Saroia & Gao, 2019; Shankar & Kumari, 2019), who found that perceived accessibility had a positive influence on PEOU. However, the results are in line with the result of (Rafique et al., 2020; Salloum et al., 2019; Salloum, 2018; Saroia & Gao, 2019; Shankar & Kumari, 2019), who reported a positive influence of PA on PU. These means that for Grade 12 leaners, if SEA is accessible, then the application is useful for them to learn mathematics. However, Grade 12 leaners concluded that perceived ease of use of SEA is not influenced by the accessibility of the application.

In SEATAM model (Figure 4.4) PU and PEOU were playing an important mediating role between PA and AU. There was an indirect hypothesis that was tested between perceived accessibility and actual use. The results in Table 4.19 show that the relationship between PA -> AU ($\beta = 0.220$, $p<0.05$) was accepted. This means that PA has a positive influence on the actual use of SEA, therefore PA is a good predictor of Grade 12 learners actual use of SEA. The research suggest that DBE should use offline portals to support learners with accessibility of the application.

5.2.1.2 Perceived Social Influence (PSI)

The PSI construct had three hypotheses that were tested (see Figure 4.4). Social influence has a positive effect on perceived useful (H3), social influence has a positive effect on perceived ease of use (H4) and social influence has a positive effect on attitude towards use (H5). The results in Table 4.18 show that the H3 ($\beta = 0.307$,

p<0.05) and H5 (β= 0.252, p<0.05) were accepted, while H4 (β= 0.008, p>0.05) was rejected. These means that PSI had a significant influence on both PU and ATT, but there is no positive relationship between PSI and PEOU. These results imply that Grade 12 leaners believe that social influence an important factor in their use of the application and if they are influence by social then they have a positive attitude towards the use of the application.

In a relationship between PSI and PEOU (H4) Grade 12 learners believe that social influence had nothing to do with effort of using the application. The result of this study was not consistent with what was revealed in the literature, where a number of studies prove that social influence has a positive influence on PU, PEOU and ATT (Lee et al., 2003; Scherer et al., 2019; Tayo, 2015; Zhang et al., 2020). This study revealed that PSI had a positive effect on PU and ATT not on PEOU.

SEATAM model (Figure 4.4) PU, PEOU and ATT were playing and important mediating role between PSI and AU. There was an indirect hypothesis that was tested between PSI and AU. The results in Table 4.19 indicate that the relationship between PSI -> AU (β= 0.346, p<0.05) was accepted. These means that PSI had a significant influence on actual use of SEA. These results means that Grade 12 learners are not immune to what the society say about the use SEA for learning mathematics. Therefore, the DBE should do awareness programs on the usefulness of SEA.

5.2.1.3 Perceived Skill Readiness (PSR)

Two hypotheses gave direction on this construct: perceived skill readiness has a positive effect on perceived usefulness (H6) and perceived skill readiness has a positive effect on the perceived ease of use (H7). The results in Table 4.18 show that both hypotheses H6 (β= 0.199, p<0.05) and H7 (β= 0.547, p<0.05) were accepted. These means that PSR had a positive influence on both PEOU and PU. These means that the technical skills they have helped to increase the usefulness of SEA and to lessen the effort needed by the Grade 12 learners to learn to use SEA for learning mathematics using SEA. The results of hypotheses H6 and H7 are in agreement with those of Al-Maroof et al. (2021), who found that there was a positive influence on PU. Iqbal and Ahmed Bhatti (2015) also found that there was a positive influence on PEOU. However, the results implies that Grade 12 learners have the required technical skills

when using any devise for the implementation of SEA. It shows that it is easy for them to engage with SEA because of the technical skills.

The model of this study (Figure 4.4) shows that PU and PEOU were playing and important mediating role between PSR and AU of SEA. There was an indirect hypothesis that was tested between perceived skill readiness and actual use of SEA; the results in Table 4.19 indicate that the relationship between PSR -> AU (β= 0.218, p<0.05) was accepted. These means that PSR had a significant influence on actual use of SEA. These results means that teachers should equip their learners with skills needed to learn mathematics using SEA and other educational software.

5.2.1.4 Computer Self-Efficacy (CSE)

Two hypotheses underpinned the CSE construct were tested: computer self-efficacy has a positive effect on perceived usefulness (H8) and computer self-efficacy has a positive effect on perceived ease of use (H9). The results from the model showed that both H8 (β= -0.037, p>0.05) and H9 (β= 0.082, p>0.05) hypotheses were not supported. This means that CSE had an insignificant negative effect on both PEOU and PU, implying that Grade 12 learners believe that their perception of their ability to use any computer technologies does not influence its usefulness and the effort of learning mathematics using SEA. The results shows that both hypotheses were not supported which contradict with other research studies conducted by (Chibisa, 2021; Liao et al., 2018), who found that CSE has a positive effect on PU and PEOU.

In the SEATAM model of this study (Figure 4.4), PU and PEOU were playing mediating role between CSE and AU. There was an indirect hypothesis that was tested between computer self-efficacy and actual use of the application; the results in Table 4.19 shows that the relationship between PSR -> AU (β= -0.010, p>0.05) was not supported. These means that CSE does not influence the actual usage of SEA.

5.2.1.5 Perceived Usefulness (PU)

Two hypotheses anchored the PU construct that were tested: PU has a positive effect on attitude towards using SEA (H10) and PU has a positive effect on actual use of SEA (H11). The results from the model showed that both hypotheses H10 (β=0.442, p<0.05) and H11 (β=0.378, p<0.05) were supported (see Table 4.18). This means that Grade 12 learners' PU have positive influence on their ATT and their AU respectively. In the context of this study, these implies that Grade 12 leaners decided that SEA is

useful to them which also influence their attitude and actual use of the application when learning mathematics. The results of the hypotheses H10 and H11 are in agreement with those of Šumak *et al.* (2011), who found that PU has a positive influence on ATT, and Masrom (2007), found that PU has a significant effect on AU of the e-learning as an effective learning tool by universities. PU plays an important role in the actual usage of SEA. There was an indirect hypothesis that was tested between PU and AU. The result in Table 4.19 indicates that the relationship between PU -> AU ($\beta= 0.639$, $p<0.05$) was supported. These means that PU had an influence on the actual usage of SEA. These means that learners' belief that using SEA will improve their performance in mathematics reinforces their positive attitude towards SEA. When learners are having a positive attitude towards SEA, they want to use it.

