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Digital Game-Based Learning(DGBL) as a pedagogical tool to Stimulate learning of Mathematics and English: A Case of Gauteng schools.

BY

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Submitted in partial fulfilment of the requirements of the Masters of Education by Coursework and Research Report, Med, at the University of Witwatersrand.

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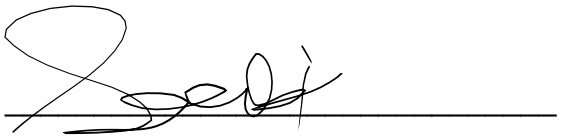
Date: September 2021

ACKNOLEDGEMENTS

This report has been a learning curve to a woman who grew up in a dusty village in Limpopo. The report has helped me to do self-introspection, and transform my career life in all aspects. A heartfelt gratitude is extended to the following individuals whom have helped, inspired and motivated me to complete this dissertation report. These individuals were a source of my stimulation. Firstly, I would like to thank God for giving me the strength and guidance to complete this research report. Secondly, to my husband for the support; assisting and making my life manageable. Thirdly, to my children for their love and support as well as my brother for consistently believing in me and my abilities. Fourthly the Gauteng Department of Education (Research division) to give me permission to conduct research in selected Primary schools in their Department and financing my studies. Appreciation to the principals; teachers; learners of Tshepisa Primary school and Tlamatlama Primary School in Tembisa. They tirelessly sacrificed their time to assist me in collecting data; completing questionnaires, attending my meetings and interviews after school. The parents of the selected learners for giving a consent for their children to participate in this research without getting any form of reward. To the University of Witwatersrand for admission, resources as well the continuous support given to me throughout the years by different lectures and tutors. The University IT Department for installing SPSS on my laptop and ensuring continuous function of my devises. The library personnel for helping me select the right material for the research. Lastly; to a very influential academician, my supervisor Doctor Reuben Dlamini for the motivation, constructive criticism, valuable suggestions, consultations and on-going guidance.

DECLARATIONS

I declare that this research is presented to the University of Witwatersrand as partial requirement for my Master's degree and is my own original work and has not been submitted to any other institution. I further declare that all research documents used in this study has been acknowledged and supported by means of comprehensive list of references.



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30 September 2021

Abstract

Digital Games Based Learning (DGBL) builds upon the concepts of deriving the satisfaction and the stimulating potential of games in the educational context (Prensky, 2005). Thus, the design of educational games has to address optimising satisfaction as well as learning. DGBL have been reported in literature to offer enjoyment, entertainment and often associated with greater cognition efforts, offering collective e-learning discourses that are grounded on pedagogical comprehensive philosophies of dialogue.

It has been reported that most of South African schools; especially the previously disadvantaged schools; are experiencing performance barriers in the Language of Learning and Teaching (LoLT) English as well as in Mathematics. The state of learner's performance in the above mentioned subjects present a serious crisis which is characterised by underperformance. Learners are not able to solve mathematical problems, and find it difficult to read simple text and construct a meaning from such text.

The study was piloted in selected schools in Gauteng Province South Africa (SA). Mixed method research was used and combining qualitative and quantitative surveys. Data were collected in selected schools; teachers and learners in the field of English and Mathematics were sampled; interviews were conducted and questionnaire forms were completed.

Even though in-depth research has been done on DGBL in other countries, South Africa(SA) has not done enough. Research findings are teachers in SA school do not use games in teaching on a regular basis. Therefore, it is recommended that, research and continuous update on DGBL software; teachers support by DBE as well as SMT should be emphasized to ensure that DGBL materialised in a classroom environment.

This research is performed ethically and permission was obtained from the relevant institutions for the research to take place. Questionnaire has been completed anonymously and voluntarily, participants were also informed that their answers would be kept completely confidential. There will be no harm to the participants. The same processes were applied to the interview instrument.

To enable collaboration, technologically independent and for designing suitable computer based and computer mediated discourse; a constructivist approach has been used in this research. These computers based and computer mediated discourse includes digital-games designed, to enable affordances.

Key words: *Game-Based Learning; Pedagogy, Stimulation, Learning*

List of acronyms

ANAs	The Annual National-Standards
ARCS	Attention, Relevance, Confidence and Satisfaction
ATP	Annual Teaching Plan
CAS	Council for the Advancement of Standard
CAPS	Curriculum Assessment Policy Statement
DGBL	Digital-Game Based Learning
DBE	Department of basic Education
DoE	Department of Education
EM ABLE	English and Math ABLE
ECD	Evidence Centred Design
GBL	Game Based Learning
GOM	Games Object Model
ICT	Information Communication Technology
LoLT	Language of Learning and Teaching
NS	Natural Sciences

SA	South Africa
SACMEQ	Southern and Eastern African Consortium for Monitoring Educational Quality
SMT	School Management Team
SPSS	Statistical Package for the Social Sciences
TESOL	Teaching English to Speakers of Other Languages
TIMSS	Trend in International Mathematics and Science Study
3D	**T**hree-Dimensional
2D	Two-Dimensional

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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

The use of games, originates back to the 1960's, when Piaget indicated that games could not only assist children to dominate their world nonetheless to craft the world of their imaginative faculty (Piaget, 1964). Games cannot only be regarded as pure amusement, but as an influential instrument for knowledge attainment (Piaget, 1964). Vygotsky (1978) stated that, learners learn better when using games. The use of DGBL is changing the way in which education is loomed and the way learning occur. DGBL is being instituted to educational sets from pre-primary through to workplace settings. In this research investigations are made and reasons for the research are stipulated.

Teaching and learning have shifted from its traditional ways; that is the obsolete teacher centred models of classroom and textbook lessons around the globe (Mcdonald, 2017). Educators should therefore teach learners how to think and not what to think. This will enable learners to engage in learning and improve their learning skills. Instructional methods should be amended to an extend that learners acquire learning skills in the place of memorisation and or chorus singing (Snyder and Snyder, 2008).

Research demonstrates that SA learners are encountering performance barriers in subjects like Mathematics and LoLT (English).SACMEQ monitors grade six numeracy and literacy reports; brought evidence that there were no improvements in South African grade six literacy and numeracy over the seven-year period of study (DBE, 2017). In 2007 SA learners were ranked 10th of the 14 education systems for reading and 8th for Mathematics, behind much poorer countries such as Tanzania; Kenya and Swaziland. The study showed that 27 per cent of the South African grade six learners were illiterate since they could not read a short and simple text and extract meaning (DBE, 2017). PIRLS reports that the South African grade 4 learners; achieved well below average (Howie, 2011).

TIMSS showed that there were no improvements in grade 8 achievements for Mathematics and Sciences tests achieved between the year 1995 and 2002 (Mullis

& Arora, 2011). Following such poor results, it was therefore decided that International grade 8 test are too difficult for South African grade 8 learners, and therefore from 2011 the grade 9 wrote the grade 8 international test. TIMSS provided evidence that South African level of performance is still the lowest of all participating countries, with the average grade 9 learner performing two and three grade levels lower than the average grade 8 learner from middle income countries (Mullis & Arora, 2011). Even with numerous efforts to increase the pass rate in inter alia the DBE, the now defunct forerunner, Doe, the South African Mathematics Foundation, the Zenex Foundation and the Maths Centre, SciBono, South African learners are still underachieving in mathematics, (Howie, 2004; DoE, 2009; Meier, 2011; Nicolson, 2012) (*ibid*).

The idea that critical thinking skills is acquiring knowledge through experiential learning as the opposite of abstraction; paying attention. Psychologically; DGBL has several sensual stimulators such as visual, audio and psychomotor skills in enhancing critical thinking skills and creativity (Spires et al.,2019). This multitasking gamification process, is in tandem with the 21st century learner's need. (Snyder and Snyder, 2008) support the statements; by indicating that critical thinking skills is a learned skill that must be improved, trained, and repeatedly incorporated into the curriculum to engage learners. This research will cover many features that characterise GBL and benefits that accrue with their practice and implementation. The aim is to consider GBL in broad ways and recognise the affordances that may be accumulated by DGBL.

1.2 Problem Statement

As stated above the greatest number of South African schools; particularly those that were previously disadvantaged; are experiencing performance barriers in the Language of Learning and Teaching (LoLT) English as well as in Mathematics. The state of learners' performance in such critical subjects (Mathematics and English) is in crisis and characterised by underperformance. Learners are not able to solve mathematical problems, and they find it difficult to read simple text and construct a meaning from such text (Graven & Sibanda, 2018).

It is recorded that learners participates in a number of local and international test that reflects results of underperformance. These reports include the following:

The Annual National-Standards (ANAs) are tests of achievements for grade one to six and nine. The ANAs provides some standardised indication of learning at the primary grades allowing for early identification and remediation of learning deficits (Graven & Sibanda, 2018). The ANAs reports confirm that the South African learners are underperforming in Mathematics and Language (Spaull, 2013).

Spaull (2013) reported that South African schools performs worse in such subjects; as compared to other low-income African countries such as Zimbabwe and Zambia. Spaull (2013) further indicated that; “most of the South African learners cannot read, write and compute at grade appropriate levels, with large proportions being functionally illiterate and innumerate…” (p.3). With that said, Thaba-Nkadimene (2020) also argues that such learners are underprivileged and they usually continue to be innumerate and illiterate regardless of whether they progressed through the full education system of primary school.

From the observation, numerical content turns to be a challenge to learners. It is a struggle to do calculations due to lack of memory; failure to remember formulas and the methods of calculations. This could be attributed to lack of stimulation and disengagement. On the other hand, Bowie (2013) contends that if the learning context is presented in a way that is deep and connected to learners, they can come out with an understanding that is profound to enable learners to engage in the learning of mathematics and rather than to be *dis*-engaged (Hanson-Peterson, 2013).

Battista (2010), alluded that participation in the learning process is regarded as an important factor. Battista further said that there is a consistent relationship between engagement and encouraged learner competency and performance in mathematics. Andrew and others highlighted that knowledge and skills are always married to each other and there are no chances of divorcing each other (Andrew J, 2009, p. 21). Therefore, digital games may be used as a tool to stimulate and improve learning skills such as critical thinking skills.

1.3 Purpose of the Study

The dissertation report aims at identifying, describing as well as evaluating game-based learning as one of the critical tools to stimulate and engage learners into the learning process. The benefits as well as the impact of game-based learning as pedagogical tool to stimulate and engage learners in the learning process. The focus is on summarizing and synthesizing the ideas of many writers on managing and supporting learning through games. A comparative study between the traditional methods of teaching and teaching with games to stimulates learning has been evaluated. The dissertation further aims at eradicating high rate of dropouts in SA learning institutions as well as improving results especially in critical subjects such as Mathematics and English for global competence.

1.4 Significance of the Study

The importance of this study is to help educators develop a new mind-set towards DGBL as well as exploring the impact of DG towards teaching and learning. Further knowledge is added in the field of DGBL. The dissertation will empower the users of DG to identifying, describing as well as evaluating GBL as a critical tool to stimulate and engage learners in the learning process. Benefits such as the discrete skills obtained, such as fantasy elements, collaboration, interaction are emphasized to gain an in-depth knowledge of what GBL means for Educational community. The study will transform the learning and teaching platforms from traditional teaching to DGBL.

1.5 Objectives

Below are the general objectives, theoretical objectives as well as the empirical objectives set out for the study:

1.5.1 General Objectives

The objective is to determine the benefits and affordances gained from DGBL, assist in improving results in SA schools especially in previously disadvantaged groups, create some form of interest and stimulate learning of subjects such as Mathematics and English. DGBL have a potential of opening doors for SA learners to compete with the global world, as well as helping the SA education system in breaching gaps created in the past in the learning of English and Mathematics. The research can also be used to strengthen learning procedures in Mathematics and English.

1.5.2 Theoretical Objectives

- Carry out literature review on how DGBL can be used as pedagogical tool to stimulate learning of Mathematics and English in two selected Schools in Gauteng.
- Identify affordances that can be acquired from DGBL.
- Identify the attitude of teachers in teaching with games.

1.5.3 Empirical Objectives

Teachers observed; to determine the extent to which they use games in teaching and learning practices.

1.6 Research Questions

Emanating from the objectives, the research questions guiding the study are detailed below:

1.6.1 Main Research Question

1.6.1.1 To what extent are DGBL used as pedagogical tools to stimulate learning in selected schools?

1.6.2 Sub-Questions

1.6.2.1 What are teachers' attitudes towards the use of game-based learning in teaching Mathematics and English?

1.6.2.2 To what extent do teachers use game-based learning in their practice?

1.6.2.3 What are pedagogical affordances of game-based learning in and outside the classrooms?

1.7 Rationale of the Study

Despite numerous theories of benefits of DGBL; empirical research on the usefulness DGBL is narrow and considered to be mixed (Fox & Hanus, 2015). Insight into GBL learning is not sufficient and considered to be unclear; taking into consideration the following: what, when, how, why participants learn, and on which phase of learning outcomes does learning take place? In this study the researcher regards participants as teachers and learners. Research has shown that; the efficacy of GBL has been

appreciated and accepted over traditional methods in more developed countries such as United Kingdom, Singapore and Australia (Zapata-Rivers & Bauer, 2014).

Research findings by Zapata-Rivers and Bauer (2014) have noted that there are potential benefits that may be gained from incorporating game based into instructional applications and assessments. According to literature review; games can be characterised in the following broad six categories: fantasy, rules/goals, sensory stimuli, challenge, mystery and control. There is substantial research internationally on the use of GBL as a pedagogical tool (Mayer, 2005; Gee, 2008; Linek et al, 2009; Jones, 2013). However, limited research has been done in SA and in
SA schools (Amory, et al., 2011).

1.8 Research Methodology

The mixed method approach was used in this research. The mixed method approach is a combination of a qualitative and quantitative survey together (Johnson & Oonwuwuegbuzie, 2004). The qualitative research is useful for obtaining insight into situation and is both textual and verbal. While on the other side a quantitative method includes mathematical and statistical sampling that will be tested and validated (Muijs, 2011). This study advocates for a number of ways in which usage of different research methods can be complementary. Howe (1988) said that this method has been used for the facilitation of communication, promotion of collaborative environment and the provision of superior research. The aim was to mix and match design components that provides the best opportunities to answer the research question (Howe, 1988). Data was collected using instruments such questionnaires as well as interviews. Data has been processed and analysed using SPSS for quantitative research.

1.9 Definition of Terms

The following words are defined and explained to allow the study to take meaningful shape:

1.9.1 Digital Game-Based Learning: can refer to the usage of computer-based games or any other form of games that can be played digitally to back or enhance learning within a classroom environment (Papadakis, 2018). (DGBL) builds upon the concepts of deriving satisfaction and stimulating potential of games in the educational context (Prensky, 2005). DGBL is an ideal instrument which utilizes games as a

medium for conveying the learning contents by, leveraging the power of computers to captivate and engage end-users for specific purposes such as develop new knowledge and skill (Zin, et al, 2009).

1.9.2 A game: is defined as a deliberate, amusing activity; in which the player chases a challenging goal based on game rules (Kinzie and Joseph, 2008). It is a rule-bound system which consists of imaginary and creative experiences for the participant or player to do some kind of problem-solving activities and learning (Skykes and Reinhardt, 2013).

DGBL is an ideal instrument which utilises games as a medium for conveying the learning contents by, leveraging the power of computers to captivate and engage end-users for specific purposes such as develop new knowledge and skill (Zin. et al, 2009). A game is defined as a deliberate, amusing activity; in which the player chases a challenging goal based on game rules (Kinzie & Joseph, 2008). It is rule-bound system which consists of imaginary and creative experience for the participant/player to do some kind of problem solving activities and learning (Skykes & Reinhardt, 2013).

1.9.3 Affordances: Conole and Dyke (2004, p. 115) refers to affordances as “the perceived and actual properties of a thing, primarily those functional properties that determine just how a thing could possibly be used”.

1.9.4 Learner: A learner refers to an individual that learns how to do something or about a particular subject (Collins Dictionary, 2021).

1.9.5 Teacher: one that instructs or teaches others about a particular subject. It can also refer to an individual whose occupation is to teach (Merriam-Webster, 2021).

1.10 Conceptual Framework

Figure 1; highlights the conceptual framework the researcher adopted for this study in light with the literature review and research questions. To scale the effects of Game Based Learning, a framework has been adopted to create a dialectic between pedagogical magnitudes and game components. This conceptual framework can be used not only to support the development of educational computer games but to provide a mechanism that evaluates the use of computer games in a classroom.

Amory (2007) mentioned that educational games should present relevant, explorative, emotive, and engaging environments where solutions to complex challenges are resolved. The framework designed is influenced by digital game elements, pedagogical value, affordances and learning outcomes.

1.10.1 Overview of the Framework

The difficulties in designing or coming up with the relevant tools to observe the extent to which DGBL is utilised as a tool in a classroom; this led the writer to come up with the framework that embraces it and is a progression and amalgamation of the two models that Bulander (2010) quotes by Garries, et al, (2002) and Keller (1983). Bulander (2010) further states that although Garries, et al, (2002) gives a description on the complete gaming process; the ARCS model according to Keller (1983) reflects on the stimulation of the learner to play games and retain on learning; while playing. The framework includes the digital game elements; the pedagogical value of digital games, affordances as well as learning outcomes (Bulander, 2010).

There are various objectives as well as goals that are subjective to the learning process. To measure the extent and interpret the learning effects, it is imperative to consider the game elements; type of players as well as the type of games. The ARCS model consists of four features for supporting and sustaining stimulus in the learning process and it includes attention, relevance, confidence as well as satisfaction. Learning outcomes are the abilities learners acquire after engaging in games. Learning outcomes can be coupled with game affordances in playing. The games and can be adjusted and focused around goals attainment feedback.

Benefits of using games by learners are highlighted, GBL attributes are emphasized and outcomes that are gained from using DG in learning are elaborated. Learners are being tested in the process of playing games, without realising that they are tested. Affordances obtained and achieved in DGBL are realised. These conceptual framework considers the interaction between learners and their world outside the classroom into consideration. It focuses more on the establishment of a motivating environments through DGBL.

Figure 1 below summaries the framework of GBL and the manner in which it covers all parts of leaning engagement:

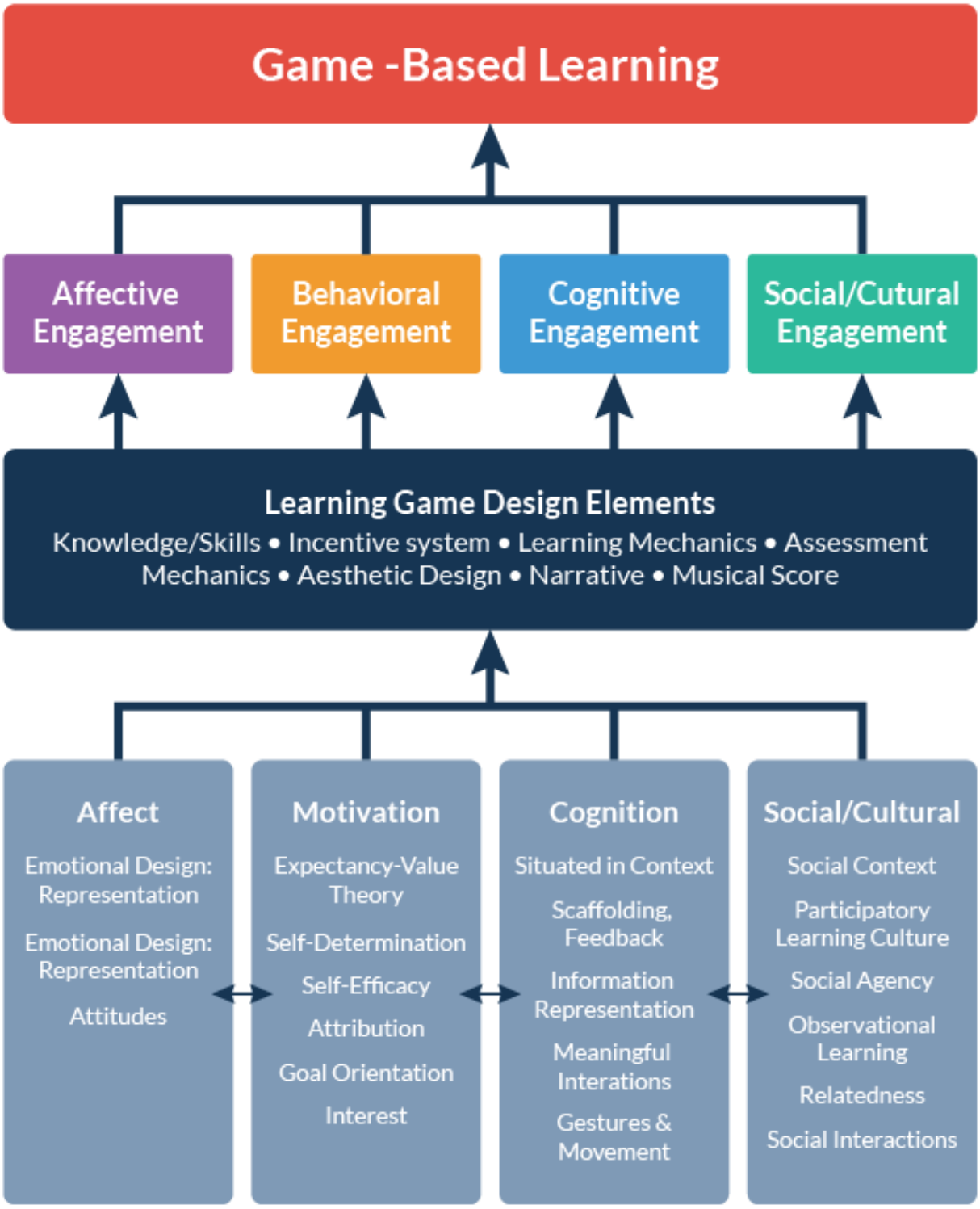

Figure 1 Conceptual Framework (Juraschka,2019)

1.11 Organisation of the Study

The study is written and structured into five different chapters and each chapter is detailed below:

1.11.1 Chapter One

Chapter one is an introductory chapter that provides a background into GBL. The chapter highlights the problem statement, critical research questions, sub questions as well as the rationale of the study. Objectives, purpose of the study and an overview are also included, with a brief description of the research design and methodology being presented.

1.11.2 Chapter Two

Following an overview presented in Chapter 1, Chapter 2 uncovers the study within the current thesis of GBL. The chapter begins with the debate around GBL, that includes the origin of games and their importance as well as the influence of GBL to pedagogical practices. The types of games and their functions.

1.11.3 Chapter Three

This chapter presents and details the research design and the methodology used; outlines the data collection tools used; research design, discussion approach and paradigm basing the study. The chapter include the selected school, participant, research settings and why I choose to use the method of research chose.

1.11.4 Chapter Four

This chapter outlines the analysis of data and presentations of research findings. Generation of data was through observations, interviews and structured questionnaires and psychometric test.

1.11.5 Chapter Five

Research questions are discussed and an attempt to answer the questions is made through collected data and literature review. Data presented in chapter Four as well as the Literature review presented in chapter Two is synthesised and analysed with the aim of answering the research questions.

1.11.6 Chapter Six

This chapter consist of conclusion and practical recommendations made. The chapter presents the knowledge contributions of the study based on the empirical evidence presented in chapter 4. I also present practical recommendations towards the use f DGBL in teaching and learning.

CHAPTER 2

LITERATURE REVIEW

2.1 Chapter overview

This chapter presents an overview of the key literature relevant to DGBL. The chapter critical analyse; evaluates and synthesis the research theories as well as practices with reference to other writers in the field of DGBL. The focus will be on summarising and synthesising the ideas of many writers on managing and supporting learning through games. The chapter further identify, describe as well as evaluating GBL as one of the critical tools to stimulate and engage learners into the learning process. The chapter begins with the origin of GBL, followed by the types of games. This lead to the affordances gained in using the types of games and shows the results of these affordances. The chapter ends on giving us a picture on how DGBL stimulate learning.

2.2 Introduction

The use of games, GBL and game components started way back. In recent years' digital games have received attention as tools that engage learners, provide active learning experience as well as effective learning. Piaget (1964) alluded that games cannot only assist children to dominate their world, but to craft the world of their imaginative faculties. Not only do games provide pure amusement, but are regarded as influential instruments for knowledge attainment (Arnab, et al., 2015) . The use of GBL is changing the way in which education is viewed and the way education happens. GBL is being incorporated into educational settings by some of the teachers while some finds it difficult to incorporate games in teaching. Beginning with pre-primary through to workplace settings.

Shin (2015) states that educational games have been used to teach a wide variety of fields, such as business, military and policy analysis. Although much is learned about games and learning in general, little is known about what elements of these games influence learning. TESOL standards for P-12 teachers programmes, English teachers are expected to select the right tools for teaching using technology and utilise the tools, to enhance learning (Shin, 2015). Insight into learning process using games is limited, and it is still unclear why, what, how, when participants learn from which phase in the

games or learning outcomes of the game. Although the efficacy of GBL has been popularised over traditional methods, and many have noted the potential benefits that may be gained by incorporating game characteristics into instructional applications. There is clearly little consensus regarding how these essential characteristics are described. The literature review states that games can be itemised in the following six broad categories: fantasy, rules/goals, sensory stimuli, challenge, mystery and control.

GBL involves digital-entertainment; where students engage in games with defined curriculum outcomes (Casañ-Pitarch, 2018). It equilibrates subject matter with gameplay. The benefits of GBL amongst others include; the increase in student ability to store and recall information, they increase motivation, engagement, confidence as well as self-esteem (Casañ-Pitarch, 2018). On the other hand, it reduces academic related anxiety and helps learners apply learning in different contexts. For example, in subjects like English, students might do a role-play to enhance understanding.

2.3 Types of Games

Games are designed for several purposes, and over the years the purpose of games has shifted for merely entertainment, but also to educate. There are games that are designed to assist learners in the learning process. For examples quizzes, social mind games, mobile games and group quiz. Researchers have found different categories to classify Games (Cheng, et al., 2015). Types of games are discussed below:

Types of games and discussion.

2.3.1 Digital Games/Video Games or Computer Games

DG are including a communication technology within multimedia learning environment that could foster learning processes effectively and interestingly especially among young learners (Zin, et al., 2009). While intended for fun, video games also include the elements such as skills improvement; blended learning is practicable; remove the Mathematics anxiety that learners always have on the subject; as well learner engagement (Cheng.etal.,2015). Video games are demonstrated as 2D and 3D images and are manipulated by single players and multiple players (Cheng, Chen,

Chu, & Chen, 2015). Meaning that learners can learn playing this games alone and or play with their friends online or offline while learning.

There is a distinctive balance received from these types of games. This games assisted/assist teachers immerse learners in educational content like never before. As technology has evolved, these classes of games has become more crucial in and outside the classroom.