The developers of SEA must ensure that they make use of videos that demonstrate and clarify mathematics problems to make SEA useful to learners. Additionally, teachers must also encourage the proper use of SEA to leaners, for them to improve mathematics grades.

5.2.1.6 Perceived Ease of Use (PEOU)

Perceived ease of use had three hypothesis that were tested: Perceived ease of use has a positive effect on PU (H12), PEOU has a positive effect on attitude towards use (H13) and PEOU has a positive effect on actual use of SEA (H14). The results in Table 4.18 shows that two of the hypotheses H12 ($\beta= 0.162$, $p<0.05$) and H13 ($\beta= 0.225$, $p<0.05$) were accepted, while H14 ($\beta= -0.070$, $p>0.05$) was not supported. These results imply that there is a positive relationship between PEOU and PU and between PEOU and ATT, but there is no positive relationship between PEOU and AU of SEA. The implication is that PEOU does not have a direct influence on AU, but and indirect influence through ATT and PU of the SEA.

The results of the hypotheses H12 and H13 are consistent with what was revealed in the literature. Davis et al. (1989) found that PEOU influence PU and Mutahar et al. (2018) reported that PEOU had a significant on ATT. In this study, H14 was not supported which contradict with the result found by Al-Adwan et al. (2013), who found that PEOU has positive influence on intention to continue use the e-learning system. In this study Grade 12 learners' effort to learn to use SEA assist them to increase the attitude and usefulness of the application.

There was an indirect hypothesis that was tested between PEOU and AU. The results in Table 4.19 (total indirect Table) indicate that the relationship between PEOU -> AU (β= 0.166, $p<0.05$) was supported. This means that PEOU has a positive relationship on the actual usage of SEA. This means Grade learners effort to lean to use SEA influence their actual use of SEA. Therefore, teachers and DBE should encourage the use of technologies during the teaching and learning of mathematics for Grade 12 to improve their computer skills which will lead to learners using SEA.

5.2.1.7 Attitude Towards Using (ATT)

The construct was having one hypothesis that attitude towards use has a positive effect on actual use of SEA (H15). The hypothesis H15 (β=0.590, $p<0.05$) was supported by the data. This result indicates that Grade 12 leaner's attitude towards the application has a positive influence over their actual use of SEA. This implies that Grade 12 learners in this study feel good about their actual use of SEA. The results were consistent with those of Salloum (2018), who found that ATT has a positive influence on AU. This is similar to the findings by Mutambara and Chibisa (2022), who found that pre-service teacher's attitude towards the use affect actual use of virtual learning. Therefore, teachers should pay attention to the factors that improves the learners' attitudes towards SEA, as attitudes plays an important role in actual use.

5.2.2 The Extent of Factors That Affect the Receptiveness of SEA in the Learning of Mathematics

The aim of this research objective in this study was to find out that how far do these seven factors (PA, PSI, PSR, CSE, PU, PEOU, and ATT) explain the actual use of SEA in the learning of mathematics. The result explained a substantial 74.6% of the variance in the AU of SEA by Grade 12 learners in the context of learning mathematics. The result of this model are considered substantial (Cohen, 2013). Mutambara and Chibisa (2022), reported that the factors: computer self-efficacy (CSE), perceived enjoyment (PEN), social influence (SI), facilitating conditions (PR), perceived ease of use (PEOU), perceived usefulness (PU) and perceived attitude towards (ATU), that were identified in the model, are good predictors of rural STEM pre-service teachers' acceptance of virtual learning. Their model explained a substantial amount of variance of the actual usage of VL.

The explanatory power of this model was substantial, as the result obtained by Chibisa and Mutambara (2022), were substantial with factors (ATT, PU, PEOU, PR, PSI, PSR, and PPR) that affect rural high school educators' and students' behavioural intention. This means that these factors explain a substantial result. This study findings support the suggestion made by authors who propose that adding context-related external variables to TAM it then improves explanatory power.

The results of this study were consistent with that of Al-Adwan et al. (2013), who reported that students at Jordanian universities accept the adoption of e-learning platform; he further reported that the implementation requires the extensive understanding of the user acceptance process. Further, these results are in agreement with that of Al-Azawei et al. (2017), who reported the effect of learning styles in a blended e-learning system to students, and found that the students' perception was substantial to blended learning.

The aim of objective 2 in this study was to investigate the extend of Grade 12 learners actual use of SEA in the learning of mathematics. In this study, the model has explained the factors that affect the receptiveness of SEA. However, this means that all the total construction of the model of the constructs: PA, PSI, PSR, CSE, PU, PEOU and ATT is 74.6%, according to Cohen (2013) these R-square value is considered substantial. This means that the factors identified in this model explained the extent to which these factors affect the receptiveness of SEA. The researcher recommend that other researchers should find the other factors that account for the remaining 25.4%

5.2.3 Demographic effects of Grade 12 learners on the Receptiveness of SEA in the Learning of Mathematics

To answer this objective, multigroup analysis was used to determine the role played by demographic effects on receptiveness of SEA. The aim of objective 3 in this study was to establish whether demographics influence the use of SEA by Grade 12 learners in the learning of mathematics, which includes residential location, hours they spend using SEA, and gender of Grade 12 learners at uMhlathuze circuits schools. The researcher did not consider age because the age difference of Grade 12 learners is negligibly small. The smartPLS software was used for multigroup analysis of the respondents' demographics.

5.2.3.1 Residential Location

In this study, the residential location of Grade 12 learners was included to find out how Grade 12 learners in various locations receive SEA in the learning of mathematics. The results in Table 4.22 indicated that out of 15 paths, only two were accepted: ATT to AU ($t > 1.96$, $p < 0.05$) and PU to AU ($t > 1.96$, $p < 0.05$); the rest were not supported. This result means that Grade 12 learners' ATT and PU have a significant effect on AU, which implies that their ATT and PU are affected by where they reside. Most of the paths were rejected, which implies that the residential location variable does not influence the actual use of SEA. The findings of this study are contradictory to those by Syahruddin et al. (2021), whose results showed a huge difference when it comes to the acceptance of distance learning. Learning behaviour patterns and access to technology were revealed to be different in different location.

5.2.3.2 Gender

In this study, the researcher wanted to find out if there was any significant effect of gender in the receptiveness of SEA in the learning of mathematics by Grade 12 learners. The results indicated in Table 4.21 show that three paths show a significant difference on the receptiveness of SEA: ATT to AU ($t > 1.96$, $p < 0.05$), PSI to ATT ($t > 1.96$, $p < 0.05$) and PU to AU ($t > 1.96$, $p < 0.05$), while the rest of the 13 had no effect on gender. This implies that ATT and PU had a significant effect on AU of SEA and also PSI had a significant effect on learners' ATT. Most of the paths had no significant influence on the receptiveness of SEA. Therefore, gender has no significant effect when it comes to the receptiveness of SEA. The findings of this study are consistent with those by Tshabalala et al. (2019), that gender has no effect on the relationship between pre-service teacher's use of Moodle to enhance learning.

5.2.3.3 Hours They Spent Using SEA

In this study, the hours spent by Grade 12 leaners using SEA per week was included to find out whether the hours spent using SEA between maximum (5 hours or more) and minimum (less than 5 hours) hours spent have a significant difference on learners' responsiveness to SEA. The results in Table 4.23 show that there is no significant difference because all tested paths had no significant effect on receptiveness to SEA.

These findings imply that the demographic variables gender, residential location and hours spent using SEA do not influence the receptiveness of the SEA.

5.3 SUMMARY OF THE STUDY

The study has five chapters. The first chapter presented the introduction, the purpose of the study, three research questions, and three research objectives of the study was stated. The study in this chapter identified the gap in the learning of mathematics by Grade 12 learners, as well as the significance and possible contribution that this study will make.

A review of the literature containing the different types of learning management system, and the rational of choosing SEA was presented in Chapter Two. The theory underpinning the study was also presented in Chapter Two. The study used TAM, which allows researchers to continue find other variables that are context related, in order to extend TAM. The study in Chapter Two presented the proposed model which is SEA technology acceptance model, and all eight constructs of this model were presented in this chapter. The Hypotheses of the proposed conceptual model were also explained.

A detailed methodology used in this study was described in Chapter Three. The instrument development and how data will be validated was explained in this chapter. Further to that, a pilot test was then conducted in ensuring instrument validity and reliability. A detailed presentation on how data were collected and analysed, partial least squares structural equation modelling was also presented in Chapter Three.

A presentation of results was presented in Chapter Four. The measurement model and structural model of this study was presented. Also, a detailed hypotheses testing was presented.

In the last chapter, the discussion of the findings was presented based on the three research objectives included in this study. The summary, conclusions and further studies recommendation was presented in Chapter Five of this study.

5.4 LIMITATIONS OF THE STUDY

This research study has the following limitations:

- The current study only focused on the receptiveness of Siyavula Educational Application in the learning of mathematics for Grade 12 learners in the district of King Cetshwayo, in KwaZulu-Natal.
- To get a clear picture and opinion of other learners, the study could also have been conducted from other districts and provinces.
- The study followed a quantitative design to understand the factors that affect the receptiveness of SEA. However, applying a qualitative method to get a deeper understating of the factors that explain the relationship among constructs could have given more insight to the phenomenon under study.
- This study used only Grade 12 learners to examine the factors that affect receptiveness of SEA. Including their teachers and learners from other grades could have added more value to the research.

5.5 CONCLUSION

The main aim of this study was to examine the factors that affect Grade 12 learners' receptiveness of the SEA in the context of learning mathematics. In order to achieve this, the researcher developed the model which was used to answer the research objectives of this study. The model of this study (SEATAM) had eight constructs. There were 15 hypotheses connected to these eight constructs: 10 hypotheses were accepted, while the other five hypothesis were not supported (see Table 4.17). The SEATAM model had indirect mediating effect of each of the constructs that connect to actual use of SEA; the results in Table number 4.19 shows that six were accepted and one was not supported.

The eight factors identified in this study all play an important role in Grade 12 learners' actual usage of the application, which means that they all influence the receptiveness of the SEA. All the external factors of the model: perceived accessibility, PSI, perceived skill readiness, and computer self-efficacy, contributed 61.3% to PU and 46.4% to PEOU. Both PU and PEOU, together with the PSI, explained 61.9% to attitude towards of the application. About the actual usage of the application by Grade

12 learners in learning mathematics, it was established that the identified variables for the proposed SEATAM were the good predators of the Grade 12 learners' receptiveness of the application. The explained variance of the SEATAM was a major 74.6% of the actual usage of the SEA. This 74.6% of the actual use means that the model was substantial for examining the factors that affect Grade 12 leaners receptiveness of the SEA.

Lastly, the demographics of residential location, gender, and hours they spent did not have any effect on the actual use of the application, due to several reasons given in the second section of this chapter.

5.6 THEORETICAL IMPLICATIONS, RECOMMENDATIONS AND FUTURE STUDIES

5.6.1 Theoretical Implications

The researcher in the SEATAM model (Figure 4.4) tested the relationship between PEOU and AU, the results revealed that the relationship is insignificant. This support TAM because originally that relationship was not there in the original TAM.

Even though TAM was developed 30 years ago, but it still useful to explain the acceptance and receptiveness of technology even up today.

This study has managed to contribute to theory that these external variable (PA, PSI, PSR and CSE) can be added to TAM to explain the receptiveness of SEA by grade 12 learners.

Figure 5.1 demonstrate the SEATAM model with ten supported hypotheses and constructs that were retained: PA, PSI, PSR, PU, PEOU, ATT and AU. CSE was taken out because all its hypotheses were not supported.

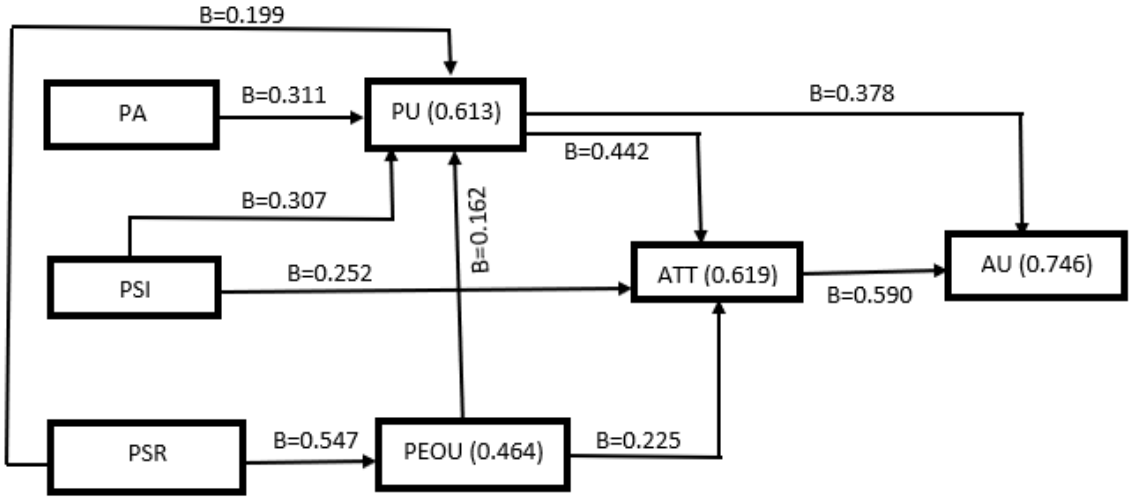

Figure 5.1: SEATAM Grade 12 leaners actual use of the application

This study makes a contribution to the field of new technology usage, user acceptance research, receptiveness, and information systems.