Figure 2 below demonstrate the examples of video games that can be found among others:

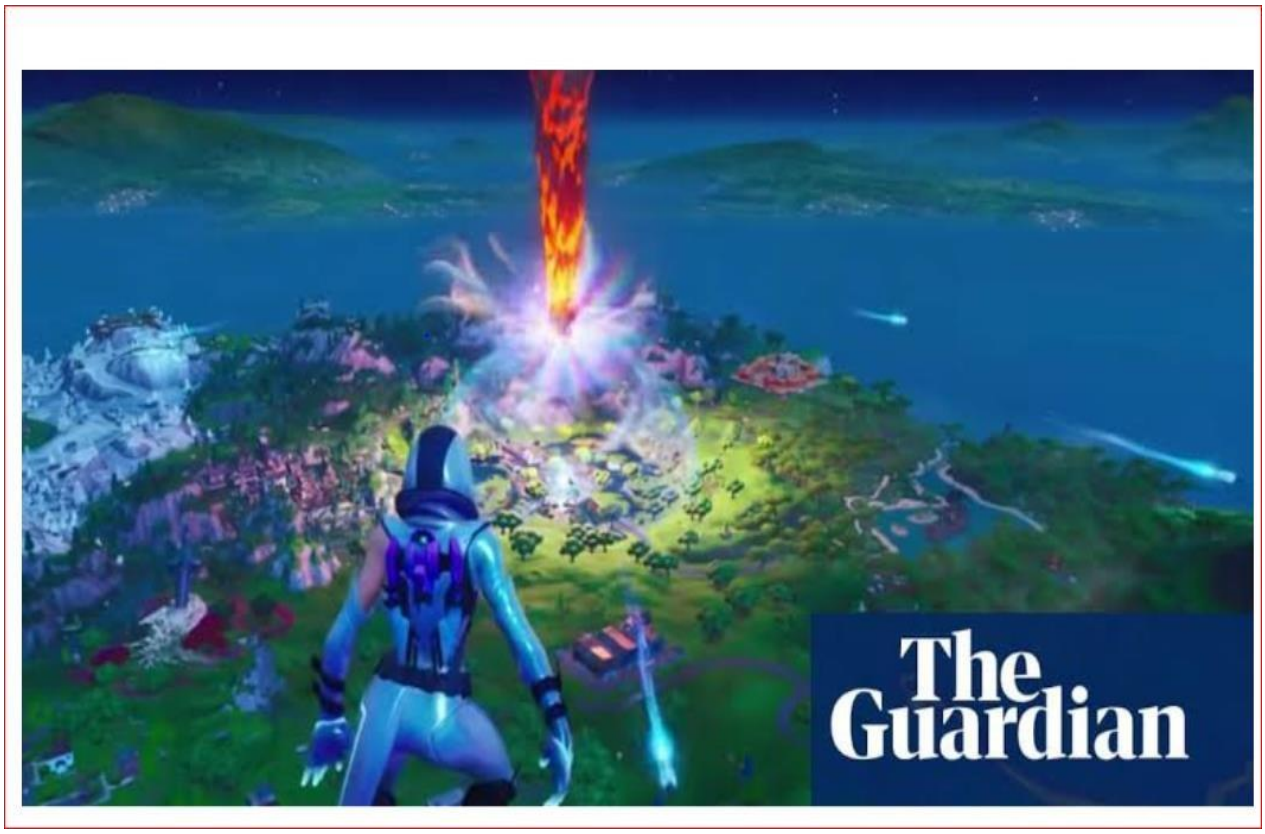

Figure 2 Example of Video Games (Sugg,2017)

2.3.2 Serious Games

Serious games are designed to assist learners practice specific skills or content. Serious games create a virtually dipped context wherein learners are permitted to practice subjects and echo experimentations that are unusual realised in their daily experiences (Cheng, Chen, Chu, & Chen, 2015). I view serious games to be important because, this type of games assist learners in educational context. These types of

games are mostly aiming to educate more than entertaining, although learners enjoy this process of learning.

2.3.3 Extrinsic Mind Game

Grants challenges including reasoning of some sort. The fantasy of the game does not affect the reasoning challenge. Examples of this types of games is Minesweepers, Mastermind and Cuboid (Wang, Mørch-Storstein, & Kristian, 2009). To me this means that the games have the ability to help learners improve their problem solving skills and their creative thinking level.

2.3.4 Corporative Problem Solving

Mind games where parameters affect the games of other users without fantasy of the game affecting the challenge at hand (Wang,2009).

Figure 3 below demonstrates the types of games that exist among others:

Figure 3 Types of Games (Juraschka,2019)

2.3.5 Drill and Practice Games

Drill and practice players modify actions until their score is improved (Killi.2005). Behaviour is only based on trial-and-error type of games. Looking at this types of games the learners answer questions from another possibility, visual recognition or textual input. For example, internal force master, quiz games. There is a strong interaction amongst the players, inside as well as outside the game. To me this type of gaming will allow learners to practice

2.3.6 Meaningful and Engaging Educational Games

Meaning and engaging educational games are defined by Chiu, Kao and Reynolds (2012) as games that offers opportunities for players to explore phenomena; test hypothesis and construct objects. Such educational games lead to direct experience with the game world (Chiu, Kao & Reynolds, 2012). This games will assist learners to construct knowledge and to master their own world.

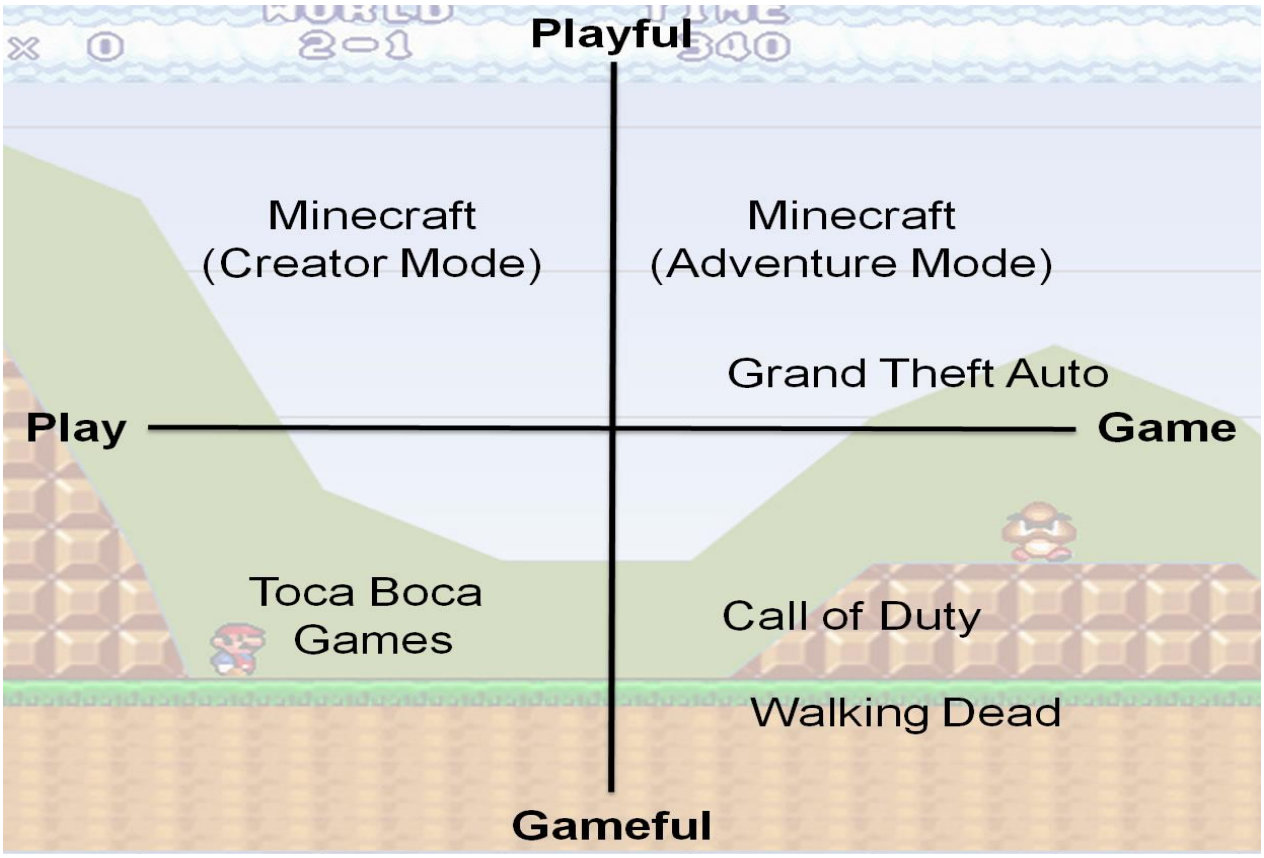

Figure 4 Example of Games (Markzewski,2015)

2.3.7 Mathematical Computer Games

Mathematical computer games are designed to facilitate the realisation of mathematics education in grade 1 and 2 of primary school, with the emphasis on learning basic mathematics. Research was conducted in Chile; and three groups were sampled; (experimental, control and external group). The experimental group played computer games for 30 hours; and the results of the experiential were higher than the results of the group (Statista Research Department in Chile,2018). The group's mathematical skill and the motivation was compared to other groups and it came on top. A further study was conducted on higher grades.

An example of a Mathematical computer game image:

In this game learners race through levels shooting and dodging fast-flying obstacles to reach an Alien Boss, they use math skills to battle and unlock new tools as they go.

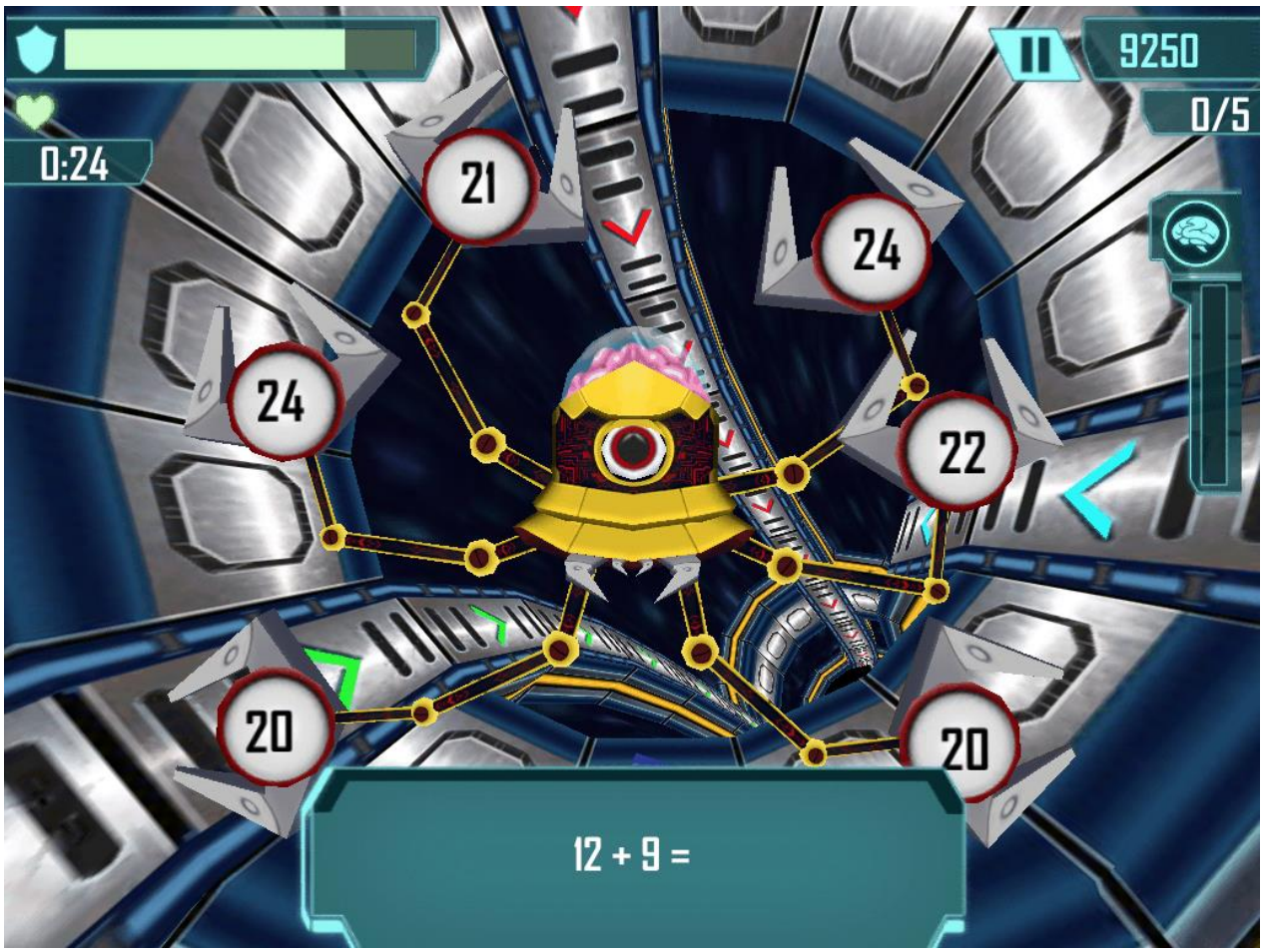

Figure 5 Example of Mathematical Games (Ryerse,2017)

2.4 The Taxonomy of Games Affordances

Within this study the concept of affordances has been used to give a descriptive language in the interpretation of real and perceptive use of DGBL. The taxonomy is useful for this study as a means of capturing teacher's perception towards the use of DGBL. (Luarillard, et al.,2000) views affordances as the characteristics of the learning process. Luarillard further consider them to be the internal relation between the perceiver and the perceived. While Salomon (1993, p.51), on the other describes affordances "as the observed and the actual properties of a thing, mainly those functional properties that determine just how the thing could possibly be used." There are over ten affordances in the taxonomy created by (Conole & Dyke, 2004, p. 115). These affordances include among others, accessibility, diversity, communication & collaboration etc. They are explained below:

2.4.1 Accessibility

The range of ICT present comparatively comfortable access to vast amounts of data through a variety of distinguished mechanisms (Conole & Dyke, 2004). It is further said that online access is possible through gateways, portals, applications and websites (Conole & Dyke, 2004). There is various platform on Android, Apple and other application software where digital games can be downloaded and uploaded on devices. Once uploaded, the game can be played anytime, anywhere and that makes it easier for learners to play games without using internet access as that might be costly to some extent to some learners; particularly for those in areas that are not well resourced. Learners acquire unrestricted access to learning materials on DGBL platforms such as MGbl (Zhao, Zhou, & Ding, 2021).

2.4.2 Diversity

Digital games give access to a vast range of diverse and different experiences that can inform learning, such as overseas websites, access to subject experts, or use of stimulations to replicate complex behaviour (Conole & Dyke, 2004). Exposure to the experiences of others is a key ingredient to effective learning and a potential affordance of ICT. Bound (1993) argued that learning is a holistic activity that needs to connect with people. Games are viewed to have an impact on social relationships on learners, and it is seen to have an impact on learning because it is easy to see

when one wins in a game by the number f badges that they may have. Therefore, games encourage learning in a social context.

2.4.3 Communication and Collaboration

Digital games provide the potential for learning and enhance participation with others. New technologies have opened up the possibility of new forms of dialogue and communication (Conole & Dyke, 2004). Games can be played online and learners may be able to communicate via digital games and they may be able to play games on online platform; for example, games like fourtnite. Collaborative learning provides strong pedagogical potential and support learners through interaction (Krouska, et al., 2021)

2.4.4 Multimodal and Non-Linear

The non-linearity of the web is espoused by hypertext and the use of search machines which is believed to foster distinguished routes and forms of learning.

2.4.5 Feedback and Rewards

In a traditional classroom setting; feedback is delivered to learners; however, the feedback process is frequently prolonged and not easy for learners to get feedback immediately (Fox & Hanus, 2015). In DGBL feedback is instant and learners are constantly repeating the same process over and over again; and that allows them to practice and learning (Zin et al., 2009). Games are regarded to be typical in giving participants permission to restart or play repeatedly, allow them make mistakes and correct them and that is viewed as learning (Fox & Hanus, 2015). He further views games as a tool that continue to give learners the freedom to experience without anxiety and increase their ability to engage without fear. Zin, et.al, (2007) said that rewards and awards are ways to motivate learners to continue playing.

2.4.6 Immediacy

The speed at which information can be transferred in GBL. With games learners get feedback immediately and they are therefore encouraged to do more and try again. That allows competency, that results into courage as well as continuous practice; that might not be available in traditional learning.

2.4.7 Multimedia Technology

Multimedia effects with 2D or 3D animations; immersive graphical environment and imitative sound are important to attract learners to involve themselves in every game play.

2.4.8 Challenge and Competition

(Zin, et al, 2009) highlighted that every learner has unique strength for every game play. Challenge of one game play should match learner's skill level without being boring and not to let them give up easily (Zin, et al, 2009).

2.5 Games as Pedagogical Tools to Stimulate Learning

It is primarily argued that one of the key benefits of introducing games in the classroom is that it stimulates learning (Haug, et al, 2011). This statement is supported by Papadakis (2018) who points out that, games that are digital have the potential of being learning tools, stimuli as well as creators of interest, as part of the educational use of ICT. It is further stated that this can lead to an operative resource of enhancing the performance and overall learning experience of learners in day-to-day educational exercise (Papadakis, 2018). Alsultan (2021) revealed that teacher's roles differ based on the adapted pedagogical role of video games. Alsuntan further alluded that teachers' pedagogical roles and activities became evident in various DGBL processes: planning, realization, and assessment (Alsultan, 2021). DG are proven to bring up greater improvement as compared with other inventions, such as script based approaches and lectures in the medical field (Zhao, Zhou, & Ding, 2021). (Zhao, et al., 2021) further stated that when DG are compared to other controls, it was found to be effective in knowledge retention and demonstrated consistency in the positively affecting learning.

2.5.1 Theoretical Framework

The theory that seems to best fit this study is GOM, because this model supports concepts that are applicable, explorative, affecting, engaging, and include multifaceted experiments, support authentic learning activities that are designed as narrative in social spaces. Where learners are transformed through examination of several illustrations, and reflection, be gender inclusive, include non-confrontational outcomes, and provide suitable role models; develop democracy, and social capital through dialogue that is supported by means of computer mediated-communication tools; and

include challenges, puzzels, which form the core of the learning process, where access to explicit knowledge, conversation, reflection results in the construction of tacit knowledge (Amory, Molomo, & Blignuat, 2011).

Game Objects Model Version II which is further explained below:

2.5.1.1 *Games Objects Model Version II*

Game Object Model delivers a hypothetical basis for the design of instructional games (Van-Staalduinen & de-Freitas, 2011). According to Van-Staalduinen and de-Freitas (2011) GOM create a dialectic between pedagogical magnitudes and game components. Amory (2007) stated that GOM version II can be used not only to support the development of educational computer games but to provide a mechanism to (Krouska, et al., 2021) (Krouska, et al., 2021) evaluate the use of computer games in a classroom. Amory (2007) further mentioned that the core concept of the model is that educational games should present relevant, explorative, emotive, and engaging environments where solutions to complex challenges are difficult, requiring multifarious dialogues.

GOM consists of various complex interrelated objects used to describe educational games that could be simplified into the three major spaces; challenges, narrative and conversation (Van-Staalduinen & de-Freitas, 2011). Van-Staalduinen and de-Freitas (2011) continue to state that the GOM consists of components (represented by rounded square frames) that promotes educational objectives (abstract interface) as well as those that allow for the realisation of such objectives (concrete interfaces) contained within different spaces (Van-Staalduinen & de-Freitas, 2011). Reasons for adopting this Model are:

The model always supports educational concepts, such as relevance, explorative, emotive, engaging, and includes complex challenges, support authentic learning activities that are designed as narrative social spaces where learners are transformed through exploration of multiple representation and reflection. GOM include non-confrontational outcomes and provide appropriate role models.

Figure 6 presents the GOM Model:

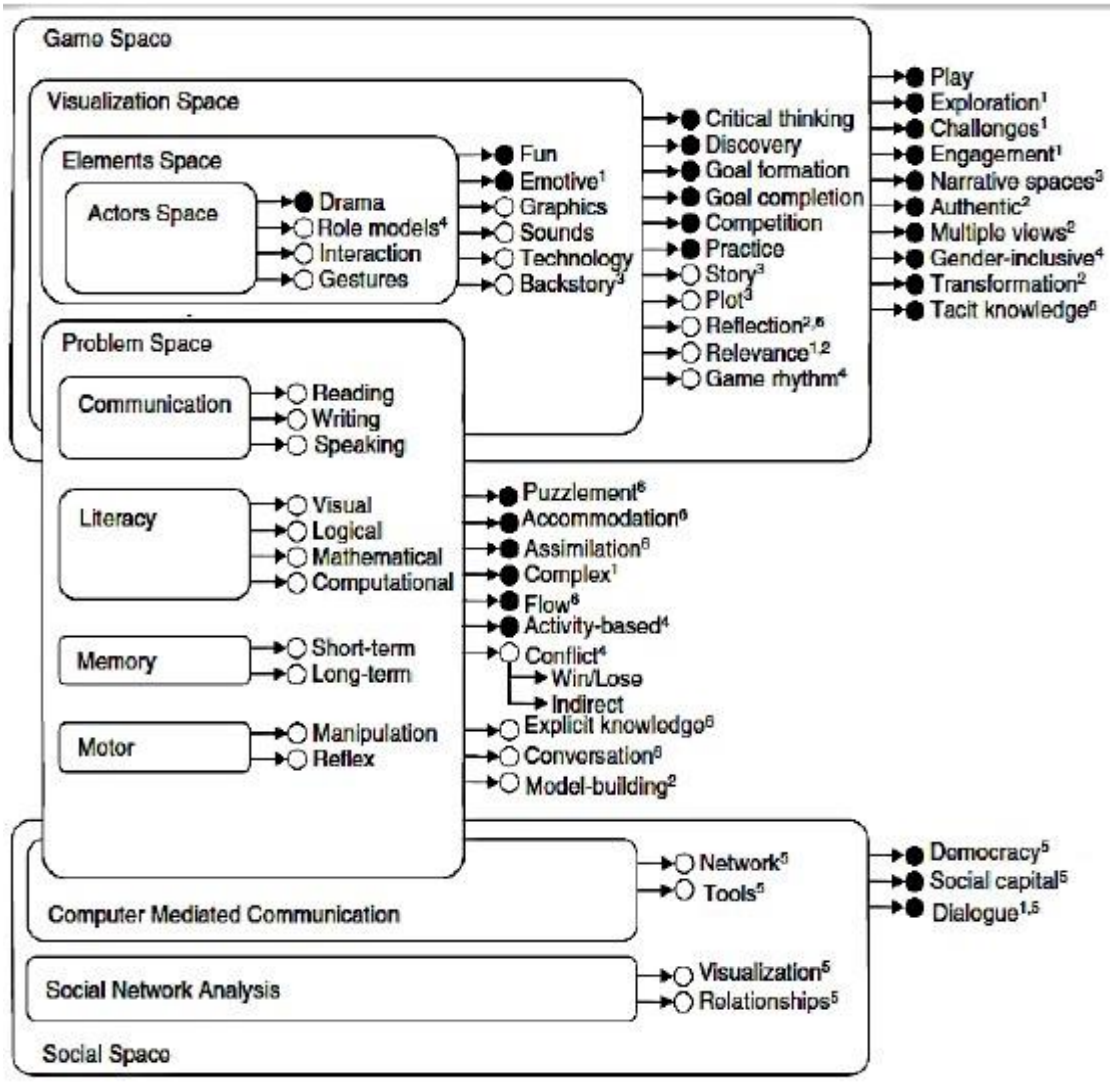

Figure 6 Amory and Seagram' s Game Object Model Version 2 (GOM) Source: Van-Staalduinen and de-Freitas (2011)

2.5.1.2 *Clear Player Goals*

Van-Staalduinen and de-Freitas (2011) mentioned that goals in a game cannot be compared to the learning objectives and therefore this goal should be mentioned separately. Win criteria for a game does not necessarily connect with things players are supposed to learn through playing the game.

2.5.1.3 *Learning Content*

Successful pairing of instructional content with appropriate game features results in recurring and self-motivated gameplay. This continual process eventually leads to specific learning outcomes often reinforced by debriefing and blended approach (VanStaalduinen & de-Freitas, 2011).

2.5.2 Game-Based Learning Fosters Problem-Solving Skills and Critical Thinking Skills

Generally, claims concerning the impact of DG in classroom settings can be categories into two classes, that is cognitive outcomes and motivational outcomes (Huizenga, ten, Akkerman, J.M, & Admiraal, 2017). Critical thinking is more important in this era. Learners are to be taught on how to think and not what to think. Anderson (2008) defines critical thinking as a process of evaluating knowledge. It is further claimed that, it is a process of critically interpreting, analysing and evaluating evidence. The evaluation of the quality and relevance of knowledge to make appropriate conclusions. Critical thinking is also called critical evaluation or high performance thinking (Anderson, 2008). It is further defined as the ability to evaluate and find information (Shin, 2015).

Piaget (1970) described critical thinking as the last stage of hypothesising, at this stage a child reaches a level of what is called formal or hypothetic deductive operation. That is; the learner can reason or hypothesise; not only about objects but abstractive reasoning. Piaget said that at this stage; the learner constructs new operations. The learners are said to have reached the highest stage of propositional logic and not only the operations of classes, relations and numbers (Piaget, 1970).

Peter (2012) postulated that critical thinking skills are important because they give learners the ability to deal effectively with social, scientific and practical problems. Simply put learners who think critically are able to solve problems effectively. It is further stated by Cottrell (2017) that critical thinking skills help learners to have the cognitive skills of interpretation, analysis, evaluation, inferences, explanation and self-regulation.

Snyder and Snyder (2008) supposed that critical thinking skills are learned skills that require instruction and practice. Peter (2012) mentioned that instructors at both the primary, secondary and post-secondary levels can enhance student's critical thinking skills. It is further mentioned that in the process of enhancing critical thinking skills they can use strategies that actively engage students in learning processes; rather than relying on the lecture or routine memorisation. Focusing instruction on the processes of learning rather than solely on content, memory recall. Snyder and Snyder (2008) further emphasised that there are several barriers that can impede critical thinking

skills instructions; such as: lack of training; biased preconceptions and time constrains. Critical thinking skills are further defined as metacognition or the thinking about thinking as defined and originally proposed by Flavell (1979).

An indication that video games are new technological tools with which we can externalise some of their functions. He gave an example of videos such as action-and goal-directed stimulus of embodied cognition like half-life 2, rise of the nation and more (Gee, 2008). He further highlighted that in various video games "players inhabit the goals of virtual character in a virtual world" (Gee, 2008). Examples of such games are "fourtnite online playing". In these video games, the real-world player gains a surrogate are your goals. Paul Gee said that virtual characters have virtual minds and virtual bodies.

They become the player's surrogate mind and body. Paul elaborates by giving an example that situated cognitions are said to believe that experience is stored in the mind. Games such as Half-life involve a visual and auditory world in which the player manipulates a virtual character. Such games often come with editors or other sorts of software with which the players can make changes to the game world or even build a new world . The players can build a new landscape, a new set of buildings or new characters. They can build new world by edifying the existing world (Gee, 2008). He further shows that positivism point of view, is that games stimulate critical thinking skills, while "games can be used as a tool to increase comprehension and retention of information". DGBL stimulate active learning and engagement by supplying learners with the potentials to place problem solving skills within the setting of the play (Vankúš, 2021).

Faiola, Newlon, Pfaff and Smyslova (2013) said that game-based learning has a positive impact on learning because it encourages critical thinking skills. This level of motivation is only maintained, when there is a thrill of discovering and new knowledge and adventures that are laden with surmountable challenges creating a balance between skills and difficulty.

Recent studies show that skills such as problem solving skills, critical thinking skills, collaboration skills, communication, creativity, which are developing by learners while playing games are essential for the 21st century education (Kaimara et al., 2020).

Moreover, playing brain training games that are focused on specific executive function skill can have a strong and a consistent effect in improving this skill (Kaimara et al, 2019). Therefore, DG have the ability to foster problem-solving skill as well as critical thinking skills (Kaimara, 2021).

2.5.3 Game-Based to Foster Sustainability Learning

When designing a pedagogical strategy, it is very crucial to look into strategies that are sustainable for teachers as well as learners. In my view DG can be used as a tool to foster sustainability in learning. UNESCO (2005) denoted that sustainability learning entails engaging learners in challenging environments; connected with important sustainability standards and ideas, showing them difficult traits engendering the physiognomies of the sustainable mind-set and stimulating learning as an adaptive response to complex dynamic settings. Davis and Sumara (2006) identified specific conditions connoting this type of learning:

1. *Peer interaction*; demonstrating the interchange between learners and collective learning
2. *Shared understandings and language;* permitting engaging peer collaboration
3. *Heterogeneous of perspective;* advancing diverse responses to contextual change
4. *Decentralised control;* promoting discrete and collective decision making and collaboration.
5. *Enabling constrains;* operational as rules allowing coherence through minimal restrictions
6. *Randomness and disruptions*; engendering unexpected possibilities eliciting adaption

Salen and Zimmerman (2003) also Fabricatore (2007) mentioned that digital games learning are tools in which players engage in activities to fulfil overarching aims; such as interacting with each other. This may involve artefacts, founded on mechanics guided by game rules. Gameplay engagements are processes whose achievements yield accountable results relevant to progress in the game (Ke & Abras, 2013). They can be regarded as problem-solving activities, since they require players to generate enthusiasm and drive that sustains further learning.