5.6.2 Recommendations

The study has contributed to the body of knowledge by examining the factors that might affect Grade 12 learners' receptiveness of the SEA in the context of learning mathematics by Grade 12 learners at uMhlathuze circuits under King Cetshwayo District. In modern times, daily life depends much on the use of technology in many and various ways. However, learning has mostly resumed through online platforms. This presented an even more pressing need for the launching of software applications such as the SEA (SEA), specifically in Grade 12.

The possible recommendation is presented:

- The research suggest that DBE should use offline portals to support learners with accessibility of the application.
- The DBE should do awareness programs on the usefulness of SEA.
- The results of this suggest that teachers should equip their learners with skills needed to learn mathematics using SEA and other educational software.

5.6.3 Future Studies

- The current study focused on Grade 12 leaners receptiveness of SEA. Future studies could focus on acceptance of the application by teachers teaching mathematics in high school.
- It would be more interesting to see a similar study being conducted now using the qualitative method, which could reveal more details and deeper understanding of the application.
- The model of the current study explained 74.6% of the variance in the actual use of the application. This means that 25.4% of the factors outside this model that explain the receptiveness of SEA were not captured in this model. It is therefore recommended that future studies focus on finding these missing factors.
- The current study established that all three demographics of the study did not influence Grade 12 learners' receptiveness of the application. Future studies may need to determine why demographics were not influencing the actual use of the application.

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APPENDICES

APPENDIX 1: RESEARCH QUESTIONNAIRE

UNIVERSITY OF ZULULAND

QUESTIONNAIRE

This questionnaire intends to collect data on **Grade 12 learners' receptiveness to Siyavula Education Application in the context of learning of Mathematics.**Collected information will be solely kept by the researcher and will not be disclosed to any third party, it will be used for academic purpose only. This questionnaire is organized into two sections Section A and Section B. Respond to all the questions by placing ***X*** in the appropriate box.

SECTION A

Demographics of Participants

1. Gender:

Male:	1	Female:	2

2. Residential demographics:

Rural:	1	Urban:	2

3. How many hours do you spend using Siyavula Educational Application per week?

1 – 2		3 – 4		5 – 6		7 or more	

SECTION B

In this section indicate the level of your agreement with the following statements by placing an ***X*** in the spaces provided. The responses are ranging from **1 – strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – strongly agree.**

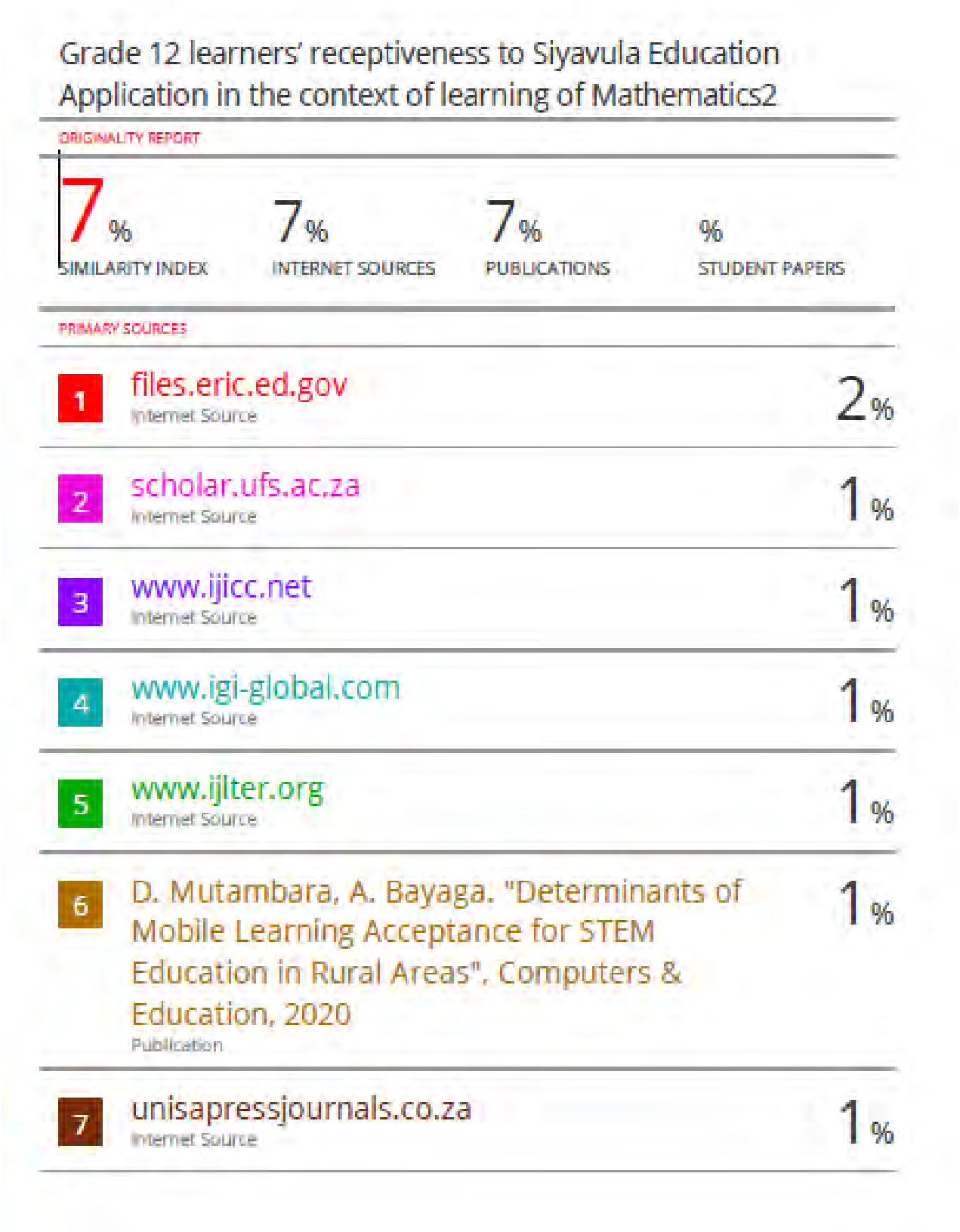
	Perceived Usefulness (PU)	**1**	**2**	**3**	**4**	**5**
PU1	Using SEA will improve my mathematics result					
PU2	I think SEA will help me to understand mathematics better					
PU3	I believe using SEA in learning mathematics is a good idea					
PU4	I can use SEA anywhere, anytime					
PU5:	By using SEA, I find it easy to answer questions in mathematics					
	Perceived Ease of Use (PEOU)	**1**	**2**	**3**	**4**	**5**
PEOU1	It is easy to log in to SAE					
PEOU2	It is easy to navigate through relevant mathematics sections on the SEA					
PEOU3	SEA is a significant addition to my Mathematical learning					
PEOU4	It is easy to access my assignments using SEA					
PEOU 5	It is easy to write assignments on SEA					
	Attitude Towards using (ATT)	**1**	**2**	**3**	**4**	**5**
ATT 1	I am happy to use SEA to learn mathematics					
ATT 2	I will continue to use the SEA to learn mathematics					
ATT 3	Using SEA helps me to improve my mathematics grades					
ATT4	I have positive attitude learning mathematics using SEA					
	Perceived Accessibility (PA)	**1**	**2**	**3**	**4**	**5**
PA 1	It is easy to download SEA onto any device					
PA 2	I can log in to SEA using my smartphone/laptop					
PA 3	I can log in to SEA without downloading it on my device					
PA 4	SEA is free to access when using MTN, Vodacom & Telkom					
	Perceived Social Influence (PSI)	**1**	**2**	**3**	**4**	**5**
PSI 1	I was encouraged by other learners' beliefs who are using SEA					
PSI 2	My family encourage me to use SEA in my studies					
PSI 3	My teacher's beliefs about SEA influence me to use SEA					
PSI 4	All my friends in my school are using SEA					
PSI 5	During study groups outside my school, they encourage the use of SEA					
	Perceived Skills Readiness (PSR)	**1**	**2**	**3**	**4**	**5**
PSR 1	I have the skills to work on SEA					
PSR 2	I have a skill of using any device					
PSR 3	I understand better when learning using my device					
PSR 4	I have the ability to use the SEA interface					
	Computer Self Efficacy (CSE)	**1**	**2**	**3**	**4**	**5**
CSE 1	I believe that I can follow instructions on SEA					
CSE 2	I believe I know how to use SEA on my phone					
CSE 3	I believe I can use SEA if someone showed me how to use it					
CSE 4	I believe I know how to use SEA on my tablet					
	Actual System Use (AU)	**1**	**2**	**3**	**4**	**5**
AU 1	Practising using SEA is more interesting					
AU 2	I frequently use SEA to write my assessments					
AU 3	I use SEA in learning most of my mathematics					
AU 4	I frequently use SEA for practicing mathematics					

APPENDIX 2: DESCRIPTIVE STATISTICS OF THE INSTRUMENT (N=272)

All the construct of the model in this study, were measured using a five-point Likert scale, ranging from **1 – strongly disagree; 2 – Disagree; 3 – Neutral; 4 – Agree; 5 – strongly agree.** The indicator mean less than 3 indicate that the majority of respondents disagree with the indicator and the indicator mean of greater than 3 implies that the majority the majority of respondents agree with the indicator.

Code	Constructs	N	Mean	Standard Deviation
	Perceived Usefulness (PU)			
PU1	Using SEA will improve my mathematics result	272	3.96	0.886
PU2	I think SEA will help me to understand mathematics better	272	4.04	0.839
PU3	I believe using SEA in learning mathematics is a good idea	272	4.21	0.813
PU4	I can use SEA anywhere, anytime	272	3.95	1.044
PU5:	By using SEA, I find it easy to answer questions in mathematics	272	3.67	1.014
	Perceived Ease of Use (PEOU)			
PEOU1	It is easy to log in to SAE	272	4.02	1.025
PEOU2	It is easy to navigate through relevant mathematics sections on the SEA	272	3.74	0.623
PEOU3	SEA is a significant addition to my mathematical learning	272	3.80	0.937
PEOU4	It is easy to access my assignments using SEA	272	3.79	1.054
PEOU 5	It is easy to write assignments on SEA	272	3.78	1.046
	Attitude Towards using (ATT)			
ATT 1	I am happy to use SEA to learn mathematics	272	4.14	0.916
ATT 2	I will continue to use the SEA to learn mathematics	272	4.19	0.872
ATT 3	Using SEA helps me to improve my mathematics grades	272	3.96	0.858
ATT4	I have positive attitude learning mathematics using SEA	272	3.97	0.977
	Perceived Accessibility (PA)			
PA 1	It is easy to download SEA onto any device	272	3.79	1.118
PA 2	I can log in to SEA using my smartphone/laptop	272	4.20	0.951
PA 3	I can log in to SEA without downloading it on my device	272	3.62	1.254
PA 4	SEA is free to access when using MTN, Vodacom & Telkom	272	4.00	1.184
	Perceived Social Influence (PSI)			
PSI 1	I was encouraged by other learners' beliefs who are using SEA	272	3.36	1.321
PSI 2	My family encourage me to use SEA in my studies	272	2.96	1.355
PSI 3	My teacher's beliefs about SEA influence me to use SEA	272	4.05	1.355
PSI 4	All my friends in my school are using SEA	272	3.16	1.087
PSI 5	During study groups outside my school, they encourage the use of SEA	272	3.16	1.335
	Perceived Skills Readiness (PSR)			
PSR 1	I have the skills to work on SEA	272	3.44	1.138
PSR 2	I have a skill of using any device	272	3.63	1.090
PSR 3	I understand better when learning using my device	272	3.79	1.089
PSR 4	I have the ability to use the SEA interface	272	3.47	1.062
	Computer Self Efficacy (CSE)			
CSE 1	I believe that I can follow instructions on SEA	272	4.08	0.969
CSE 2	I believe I know how to use SEA on my phone	272	4.03	1.025
CSE 3	I believe I can use SEA if someone showed me how to use it	272	4.06	1.020
CSE 4	I believe I know how to use SEA on my tablet	272	3.83	1.066
	Actual System Use (AU)			
AU 1	Practising using SEA is more interesting	272	4.07	0.992
AU 2	I frequently use SEA to write my assessments	272	3.45	1.142
AU 3	I use SEA in learning most of my mathematics	272	3.74	1.108
AU 4	I frequently use SEA for practicing mathematics	272	3.86	1.090