Schell (2008) states that games are characterised by context; defined by interrelated conditions in which games occur. The milestones are achieved through integrating game aims, current information, settings, themes and storyline. The context permits participants to fully assimilates the meaning of gameplay activities (Gee 2007; Schell, 2008). This fosters continuity and sustainability, on the part of the learner to aspire to learn more and achieve better results.

2.5.4 Game Based Learning Makes Learning Enthusiastic While Playing Games

Learner engagement leads to enthusiastic learning. DG create a learning environment where learners feel that they own the lesson. The moment learners feel that way they end up researching on how to come-up with the best performance, and that results into enthusiastic learning.

Johnson et al. (2013), stated that “DG has pass through the territory of rebirth and has penetrated the worlds of business; output, and schooling, demonstrating to be a valuable drill and stimulation instrument” (p. 21). Philosophies and practices notwithstanding, studies have concluded that digital games stimulate theoretical, tactical, and technical learning rather than documented and repetition learning required by school curricula and standardized test-taking (Huizenga, Admiraal, & Dam, 2009).

The following are vital multidimensional traits which affect learning in multifaceted systems and can be found in games: “Emergence, Uncertainty, non- linearity; Dynamic Coupling”.

2.5.5 Games Excite Learner’s Curiosity; Progress Can Be Measured by Educators and Learners

DG can revolutionise learning systems in terms of making learning more exciting. Teaching become easy if learners are curious and there is a form of an interest in a subject. The education system can tie together learner’s energy and passion by using DG to transform the picture of education in this era. Shin (2015) describes games as a type of edutainment; that is characterised by motivation and has massive potential of conventional video games in educational context. (Wang, Mørch-Storstein, & Kristian, 2009, p. 3) views curiosity to be divided into two categories, that is “sensory curiosity (an alteration in patterns, sounds and other stimuli that attracts attention) and cognitive curiosity is people’s desires to bring completeness, consistency and

parsimony to their knowledge)". In a comparative study research analysis by Divjak and Tomic (2011) showed that learners' knowledge and understanding are enhanced when using computer games compared to teaching without any use of the games. An evaluation by Kebritcki and Hiruni (2010) (*ibid*) was made on the learner's prior knowledge of Mathematics and motivation. Results indicated that learners were highly motivated to learn with computer games as compared to learning without using DG (Divjak & Tomic, 2011).

Research findings by Divjak and Tomic (2011) on the Impact of GBL on the achievement of Learning Goals and Motivation for Learning Mathematics show that five-year-old learners; learned Mathematics proficiently and faster by playing computer games.

Figure 7, illustrates the learning process and the learning outcomes of GBL:

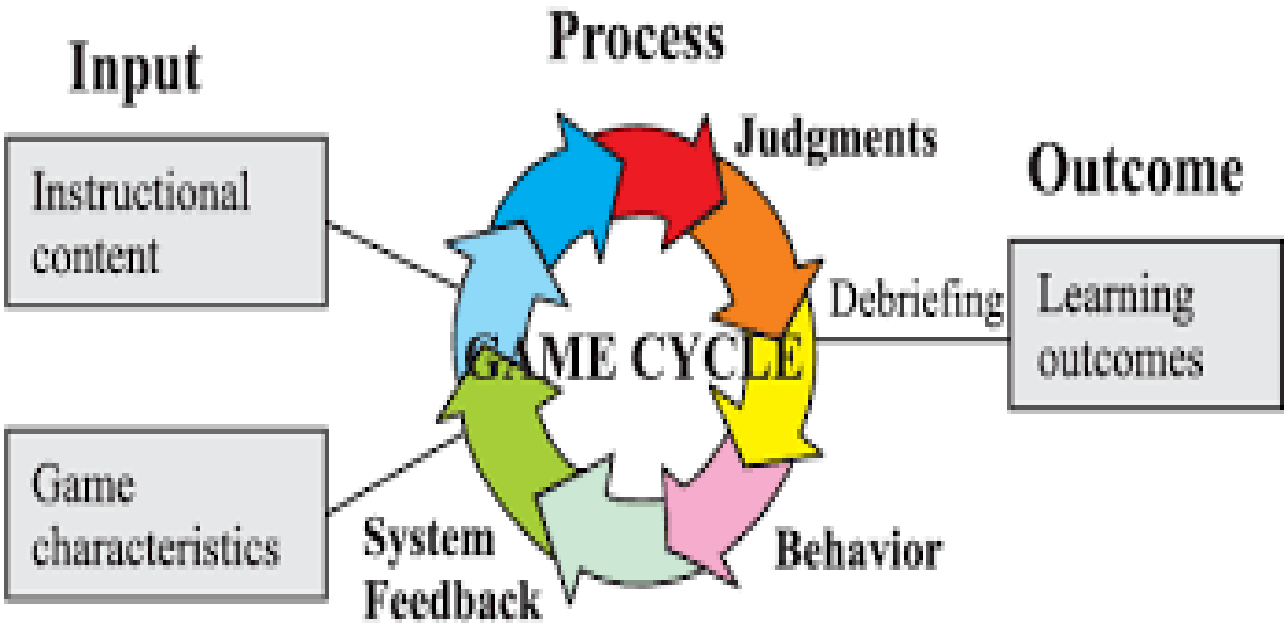

Figure 7 Learning Process and Outcome Source: Divak and Tomic (2011)

On account of the above research findings Divjak and Tomic (2011), recommended that if computer games are intended for accelerating and making learning Mathematics proficient, it was concluded that mathematical computer games should contain the following:

- *Subject Matter that Learners are Supposed to Learn*

The pedagogical implications of this refers to the focal topic. It addresses the what aspects, of what the learners are going to learn, and hands where to direct their energies.

- *Activities for Learning*

Pedagogically, this addresses the breakdown of the topic in sequential form that gives the learners a mind map of the content that has to be achieved or the task ahead. This is motivational, in a sense because the learners begin to realise purpose of the subject matter. That's answering to the why aspect in the pedagogical sense.

- *The Basic Learning Model*

The basic learning model gives an idea of how they are going to progress in a micro classroom context. It constitutes a simplified version of the Annual Teaching Plan (ATP). It represents a "conceptual framework". Presentation matters, in that learners are intellectually different. In order to cater for different forms of intelligences, educationist must vary presentation modalities to meet the needs of musical, auditory, kinaesthetic and virtual intelligences. To ensure that loose concentration or getting bored.

- *The Way and Concept of Presenting the Content*

Presentation matters, in that learners are intellectually different. In order to cater for different forms of intelligences, educationist must vary presentation modalities to meet the needs of musical, auditory, kinaesthetic and virtual intelligences. To ensure that loose concentration or getting bored.

- *Interface for the Manipulation with Words and Object*

Interaction for sustainability of learning, engendering communication and collaboration. For example, learners should be able to find for themselves dictionaries for keywords in Mathematics and English to eliminate learning barriers. Thus, implementing language across the Curriculum Policy.

- *Navigation Structure and Order of Activities*

Sequencing from simple to complex. The assessment technique should be in line with the Bloom's Taxonomy. For example; from questions demanding low order responses

like, listing, what, state to questions demanding middle order responses; describe, narrate up to high order questions such as analysing, comment, create.

- *Feedback Information and Reward System*

This is very motivational in that learners get badges for completing the game, and also, they can move to the next level after completing the proceeding tasks and that has an affordance of pushing learners to achieve milestones.

- *Fun Elements (graphic, sound, story, character, humour)* (Divjak & Tomic, 2011)

  Philosophically according to Piaget (1970) let the children be children before they become adults. Meaning that children develop in stages; from the operational stage, GBL must be fashioned in such a way that learners can enjoy, the same way they would do if they were not in a classroom. Learning becomes a habit because they are having fun.

2.5.6 Expose Learners to Multiple Styles of Learning Through, Imaginary Wording and Auditory

Gee (2008) indicated that “games encourage multimodal learning; and give teachers the ability to come up with various learning styles”. Meanwhile multimodal learning reinforces active-intuitive-visual, reflective-verbal, concrete experience, reflective observation, conceptualisation, and experimentation (Prensky, 2005). Zarabian (2019) mentioned that, there are four learning style dimensions, these are diverging, accommodators, assimilators and converges.

Karns (2006) cited Kolb (1984) who stated that Solomon and Fielder (2004) on the other hand; came up with hypotheses: active learners saw class discussion, case analysis, simulation games, life case projects, role play, case or business plan competition and homework as more effective than reflective learners. Reflective learners saw essay tests as less effective than active learners. The hypothesis that learners who are verbal would rate readings as more effective than would virtual learners was supported. Sensing learners saw a lecture as more effective than did intuitive learners. Video and simulation games were seen as more effective among specifics - oriented learners than generalisations – oriented learners.

Frontczak and Rievell (1991); observed that students can learn through multiple modalities, as well as in their more narrowly preferred learning styles. In this context, accommodative for learning styles may be sufficient. According to their research finding; the study reinforces, the importance of crafting learning activities for students to have more active attributes, given that students are predominantly active oriented learners and the more active, experiential learning activities were more seen as relatively more effective (Chang, 2021).

2.5.7 Intrinsic Motivation in Games

Van Eck (2006) said that, today's learners or the Net Generation or digital natives have a habit of disengaging. The motivational phenomena are often seen when the goals and rewards of learning are meaningful and when learning assist the learner in obtaining valued accomplishment (Brant, 1995; Chance, 1992). Jones (2013) alleged that play represents a significant opportunity to accomplish enhanced learning in the virtual world. Jones (2013) further noted that games have their own innate motivators. Vandercruysse, Vandewaetere and Clarebout (2012) said that games have the power to teach, train and educate, and they are an effective way of influencing learning skills and attitudes that are not possible to learn by routine memorisation.

In a research study conducted by (Gee, 2008), it was alluded that games are designed to generate a positive effect in player and are most successful and engaging, thus intrinsically motivational, when they facilitated the flow experience. A game can facilitate the flow experience if the challenge that the game offers up to par with the skills of the player (Gee, 2008). GBL has an extra encouraging factor as compared to traditional methods of learning and teaching (Kaimara, 2021).

Moreover, Prensky (2001) after creating more than fifty software games for learning, came-up with a theory of digital native. He postulated that learners learn differently; therefore, teachers are expected to change the way they do things, in terms of communication and content delivery (Prensky, 2001). Staalduinden and Freitas (2011) further argued that games are designed to generate a positive effect in learners and are more successful and engaging, thus intrinsic motivating, when they facilitate flow experience. Flow describes a state of complete absorption or engagement in an activity (Van-Staalduinen and de-Freitas, 2011).

It was concluded in (Zabala-Vargas, 2021), that educators who uses GB pedagogical strategies have high levels of motivation, registered in the dimensions of attention, relevance, confidence and motivation. Therefore, the use of DGBL leads to high levels of motivation.

2.5.8 Games Based Learning as a Tool to Explore Assessment

Games have the potential of improving how formative assessments are performed (Zapata-Rivers & Bauer, 2014). If games are designed appropriately, they can give learners the ability to engage in meaning tasks (Zapata & Bauer, 2014). They will yield vital data for learners and educators. Zapata and Bauer (2014) further state that GBL applies the concept of Evidence Centred Design (ECD). ECD is a methodology for assessment design that emphasises a logical and explicit representation of an evidence-based chain of reasoning from task to proficiencies (Zapata-Rivers & Bauer, 2014). ECD further helps with designing assessments that can respond to the following questions posed by Messick (1994):

1. *What complex of knowledge, skills, or other attributes should be assessed?*
2. *What behaviours or performance should reveal those constructs?*
3. *What tasks or situation should elicit those behaviours?*

ECD can help students to learn the content while at the same time help the system capture valid assessment information to adapt its behaviour. The gaming environment provides teachers and students with estimates of student performance on valued skills. One of the major goals of assessment-based gaming is to provide adaptive gaming scenarios that can be used to help students learn and provide valid assessment information to students and teachers (Shute, Ke & Wang, 2017). These gaming scenarios are composed of various interactive activities each scenario has an underlying storyline aimed at defining the behaviour to be observed and the interactive activities needed to elicit the behaviour. Below are two examples of assessment gaming environment:

English ABLE (Assessment Based Learning Environment) - In this environment the player helps the virtual students correct his writing while receiving feedback. The player can see how much the student knows by looking at the virtual students' knowledge levels. To make the game more compelling, virtual students are able to

express basic emotions, which are triggered by a list of predefined that taken into account recent student performance on particular tasks.

The second example is EM ABLE (English and Math ABLE) models both English and math competencies. This combines game elements such as immediate feedback, sound effects and progress indicators, points and power levels, pedagogical agents and various forms of scaffolding.

2.6 Conclusion

This chapter has reviewed literature on ideas and concepts pertaining to the use of DGBL as a pedagogical tool to stimulate learning. The researcher looked at literature provided a guide to research question posed, which lead to crafting of a conceptual framework of the study and subsequently led to the drafting of analytical tools.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Chapter Review

In this chapter I discuss the research design, area of study, population, sample of the population, sample technique, instrument for data collection, validation of questionnaire, administration of the instrument and method of data analysis.

3.2 Introduction

The research methodology of the study comprises of a multi-faceted approach made up of various techniques for purposes of answering the research questions. A mixed method research is well-defined as the assembly, study and incorporation of quantitative and qualitative data in a program of inquiry (Sweetman, Badiee & Creswell, 2010). Sweetman et al., (2010) views this method to be consisting of both open-ended as well as the closed-ended data. The method combines qualitative and quantitative research technique, theories, approaches, as well as language into a solo study. It is assisting to overcome battles that has always been there between the researchers by providing logical, as well as practical alternatives. It is seen as an expansive and creative form of research, not a limiting research practice, pluralistic and complementary, also considering all the appropriate characteristics of a qualitative and a quantitative research. Moodley (2002) postulated that these methods are deliberate, rational and aim to be value-neutral. He further postulated that this implies that good research methods must be cautiously created and purposely engaged in a way that is designed to capitalise on the precision, reliability and validity of the results. This chapter focuses on the design and methodology employed to conduct the study in order to answer the key research questions generated in Chapter One.

3.3 Research Setting

Research took place at two selected schools; the schools selected are full ICT schools or what we call '*pilot school'*; because they mostly have required resources. Classrooms using games for teaching and learning were visited. After a lesson; face to-face interviews were conducted with educators, while learners completed electronic questionnaires to provide their own personal feedback on the session. All teachers willingly participated in the survey, which was conducted at different times intervals.

3.4 Sampling

In obtaining a better understanding for qualitative research study a focus was on few individuals; totalling to four teachers. That is two teachers from each school and each subject that is Mathematics and English specifically using games in teaching and learning. For the quantitative phase, learners were purposefully selected; including learners learning Mathematics and English using games; the performance of the learners was also considered as mentioned above; that is the high flyers, average and underperforming learners. A group of 15 learners was selected from each school. The study used a purposive sampling in selecting the participants. Purposeful sampling involves intentional selection of participants or sites that will help an in-depth exploration of the main issue (Sweetman et al., 2010).

3.5 Participants

Participants were selected from two pilot schools that are regarded as full ICT schools in Gauteng. The participants included two teachers; teaching Mathematics and two teaching English; that use digital games in teaching in each school. Educators are selected from all age groups; newly appointed and experienced teachers; provided they are teaching Language and Mathematics using games. Learners were selected according to their performance on the subjects; that is the high flyers; average and underperforming learners. A group of 15 in the senior phase were selected from each school.

3.5.1 Background of Participants (Teachers)

Table 1, below presents teachers profile; the profile is for teachers that participated in this research study.

Teacher	Age	Years of experience	Gender	Subject teaching	Qualifications
Teacher A	42	7 years	F	English	B-ed hons ICT
Teacher B	35	5 years	M	Mathematics	B-ed hons ICT
Teacher C	54	29 Years	M	Mathematics	B-ed
Teacher D	29	3 Years	F	English	B-ed

Table 1 Participant profile (Teachers) created by NE Seabi

3.5.2 Background of Participants (learners Profile)

A quantitative research was conducted from the learners' side. To determine the learners' views, a questionnaire was completed by thirty learners according to the criteria specified, that is the highflyers, average and the learners that are struggling to progress. A quantitative report was processed and pulled from SPSS to analyse responses. The questionnaires were distributed to 30 learners using google forms and were expected to make a selection of responses on google forms and therefore submit their responds on Google platform. Learners were asked various questions, with an aim of trying to determine if they are interested in learning with games or on whether they prefer traditional ways of learning and teaching. These Google forms were also designed in a way that learners were to view the teachers' attitude towards DGBL. Graphical representation as well as statistical representation were pulled from SPSS using the data gathered from questionnaires through Google forms. Pie charts were used as graphic representation.

3.6 Research Instruments

With the aim of answering research questions and collecting data, instruments such as questionnaires were completed together with interviews.

3.6.1 Interviews

To triangulate the data required for probing the perception of teachers, interviews were conducted with teachers. This helped to determine the affordances acquired in GBL as well the teachers' attitudes and perception towards DGBL. Teachers were interviewed to determine their attitude as well as the impact of games on learning and teaching.

3.6.2 Questionnaire

Questionnaires were made up of twenty-one straight forward questions that were easily answered by learners. The main focus of the questionnaire was on the following: competency, participation and personal opinions as well as their interest in games. Learners' views were collected using this instrument. Google forms were completed by learners and submitted on google platforms. They were assisted by the relevant teachers to make a submission.

3.7 Methodology

The research methodology that was appropriate for this study is described in detail below:

3.7.1 The Mixed Method

The study made use of the convergent parallel design, which is a mixed method approach. Cresswell and Plano Clark (2011) state that this method refers to the researcher conducting both qualitative and quantitative elements concurrently. Meaning that they are done in the same stage of the research process and the methods are equally weighed. It is further stated that the data is analysed independently and then the results are interpreted together (Demir & Pismek, 2018). The mixed method research model is regarded to be a more attractive to researchers as it presents itself as a complement of traditional methods of research. It is philosophically pluralistic in nature; because it takes what works; and rejects what does not work from quantitative and qualitative research methods (Leech et al., 2010).

Moreover, taking multiple approaches in answering research questions, rather than restricting or constraining research. The mixed method uses the induction or discovery of patterns, deduction (testing of theories and hypothesis, and abduction (uncovering and relying on the best setoff explanation for understanding one's results). The mixed method was used in this research to systematically integrate the quantitative and qualitative data within a single study.

The reason for the selection of this method in the research is that, it integrates the two methods of research and allows a more comprehensive and synergistic use of data collection and analysis. Mixed method gave the researcher an opportunity to achieve the aim outcomes of cost, quality and participants experience in schools and the method suits a wide variety of research questions (Creswell & Plano-Clark, 2011). The researcher selected this method because of an opportunity to analyse both closed ended as well as open ended data. The mixed method helped the researcher to frame the procedures within the social constructivist and helped the researcher to understand multiple perspective of the participants on a single issue.

3.7.2 The Quantitative Research Method

Aliaga and Gunderson (2000) define quantitative research as clearing up phenomena through the collection of numerical data that was analysed with the use of methods that are mathematically based, particularly statistics). It uses objective research methods to uncover the truth; in a way that the researcher does not influence the research (Aliaga & Gunderson, 2000). Quantitative research focuses on deductions, confirmations, theories, testing, explanations, predictions, standardised data collection as well as statistical analysis.

For the quantitative approach of the study, a sample of 30 learners was sampled and evaluated using the adapted, Computer Attitude Scale (CAS), originally developed by Loyd and Gressard (1984), which is a Likert type instrument with three factors of cognitive, affective and behavioural. Data was collected through questionnaires and be administered to selected learners, depending on their performance rate. That is, the high flyers, average learners and progressed learners from each selected school; specifically, in LOLT and Mathematics. Learners were selected from previously disadvantaged schools, or schools in townships that do not pay school fees or called the non-fee-paying schools.

3.7.3 The Qualitative Method

While on the other hand; according to Johnstone; A qualitative research attempts to investigate the insights and perceptions of persons subjected to a certain phenomenon (Muijs, 2011). The qualitative research is useful for obtaining insight into situation and is both textual and verbal (Muijs, 2011). Qualitative research method is used to investigate a phenomenon and it seeks to answer questions, systematically uses predefined set of procedures to answer questions, collects evidences, produces findings that are applicable beyond the immediate boundaries of the study and seeks to understand a given problem from the perspective of local people involved.

For qualitative method two teachers were interviewed from each subject (one teacher for Mathematics and another one teacher for English) in each school to determine the extent which teachers utilizes DGBL in teaching and learning as well as their attitude towards DGBL. The researcher recorded interviews between the teacher (interviewee) and the interviewer(researcher) for future reference.

3.8 Data Analysis

Data was analysed using mixed methods analyses. Results for each method was separately analysed and a correlation has been tested and result were drawn and recommendations were made.

3.8.1 Quantitative Data Analysis

The quantitative data was entered into the latest version SPSS (Version 27.0) to check normality; calculate descriptive statistics and run independent samples and perform relevant test. A computer programme called SPSS (Version 27.0) was utilised to analyse and test the data obtained.

3.8.2 Qualitative Data Analysis

Interviews were audio recorded by the interviewer; conducting interviews, transcribed and content was coded and then be analysed.

3.9 Credibility of the Study

In ensuring validity for a qualitative the transcripts of the interviews were taken back to the participants to verify the data collected. Quantitative major test was undergone on the SPSS (Version 27.0) to test the validity of information.

3.10 Ethics

Prior to the commencement of the fieldwork the researcher obtained permission from the relevant institutions deemed fit to provide to conduct the study in their premises and the relevant stakeholders. The University of Witwatersrand ethics committee granted the researcher permission before conducting this study. Questionnaires were completed anonymously; voluntarily and the participants were told that their answers would be kept completely confidential. There was no harm or potential harm to the participants. The same method was applied to the interview instrument. This research was performed ethically and permission was obtained from the relevant institutions before the research to took place. Information letters, consent forms were issued and permission letters were obtained from participating institutions and relevant stakeholders.

3.11 Conclusion

Pragmatism as a partner of mixed method research does not aim to solve the disagreements between qualitative oriented researchers versus quantitative

orientated researchers but in state mixed method seeks a workable solution. Literature review in chapter 2 served as a guideline to select appropriate tools for data collection pertaining to DGBL as a pedagogical tool to stimulate the learning of Mathematics and English. The succeeding chapter is the presents, data presentation and analysis.

CHAPTER 4

DATA PRESENTATION AND ANALYSIS

4.1 Chapter overview

This chapter discusses the data analysis and findings from questionnaires electronically completed by learners as well as selected educators in the field of Mathematics and English. The objective was to determine the benefits and affordances gained from DGBL, assist in improving results in SA schools especially in previously disadvantaged groups, create some form of interest and stimulate learning of subjects such as Mathematics and English.

4.2 Introduction

This chapter draws the analytical tools indicated towards the ending parts of chapter one and two which lures from the conceptual framework. Prior to the presentation of data, it was found imperative to present the tool utilised, with the aim of assisting the reader to comprehend data analysed and obtained in succeeding sections. The research questions guiding how the analyses were done are as follows: (1) *To what extent are DGBL used as pedagogical tools to stimulate learning in selected schools? (2) What are teachers' attitudes towards the use of GBL in teaching Mathematics and English? (3) To what extent do teachers use GBL in their practice? (4) What are pedagogical affordances of GBL in and outside the classrooms?* These research questions align with the data that is presented and analysed, to assist in developing the sections in this chapter. The key sections below that form the basis of this chapter are as follows:(a) development of an analytical tool (b) presentation and analysis of interviews (c) presentation and analysis of lessons observed.

4.3 Development of Analytical Tools

Qualitative research is useful for obtaining insight into situation and is both textual and verbal method (Muijis, 2011). This form of research is used to investigate a phenomenon and it seeks to answer questions, systematically; uses predefined set of procedures to answer questions, collects evidences, produces findings that are applicable beyond the immediate boundaries of the study and seeks to understand a given problem from the perspective of local people involved.

In the exploratory part of the study, semi-structured interview data were scrutinised, exhausting the analytical tools, established into categories based on similar ideas and concepts that materialised from the data; in conjunction with the literature review as well as the research questions. This aided the researcher to stitch together similar thoughts and conceptions that arise from data. As already mentioned in the previous debate in this chapter, one of the glitches confronted by most researches is the fact that they are not able to build an instrument that is capable to capture teacher practices used when GBL is utilised in teaching and learning.

The researcher went through DGBL tools, features, manuals and formed criteria for use within the classroom based on content, pedagogy and assessments which are the main knowledge components emphasised by the CAPS (DBE, 2012) for effective teaching and learning. This helped in ascribing pedagogical value on the different tools and features as they were used by the educators.

Table 2, below demonstrate the interpretation and Categorisation of DGBL Tools and Features

PACK components	Features and tools	Affordances
Pedagogy	Quizalise - use on interactive white board and devices for students i.e. tablets or IT suites. Educator can create their own or choose from thousands available wants. No internet access required.	Communication and competency
Content	Integrating content with games e.g., teaching Geometry in Maths, integrating it with squares. Assist educators to identify students with learning barriers	Accessibility and discovery
Assessment	Assessment takes place when all games are played and feedback is received immediately.	Immediacy

Table 2 Interpretation and Categorisation of DGBL Tools and Features Created by NE Seabi

4.4 Teachers Profile

The profile of teachers is described in detail below:

4.4.1 Teacher A

The teacher is 35 years old, and has been teaching for seven years. She has learnt how to use DG in teaching and learning during her honours in ICT education. She teaches English as well as Natural Sciences to Grades 4 - 7. She enjoys teaching English and sometimes finds it hard to teach verbs, since learners do not enjoy dictionaries.

4.4.2 Teacher B

The teacher is 37 years old; he has over 5 years of teaching experience in the education sector. He currently teaches Mathematics; Technology and Natural Sciences. He said he enjoys interacting with the little ones; and he realised they enjoy games in learning more than any form of teaching. He said he learned about DG when he was doing his PGCE; because he was initially a qualified engineer until he found his calling and left the industry that was very frustrating to him. After finding his calling as a teacher, he decided to make teaching as enjoyable as possible and when GBL was introduced in 2015 he finds much pleasure in teaching and playing with children that he is entrusted with; that is his learners.

4.4.3 Teacher C

A long-time teacher; who has been teaching for nearly three decades. He is a foreign national that came to SA to teach Mathematics and Natural sciences. He learned ICT after almost twenty years of teaching experience and games were part of his learning experience. He enjoys teaching with games and finds it very interesting as compared to the traditional way of teaching, for example using chalks and the green board. He said teaching geometry with the square games make it very easy for learners to comprehend the subject; unlike the traditional way of teaching; it was very frustrating to learners; learning geometry was a monster to some of the learners. He mentioned that its DG simplified learning.

4.4.4 Teacher D

A 29 years' teacher who has been teaching for almost two years in primary school level. She teaches English home language and does not have much of experience in teaching. She studied remotely and did not have much knowledge of ICT before it was introduced by the DBE.

It is found that most of the teachers have knowledge of games in selected schools. It is also observed that many of the selected teachers prefer games in the learning and teaching process and they use the platforms frequently. Despite the challenge they experience in teaching with games, for instance; lack of support from the SMT, as well as a continuous change in games software and games; budgetary constraints; the possibility of not getting some resources in time, causing some delays and lack of cooperation from school management team or even DBE.