APPENDIX 3: PLAGIARISM REPORT



Grade 12 learners' receptiveness to Siyavula Education Application in the context of learning of Mathematics2

ORIGINALITY REPORT

7%	7%	7%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	files.eric.ed.gov Internet Source	2%
2	scholar.ufs.ac.za Internet Source	1%
3	www.ijicc.net Internet Source	1%
4	www.igi-global.com Internet Source	1%
5	www.ijlter.org Internet Source	1%
6	D. Mutambara, A. Bayaga. "Determinants of Mobile Learning Acceptance for STEM Education in Rural Areas", Computers & Education, 2020 Publication	1%
7	unisapressjournals.co.za Internet Source	1%

APPENDIX 4: LANGUAGE EDITOR'S CERTIFICATE

Helen Bond
IMPELA EDITING SERVICES
impelaediting@gmail.com
079 395 5873

14 February 2023

CERTIFICATE

Ntuthuko S'bonelo Xulu
XuluNS@unizulu.ac.za

Dear Ntuthuko

Thank you for using Impela Editing Services to edit your Master's dissertation entitled *"Grade 12 learners' receptiveness to Siyavula Education Application in the context of learning of Mathematics"*.

I have proofread for errors of grammar, punctuation, spelling, syntax and typing mistakes. I have formatted your work and checked the references (this means checking the formatting). I believe your work to be error free.

PLEASE NOTE: Impela Editing accepts no fault if an author makes changes to a document after a certificate has been issued.

I wish you the very best in your submission.

Kind regards

Bond

Helen Bond (Bachelor of Arts, HDE)

APPENDIX 5: ETHICAL CLEARANCE CERTIFICATE

UNIVERSITY OF ZULULAND
RESEARCH ETHICS COMMITTEE
(Reg No: UZREC 171110-030)

RESEARCH & INNOVATION
Website: http://www.unizulu.ac.za
Private Bag X1001
KwaDlangezwa 3886
Tel: 035 902 6371
Email: Mbonisi@unizulu.ac.za

ETHICAL CLEARANCE CERTIFICATE

Certificate Number	UZREC 171110-030 PGM 2021/283						
Project Title	GRADE 12 LEARNERS' RECEPTIVENESS TO SIYAVULA EDUCATION APPLICATION (SEA) IN THE CONTEXT OF LEARNING OF MATHEMATICS						
Principal Researcher/ Investigator	N.S. Xulu						
Supervisor and Co-supervisor	Dr A. Krishnannair		Mr A. Chetty				
Department	Mathematics, Science and Technology Education						
Faculty	Education						
Type of Risk	Medium risk: Data collection from people						
Nature of Project	Honours/4th Year		**Master's**	x	Doctoral		Departmental

The University of Zululand's Research Ethics Committee (UZREC) hereby gives ethical approval in respect of the undertakings contained in the above-mentioned project. The Researcher may therefore commence with data collection as from the date of this Certificate, using the certificate number indicated above.

SPECIAL CONDITIONS: **(1) This certificate is valid for 1 year from the date of issue.**
(2) Principal researcher must provide an annual report to the UZREC in the prescribed format [due date – 09 June 2023]
(3) The UZREC must be informed immediately of any material change in the conditions or undertakings mentioned in the documents that were presented to the meeting.
(4) Under the Protection of Personal Information Act, 04 of 2013 ("POPIA"), researchers have a general legal duty to protect information they process. They must ensure the security and protection of any personal information processed through the research and provide a compliant and consistent approach to data protection. The information collected via interviews must be for research purposes only. No personal information such as opinions, views and academic background may be linked to the respondents' identity or shared with anyone for marketing purposes or otherwise.

The UZREC wishes the researcher well in conducting research.

Prof. Nokuthula Kunene
Chairperson: University Research Ethics Committee
Deputy Vice-Chancellor: Research & Innovation
09 June 2022

CHAIRPERSON
UNIVERSITY OF ZULULAND RESEARCH
ETHICS COMMITTEE
REG NO: UZREC 171110-30
09
RESEARCH & INNOVATION OFFICE

APPENDIX 6: GATEKEEPER

KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

OFFICE OF THE HEAD OF DEPARTMENT

Private Bag X9137, PIETERMARITZBURG, 3200
Anton Lembede Building, 247 Burger Street, Pietermaritzburg, 3201
Tel: 033 392 1051
Email: buyi.ntuli@kzndoe.gov.za

Enquiries: Buyi Ntuli **Ref.** 2/4/8/7184

Mr Nduthuko S'bonelo Xulu
P.O. Box 1816
RICHARDS BAY
3900

Dear Mr Xulu

PERMISSION TO CONDUCT RESEARCH IN THE KZN DoE INSTITUTIONS

Your application to conduct research entitled: **"GRADE 12 LEARNERS' RECEPTIVENESS TO SIYAVULA EDUCATION APPLICATION (SEA) IN THE CONTEXT OF LEARNING OF MATHEMATICS:"**, in the KwaZulu-Natal Department of Education institutions has been approved. The conditions of the approval are as follows:

1. The researcher will make all the arrangements concerning the research and interviews.
2. The researcher must ensure that Educator and learning programmes are not interrupted.
3. Interviews are not conducted during the time of writing examinations in schools.
4. Learners, Educators, Schools and Institutions are not identifiable in any way from the results of the research.
5. A copy of this letter is submitted to District Managers, Principals and Heads of Institutions where the intended research and interviews are to be conducted.
6. The period of investigation is limited to the period from 10th **November 2021 to 30th November 2023.**
7. Your research and interviews will be limited to the schools you have proposed and approved by the Head of Department. Please note that Principals, Educators, Departmental Officials and Learners are under no obligation to participate or assist you in your investigation.
8. Should you wish to extend the period of your survey at the school(s), please contact Miss Phindile Duma at the contact numbers above.
9. Upon completion of the research, a brief summary of the findings, recommendations or a full report/dissertation/thesis must be submitted to the research office of the Department. Please address it to The Office of the HOD, Private Bag X9137, Pietermaritzburg, 3200.
10. Please note that your research and interviews will be limited to schools and institutions in KwaZulu-Natal Department of Education.

Dr M.J.B. Mthembu
Acting Head of Department: Education
Date: 10th November 2021

GROWING KWAZULU-NATAL TOGETHER

APPENDIX 7: LETTER TO CIRCUIT MANAGER

University of Zululand
Faculty of Education
Private Bag X1001
Kwa-Dlangezwa
Empangeni
3886
20 September 2021

The Circuit Manager
Department of Basic Education
uMhlathuze Circuit
KwaZulu-Natal

Dear Dr Sbeko

REF: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN SCHOOLS

I am employed by the Department of Basic Education and currently teaching at Nongweleza Secondary School. I am currently registered for a Master of Education (M.Ed.) at the University of Zululand within the Department of Mathematics, Science and Technology. The title of my research project is **Grade 12 learners' receptiveness to Siyavula Education Application (SEA) in the context of learning of Mathematics.**

I wish to seek permission to conduct research in schools under King Cetshwayo at uMhlathuze circuit. 252 Grade 12 learners at uMhlathuze schools will be used as participants to collect data for the study. Six schools will be randomly selected from a representative sample of 252 Grade 12 learners will be participate in the study respondents. Data will be gathered using a five-point Likert scale questionnaire. All ethical considerations will be followed during and after the data gathering process, which is scheduled to take place when learners are on school breaks and/or after school, in order to minimize disturbances to the co-business of the schools.

I hope the findings of this study will benefit and assist the Department of Basic Education and learning in schools.

Yours Faithfully

Mr. Ntuthuko S'bonelo Xulu

0713457229 / sbonelontuthuko94@gmail.com

Dr A Krishnannair (Supervisor) & Mr. A Chibisa (Co-Supervisor)

APPENDIX 8: LETTER TO PRINCIPAL

University of Zululand
Faculty of Education
Private Bag X1001
Kwa-Dlangezwa
Empangeni
3886
20 September 2021

The Principal

Dear Sir/Madam

REF: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN SCHOOLS

I am employed by the Department of Basic Education and currently teaching at Nongweleza Secondary School. I am currently registered for a Master of Education (M.Ed.) at the University of Zululand within the Department of Mathematics, Science and Technology. The title of my research project is Grade 12 learners' receptiveness to Siyavula Education Application (SEA) in the context of learning of mathematics.

I cordially request for permission to conduct research in your school. Grade 12 learners doing mathematics and science will be used as participants to collect data for the study. The researcher will conduct a questionnaire to gather information from respondents. The researcher will schedule convenient times with the selected learners to conduct the questionnaire. Kindly take note that all ethical considerations will be followed during and after the data gathering process, which is scheduled to take place when learners are on school breaks and/or after school, in order to minimize disturbances to the co-business of the schools.

I hope the findings of this study will benefit and assist the Department of Basic Education and learning in schools.

Yours Faithfully

Mr Ntuthuko S'bonelo Xulu
0713457229 / sbonelontuthuko94@gmail.com
Dr A. Krishnannair (Supervisor) & Mr A. Chibisa (Co-Supervisor)

APPENDIX 9: CONSENT LETTER (PARTICIPANT)

PARTICIPANT INFORMED CONSENT DECLARATION
INFORMED CONSENT DECLARATION
(Participant)

Project Title: Grade 12 learners' receptiveness to Siyavula Education Application in the context of learning of mathematics

(Mr N.S. XULU from the Department of MSTE, University of Zululand has requested my permission to participate in the above-mentioned research project.

The nature and the purpose of the research project, and of this informed consent declaration have been explained to me in a language that I understand.
I am aware that:

1. The purpose of the research project is to investigateGrade 12 learners' receptiveness to Siyavula Education Application in the context of learning of mathematics
2. The University of Zululand has given ethical clearance to this research project and I have seen/ may request to see the clearance certificate.
   By participating in this research project, I will be contributing towards understanding Grade 12 learners' receptiveness to Siyavula Education Application in the context of learning of mathematics
3. I will participate in the project by answering survey questions
4. My participation is entirely voluntary and should I at any stage wish to withdraw from participating further, I may do so without any negative consequences.
5. I will not be compensated for participating in the research, but my out-of-pocket expenses will be reimbursed. (***Should there be compensation, provide details***)
6. There may be risks associated with my participation in the project. I am aware that
   a. the following risks are associated with my participation: no risk (***state full details of risks associated with the participation***)
   b. the following steps have been taken to prevent the risks: ……...
   c. there is a …0……% chance of the risk materializing
7. The researcher intends publishing the research results in the form of thesis. However, confidentiality and anonymity of records will be maintained and that my name and identity will not be revealed to anyone who has not been involved in the conduct of the research.
8. I will not receive feedback/will receive feedback in the form of …… regarding the results obtained during the study.
9. Any further questions that I might have concerning the research or my participation will be answered by Mr NS Xulu
10. By signing this informed consent declaration I am not waiving any legal claims, rights or remedies.
11. A copy of this informed consent declaration will be given to me, and the original will be kept on record.

I, ……..have read the above information / confirm that the above information has been explained to me in a language that I understand and I am aware of this document's contents. I have asked all questions that I wished to ask and these have been answered to my satisfaction. I fully understand what is expected of me during the research.
I have not been pressurised in any way and I voluntarily agree to participate in the above-mentioned project.

……. …….
Participant's signature **Date**

APPENDIX 10: PARENT AND GUARDIANS INFORMED CONSENT DECLARATION

PARENT AND GUARDIAN'S INFORMED CONSENT DECLARATION
(Parent or Guardian)

Project Title: Grade 12 learners' receptiveness to Siyavula Education Application in the context of learning of mathematics

Mr NS Xulu from the Department of Mathematics, Science and Technology Education, University of Zululand has requested my permission to allow my child/ ward to participate in the above-mentioned research project.