Educators emphasised the stimulation factor that learners experience in using games. The fact that learners get feedback immediately is way to encourage them to learn some more. The fact that the games create an environment that disguises a playing environment rather that a learning environment that in itself encourage learners to learn. An investigation highlighted that DGBL enhances learners' interest in learning. The four teachers interviewed highlighted that learners show interest when learning with games, because they always want to win the game.

Questions and Answers

1. *To What Extent Are DGBL Used as Pedagogical Tools to Stimulate Learning in Selected Schools?*

To respond to the above question, the researcher drew on data obtained in the previous chapter as well as the literature review. Teacher A and B revealed that educators utilise DGBL to a lesser extent. They mentioned that, even though they may want to use GBL in their daily teaching; they continually experience challenges in the classroom. Among them were outdated DG software that hinders the use of games in the classroom setup, lack of support from SMT; lack of resources as well as accessibility.

On the hand; teacher C and D spend most of their weekly days utilising DG or teaching with digital games. They alluded that the use of games stimulates learning and at the same time encourages competition as well as active participation. They highlighted that DG also stimulates learner centred pedagogies that are in line with the constructivist point of view. Learner centred pedagogy is viewed by teachers as well as the education sector as a measure for real learning. DG are conceived to be an

enabler of a learner centred learning environment as well as encouraging sustainable learning.

When Teacher C was asked the question above; she highlighted that "weehh"*; when using games in teaching learners go on and on and do not want the lesson end".* The teacher went on comparing DGBL with a football game, that even if you are given a duration for the game, when loosing, one wants to continue playing so that one can end up winning and when one wins they want to continue accumulating points. She said the excitement that learners show when learning with DG makes them become lifelong learners - judging by the interest and the attraction created by DG.

Educator D, regards teachers as model learners. From his perspective on DG; teachers are master learners and knowledge fabricators, who are continuously engaged in educational trialling and inventively producing new knowledge about learning and teaching practices. Teacher said that; DG are therefore stimulators for both teachers and learners.

Teacher D views DGBL environment as learner centred environment; where learners take charge of their own environment and bring real world in the classroom environment. The educator said "*the teacher becomes the script writer and the director in this environment, the teacher provides guidance and the learners take charge of the lesson, and if they are in charge, decisions are made and learning is sustained and they do not forget the lesson".* They always try to look at ways to win and do much better in the game.

The teacher further said the reasons why she continues using games in teaching English subject is that "*children learn through play"* and to her observation that has become a fact. She said some of the games cannot be played individually and the social factor is encouraged in this instance.

She vividly smiled about the fact that DG assists learners to engage; "*learner engagement is one of the crucial aspects of education and one cannot say they taught if learners do not ask any questions and or challenge some of the concepts addressed by the teacher".* She said DG helps learners engage because they do not get disinterested; she said they do not only engage

2. What Are Teacher's Attitudes Towards the Use of Game-Based Learning in Teaching Mathematics and English?

Teacher A's attitude towards DG was that she does not see the reason why she is supposed to use games in teaching and learning, because according to her observation DG does not in any way affect results achieved. In her response, she said "DG *has nothing to do with results".* She mentioned that learners who are not using such tools like DG as a tool for learning, are doing much better than the ones using the tools. She highlighted that since games are used in the classrooms, learner's loose concentration because they always want to play.

However, the other three teachers' attitude towards the use of games in learning and teaching are positive as they strongly believe that if games are utilised effectively and efficiently, they can improve learners' performance to a certain extent. The teachers have highlighted pedagogical characteristics that are displayed in DGBL, such as interactive leaning (learner to learner, teacher to learner and as well as group learning), individual learning, learner comprehension and learner cognition level being increased, creativity and efficiency, even skills to edit and problem-solving. They alluded that games help learners create their imaginary world and bring things to real world when using games.

The attitude of teacher C to learning and teaching with games was positive, though he has been teaching for decades, in a way that, he even uses games three times in a week. He said when comparing teaching with DG with traditional ways of teaching and learning, he experiences a vast difference. He highlighted that DG modifies the learners' character and help educators to see notice learners' potential and their talents.

Teacher C said, "*games are an amazing experience in the classroom for both teachers and learners".* He alluded that games motivate and stimulate both learners and teachers and create interest in both parties, because they all want to win and continued to say "enthusiasm *is the name of the game".* He further viewed games to be stimulators for learning and view them as tools that encourages creativity and problem solving skills.

Though teacher B & Ds attitudes towards games where not the same as teacher C; they also explained that DG has changed the learning environment. They highlighted that if, it was not for the challenges they experience in teaching with games, they view games as an important tool. They elaborated by saying they games include many of the characteristics of education and the educational world. Besides, games even add the component of excitement and constant attention on the learners' side.

3. To what extent do teachers use game-based learning in their practice?

Teacher A

Teacher A mentioned that she does not use DG in teaching and learning, because she is saving herself from trouble of the DG platforms that are not always functioning, and using most of her periods trying to figure how this games work. She said that the DBE needs to ensure that DG are always functional and have backups. She said, if resources are provided and operational, it will motivate educators in using such platforms. She said DBE needs to ensure that continuous takes place, to empower teachers and ensure that they are acquainted with the games teaching platforms.

Teacher B

Teacher B said that she sometimes uses games in teaching and learning, and the reason why he does not use games often is because he is interested in completing the syllabus. When asked the above question Teacher B said, "I take longer time in setting up these games on Smartboard and feel like the time I took for the set-up I could have used it to teach the poor leaners and improve their knowledge". He further said he does not use DG frequently because DBE always change the software without informing them, and the next thing they try to open the game on the board they find something else, and it does not even correspond with what is on the learner's gadgets.

Teacher C

Teacher C said that of course they are some hindrances in trying to use DG often, *"but before going to the classroom to teach using games, I make sure I prepare ahead of time".* He said that because he realised the importance of DG in teaching, he always prepares ahead of time to ensure that the, classroom is set before the lessons. He said he uses games often because his results in Mathematics have improved and he

believes that the improvements in learner performance was due to the interventions of DG.

Teacher D

Teacher D highlighted that she frequently uses DG in teaching English, because ever since her learners start using DG in learning, "*learners writing skills has improved and they are now able to spell words that they could not spell before the use of games in the classroom".* The teacher said she enjoy DGBL because, it has brought great improvement on the way learners pronounce words, "*they actually pronounce them better"*, she reiterated. According to the teacher DG help learners improved their reading skills, because they always try to find words in the dictionary because the wat to compete.

4. What are the pedagogical affordances of DG in and outside the classroom?

Teacher A

It was observed that all teachers as well as learners believe that DG have affordances. Though teacher A's attitude towards games is not that positive with regards to learning, she still believes that games have some affordances that are gained inside the classroom and outside the classroom. She highlighted that games bring out creativity in learners. She also highlighted the affordances that may be gained from DGB. Interaction and excitement, as an English teacher; she recons that DG encourages communication skills. She further said DG "to some extent improves the learners' vocabulary as well as their communication skills, because as they play, they debate on certain issues and that in itself help develop their confidence as well as listening skills.

Teacher B

"*To me DG has a great deal of affordances; and this affordance are realised whenever a teacher uses DG in teaching and learning"*. Examples of those affordances are: I code; creativity; diversity and competiveness. In Mathematics and Sciences DG help learners to attain problem solving skills that are crucial subject in that arear of learning. Games assist learners to have an image of the outside world while they are learning in a classroom. He gave an example of Minecraft; that with this game, learners are able to build an imaginary world, that was never experienced.

He also raised the fact that learners become effective thinkers, and they tend to think fast when playing games as compared to the normal learning environment. *"Thinking skills are very important for Maths learners, because a Maths learners are expected to think outside the box".* Learning with games create a force field where learners are full of energy and excitement and that in itself create courage and learners end up researching on how to win and get badges. "*Social skills, that I regard as vital skills inside and outside the classroom are acquired through games*". He said that one can communicate on game platforms at any moment and the time factor is also very important.

Teacher C

In responding to the above question, Teacher C viewed games as a tool that affords learners an opportunity to compete with each other and the world outside. Some games are played online and they have the ability to increase the level of interaction, since there is a high level of openness in playing games. Teacher C mention that "*collaboration happens when there is interaction, and interaction happens in playing games*". He said as a Maths teacher, cognition is key and through games, an element of a high level of cognition is created in the challenge that learners experience when playing games. Another benefit is the excitement that is experienced when playing games and it is believed that if one does what they enjoy and like, there will be a consistent and motivation to the particular thing will rise from that particular experience. Teacher C mentioned that games create participation and corporation, that leads to exposure; learners that are not afraid of the outside world. He mentioned that GBL has allowed learners the immediacy affordance, that is learners get feedback immediately after a game, they get the score and thereafter they may be allowed to go to the next level that is more challenging. He further alluded that immediate feedback motivates learners to work hard so that they can move to a more complex level.

Teacher D

In the interview he mentioned the accessibility affordances, because learners at all levels gain access, they can participate in the process. He mentioned that games can be played on various platforms, gave an example of cell phones, TV, tablets and laptops. She also said DG allow learners to multitask, and that is not possible in the traditional environment. She gave an example with the learner that uses a controller

in playing a TV game, the learner is constantly watching if the enemy is attacking, while on the other side the very same learner is defending him/herself and on the other side, they are thinking of the best trick to attack also the tricks that they can use to win the game. She said digital games help learners navigate, while moving into an imaginary world and they must learners achieve learning targets by making connections between concepts, and sees learning as interconnected.

She said DGBL boost learners' engagement by encouraging them to make decisions, pursue a goal, while checking their progress and that lead to high level of comprehension, thereby being able to interconnect and burn the bridges that appears in the traditional learning environment, where teacher is a driver and a controller of the whole system. She further said GB bridges the gap between abstracts and concrete, she said they take specialised roles and build empathy.

4.5 Quantitative Research

Responses by Learners

4.5.1 Number of Participants and Their Gender

Table 3 indicates the number of learners who participated, while Table 4 and figure 8, presents their gender expressed as a percentage. The following were found:

- 30 learners participated in this survey
- Female participants were 10, while male participants were 18, 2 learners preferred not to disclose their gender
- 60% of the participants were male
- 33.3% of participants were female
- 6.7% of participants preferred not to state their gender.

Table 3 Statistical Sample of Gender

Statistics		
1.	What is your gender?	
N	Valid	30
	Missing	0

Table 4 What is Gender?

1. What is Your Gender?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	18	60.0	60.0	60.0
	female	10	33.3	33.3	93.3
	Prefer not to say	2	6.7	6.7	100.0
	Total	30	100.0	100.0	

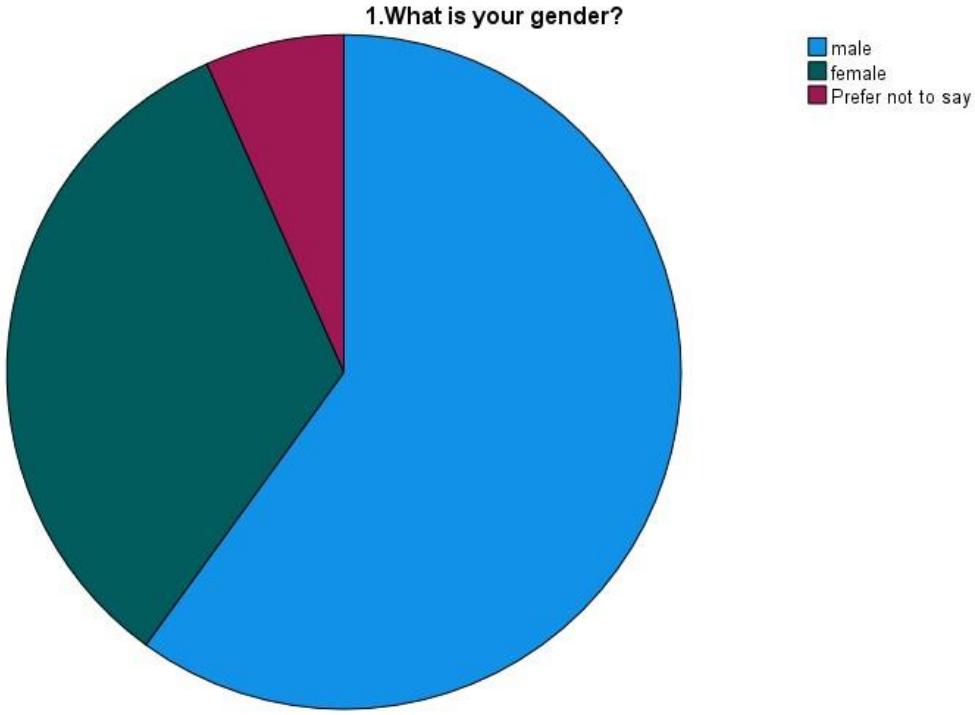

Figure 8: Report on the gender of the participants.

4.5.2 Grades and Phases of Participants

Table 5 indicates the number of learners who participated, while Table 6 and figure 9 is a representation of the number of learners in different grades, as well as the learning phases. The participants are primary school learners:

- 30 participants disclosed their grade

- 63.3 % of participants are in the junior phase in grades (4 - 6)
- 16.7 % of the participants were are in the foundation phase in grade 1-3
- 20% of the participants are in the senior phase (7-9)

Table 5 Statistical Sample of the Grade

Statistics		
2.	Which Grade are you in?	
N	Valid	30
	Missing	0

Table 6: Which Grade are You In?