The nature and the purpose of the research project, and of this informed consent declaration have been explained to me in a language that I understand.
I am aware that:

1. The purpose of the research project is to understandGrade 12 learners' receptiveness to Siyavula Education Application in the context of learning of mathematics
2. The University of Zululand has given ethical clearance to this research project and I have seen/ may request to see the clearance certificate.
3. By participating in this research project my child will be contributing towards Grade 12 learners' receptiveness to Siyavula Education Application in the context of learning of mathematics
4. My child will participate in the project by being involved in a **survey**
5. My child's participation is entirely voluntary and if my child/ward is older than seven (7) years, s/he must also agree to participate.
6. Should I or my child at any stage wish to withdraw my child from participating further, we may do so without any negative consequences.
7. My child may be asked to withdraw from the research before it has finished if the researcher or any other appropriate person feels it is in my child's best interests, or if my child does not follow instructions.
8. Neither my child nor I will be compensated for participating in the research. (***Should there be compensation, provide details***)
9. There may be risks associated with my child's participation in the project. I am aware that
    a. the following risks are associated with participation: **no risk** (***state full details of risks associated with the participation***)
    b. the following steps have been taken to prevent the risks: ……...
    c. there is a …0% chance of the risk materializing
10. The researcher intends publishing the research results in the form of a**thesis**. However, confidentiality and anonymity of records will be maintained and that my or my child's name and identity will not be revealed to anyone who has not been involved in the conduct of the research.
11. I will not receive feedback/will receive feedback in the form of …… regarding the results obtained during the study.
12. Any further questions that I might have concerning the research or my participation will be answered by Ngobese, SM (***provide name and contact details***)
13. By signing this informed consent declaration, I am not waiving any legal claims, rights or remedies that I or my child/ward may have.
14. A copy of this informed consent declaration will be given to me, and the original will be kept on record.

I, ……..have read the above information / confirm that the above information has been explained to me in a language that I understand and I am aware of this document's contents. I have asked all questions that I wished to ask and these have been answered to my satisfaction. I fully understand what is expected of my child during the research. I have not been pressurised in any way to let my child take part. By signing below, I voluntarily agree that my child …… (**insert name of child**), who is …….. years old, may participate in the above-mentioned research project.

……. ……
Parent/Guardian's signature **Date**

PARENT AND GUARDIAN'S INFORMED CONSENT DECLARATION

(Parent or Guardian)

Isihlokosomsebenzi:Grade 12 learners' receptiveness to Siyavula Education Application in the context of learning of Mathematics.

Mr. NS Xulu from the Department ofMathematics, Science and Technology Education,University of Zululand

unesicelosokutholaimvumoyakhoukubauvumeleumntwanawakhoabeyinxenyeyokuzimbandakanyanesihlokoesingaphezulu.

Inhlosongqangiyocwaningokanyenokucelaimvumoichaziwekimingolimiengiluqondayo.

Ngiyaqondaukuthi:

1. Injongoyalolugcwaningoukuphenyamayelananentshisekeloyokusetshenziswakwe-Siyavula Education Application ngabafundibebangaleshumi (grade 12) ekufundeniisifundo se mathematics.
2. Inyuvesiyase Zululand inginikezileigunyalokwenzaucwaningonesigunyazisosiyokhonjiswakodingaukusibona.
3. Ngokubambaiqhazakulolucwaningoumntwanaizobeyelekelelaekutholeniulwazikubafundimayelananokusetshenziswakwe Siyavula Education Application.
4. Iwadinomaumntwanawamiuzobambaiqhazangokuthiavumeukubuzwaimibuzoemayelananocwaningoayiphendule.
5. Ukubambaiqhazakucwaningokomntwanakungokokuzinikelafuthikomeleabeneminyakaengaphezulu kwesi-18futhiazivumeleyenaukubambaiqhaza.
6. Uma umntwanaengasathandiukubambaiqhazaocwaningwenikuvumelekileukuthiahoxenomanininga phandlekwezinqinambaeziyobalandela.
7. Umntwanaangakhishwaocwaningwenilungakapheliyinomayimuphiumuntuogunyaziweumakutholakalaukuthiucwaningoalusahambelaninezidingozomntwananomaumaumntwanaengasayilandeliimiyaleloebekiwe.
8. Akekhooyohlonyuliswa/oyokhokhelwangokubambaiqhazakulolucwaningo.
9. Zingabakhonaizingqinambangokubambaiqhazakomntwanakulolucwaningo, ngazisiwengakho.
10. Lezizingqinambaziqondenenababambaiqhazakucwaningo:Ukuvezaimibonoephazamisaimizwa.
    a. Lemiyaleloelandelayoyenzelweukuqedalezizingqinamba: Umcwaningikumeleabenesikhathisokuchazelaozobambaiqhazalaphoezochazakabanzingendlelaazizwangayomayelananokucwaningwayo.
    b. Ngaloyondlelaamathubaezingqinambaangamaphesenti awu-0.
11. Umcwaningiuyokwazisaimiphumelayocwaningongokubhala ama articles kwi Journal. Kunesiqinisekisosokuthiabafundiababambeiqhazakulolucwaningoizimpendulozabozingavezwaukuthiziqhamukakubanikungabayinomangubaniobengeyonaingxenyeyocwaningo.
12. Ngiyakutholaizimpendulo/angiyutholaizimpendulozocwaningongendlelaeqoshiwemayelananengikutholeocwaningweni.
13. Imibuzoeningabanayomayelananocwaningoiyophendulwaumcwaningimayelannokubambaiqhazaocwaningweni: NS Xulu (0713457229)
14. Ngokusayindalemvumeyocwaningoangiwulahlangaumthethonamalungeloomntwanaobambeiqhazakucwaningo.
15. I-khophiyalemvumoiyonikezwa mina besekuthiumcwaningiuzoyigcinwaiphepjile.

Mina,

……..ngifundileyonkeimininingwane/ngiyavumaukuthingichazeliwengolimiengiluqondayongiyaqondakonkeokuqukethweyilencwadi.

Ngiyibuzileyonkeimibuzoebengifisaukuyibuzangatholaizimpenduloezingenelisayo.

Ngiyaqondangokuphelelekudingwaucwaningokumntwana.

Angiphoqelelwanga ukuthingidedeleumntwanaekubambeniiqhazaocwaningweni.

Ngokusayindangezansi,

Ngiyavumangokwamiukudedelaumntwanaekubambeniiqhazaocwaningweni……
…….. **(Faka igamalomntwana)**, ona ……. weminyaka, angabambaiqhazaocwaningweni.

……. …….

Umzali/Umbheki (ukusayinda) **Usuku**