2. Which Grade Are You doing?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Foundation phase (grade 1-3)	5	16.7	16.7	16.7
	Junior Phase (grade 4-6)	19	63.3	63.3	80.0
	Senior Phase (Grade 7-9)	6	20.0	20.0	100.0
	Total	30	100.0	100.0	

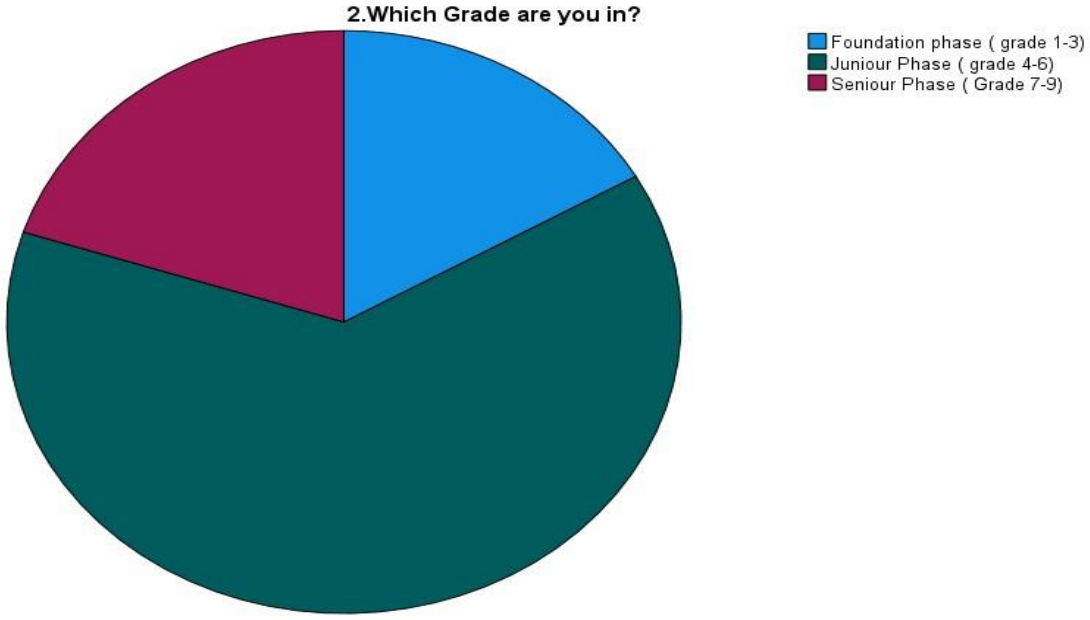

Figure 9: Report on learners grade.

4.5.3 Age of Participants

Table 7 indicates the number of learners who participated, while Table 8 and figure 10 is a presentation of learner's age range in different grades:

- 30 learners participated and disclosed their age range
- 10% are between the age of 6 – 8
- 16.7% are between the ages of 11 – 12
- 56.7% re between the ages of 9 – 10
- 16.7% are between the ages of 13 – 14

Table 7: Statistical sample of the age.

Statistics		
3. How old are you?		
N	Valid	30
	Missing	0

Table 8: How old are you?

3. How old are you?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Between 6-8	3	10.0	10.0	10.0
	between 9-10	17	56.7	56.7	66.7
	between 11-12	5	16.7	16.7	83.3
	between 13-14	5	16.7	16.7	100.0
	Total	30	100.0	100.0	

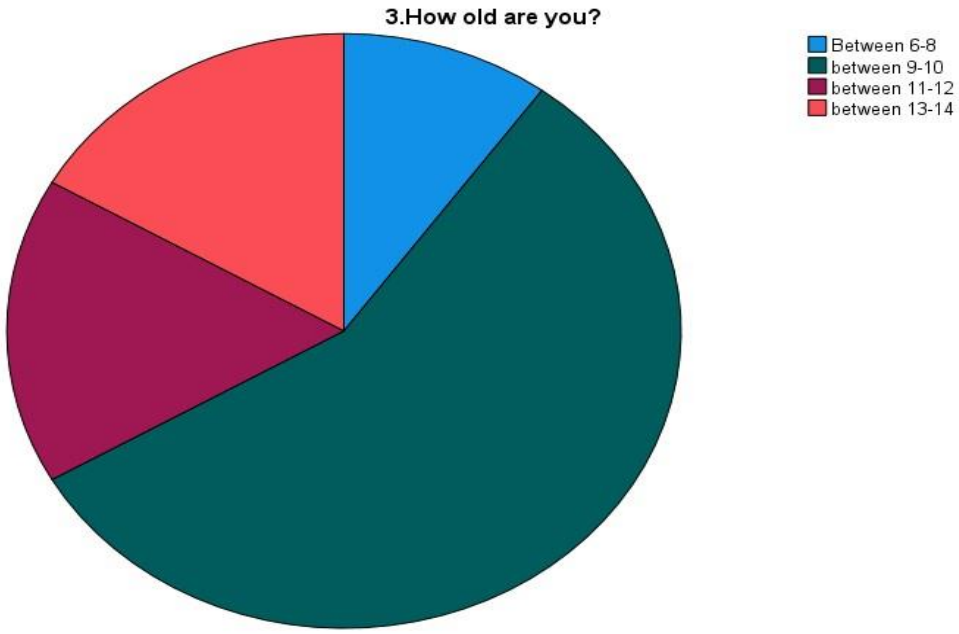

Figure 10: Report on the age of the participants.

4.5.4 Access to Computers/Smart Phones/Tablets

Table 9 indicates the number of learners who participated, while Table 10 and figure 11 demonstrate the devises that learners use to play games, be at home or at school. It was clearly demonstrated that digital games are played on different tools such as tablets, laptops and computers, these questions were posed to determine whether learners have access to this learning tools. The below was found:

- 73.3% of the group had access to either a computer, smart phones or tablets
- 26.7% of the population do not have access
- The school that this survey was conducted, each learner is given a tablet by the DBE

Table 9: Statistical Sample of access to computers.

Statistics		
4. Do you have access to computers /Cell phone /Tablet?		
N	Valid	30
	Missing	0

Table 10:Do you have access to computers /Cell phone /Tablet?

4. Do you have access to computers /Cell phone /Tablet?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	22	73.3	73.3	73.3
	no	8	26.7	26.7	100.0
	Total	30	100.0	100.0	

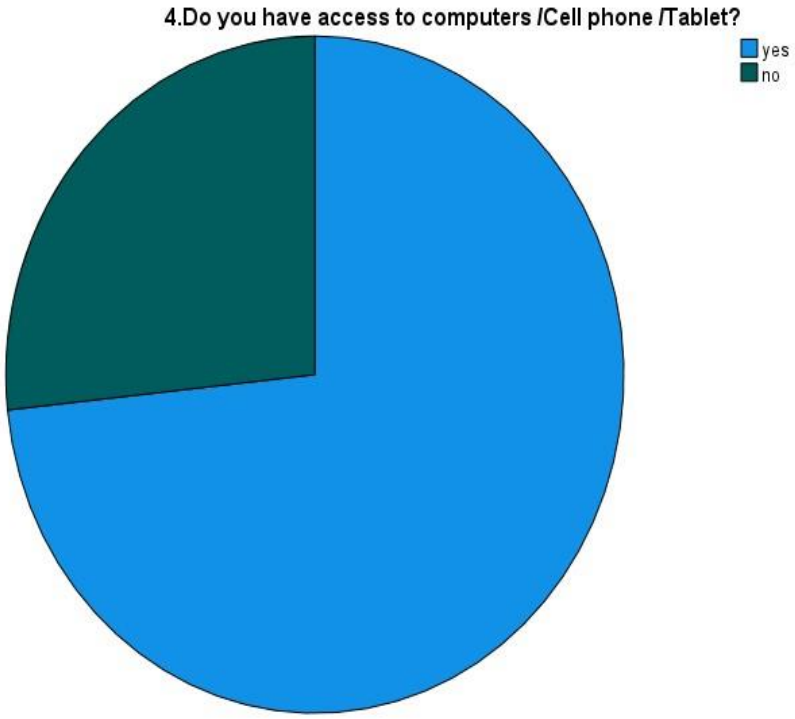

Figure 11: Report of learners access to games.

4.5.5 Games Learning

Table 11 indicates the number of learners participated, while Table 12 and figure 11 represent the number of participants that uses games in teaching and learning. They determine on whether GBL takes places in schools, learners were asked the below question and responds were gathered:

- 80% of the participants confirmed that GBL takes place in school
- 10% said it does not take place
- The other 10% were not sure

Table 11: Statistical sample of learning through games.

Statistics		
5. Do you learn through games in your school?		
N	Valid	30
	Missing	0

Table 12: Do you learn through games in your school?

5. Do you learn through games in your school?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	24	80.0	80.0	80.0
	No	3	10.0	10.0	90.0
	Maybe	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

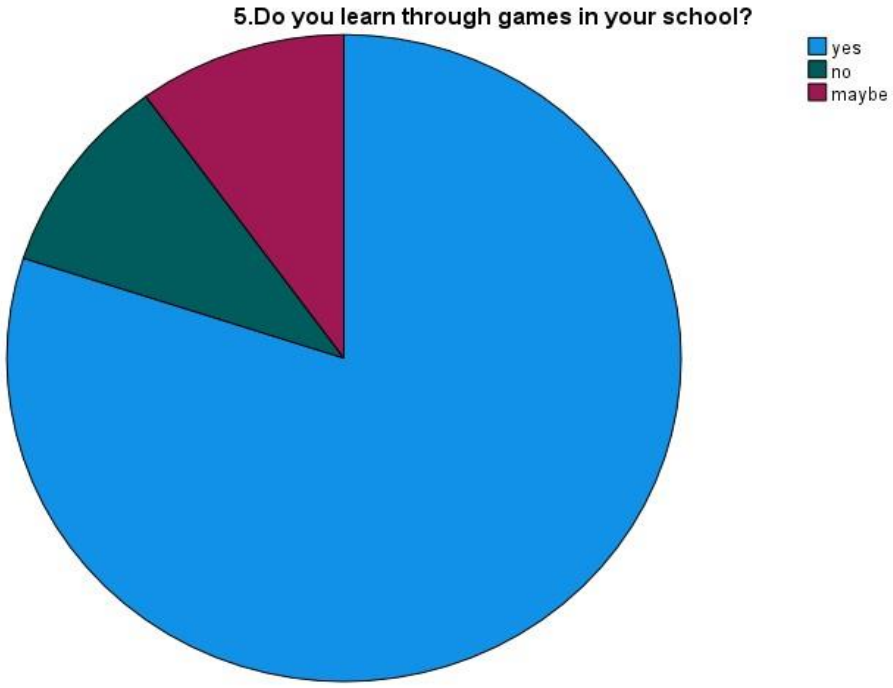

Figure 12: Report on number of learners who learn through games.

4.5.6 Times that DGBL Takes Place

Table 13 indicates the number of learners participated, while Table 14 and Figure 13, answers a follow up question from the data gathered on the previous question, on how

often do learners learn with games. This was to determine whether learners are frequently learning with games or not

- The highest group that is 43.3 % said they sometimes learn with games
- 33.3% said they learn with games most frequently
- While the 23.3% of learners said that they never, or do not learn with games

Table 13: Statistics on how often learners use games in teaching and learning.

Statistics		
6. If yes; how often do you learn through games?		
N	Valid	30
	Missing	0

Table 14:If yes; how often do you learn through games?

6. If yes; how often do you learn through games?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	7	23.3	23.3	23.3
	sometimes	13	43.3	43.3	66.7
	most frequently	10	33.3	33.3	100.0
	Total	30	100.0	100.0	

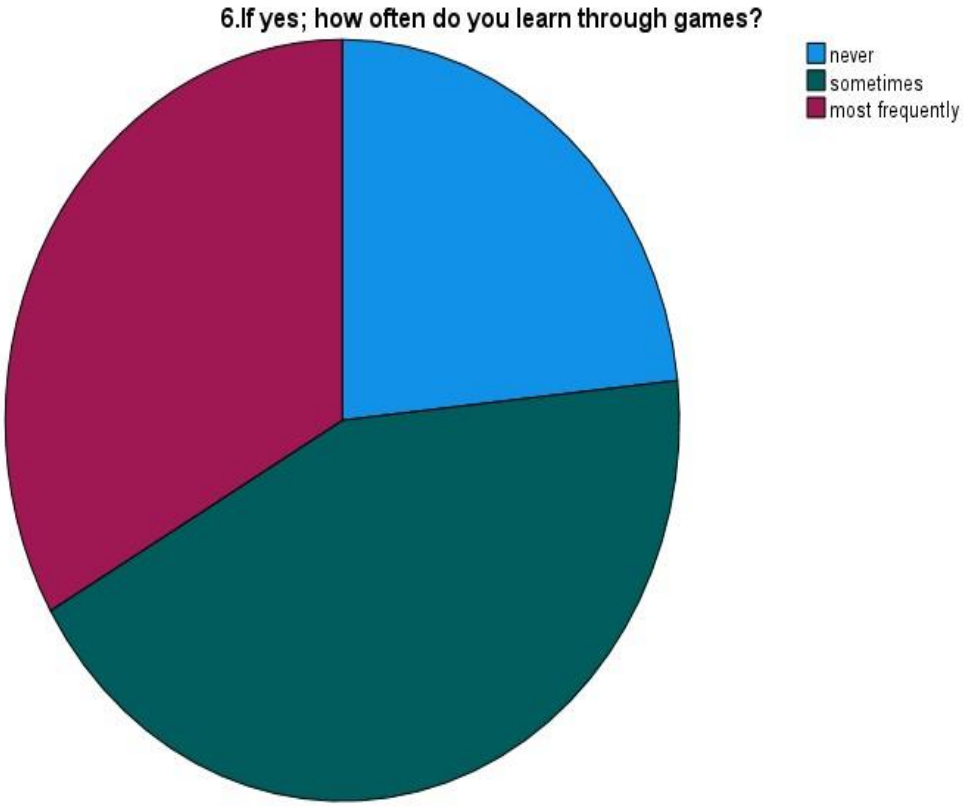

Figure 13: Report on the frequency that learners use games in learning.

4.5.7 Learners View on DG and Teachers

In table 15 indicates the number of learners participated, while Table 16 as well as Figure 14 presents, their views on whether teachers should use games in learning and teaching and the following were gathered:

- The highest percentage recommend that teachers should use games in teaching and learning, that is the 83.3%
- 10% said no to GBL
- While the other 7% was not sure

Table 15: Statistical sample on whether teachers should use games in teaching and learning.

Statistics		
7. Do you think teachers should teach using games?		
N	Valid	30
	Missing	0

Table 16:Do you think teachers should teach using games?

7. Do you think teachers should teach using games?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	25	83.3	83.3	83.3
	No	3	10.0	10.0	93.3
	Maybe	2	6.7	6.7	100.0
	Total	30	100.0	100.0	

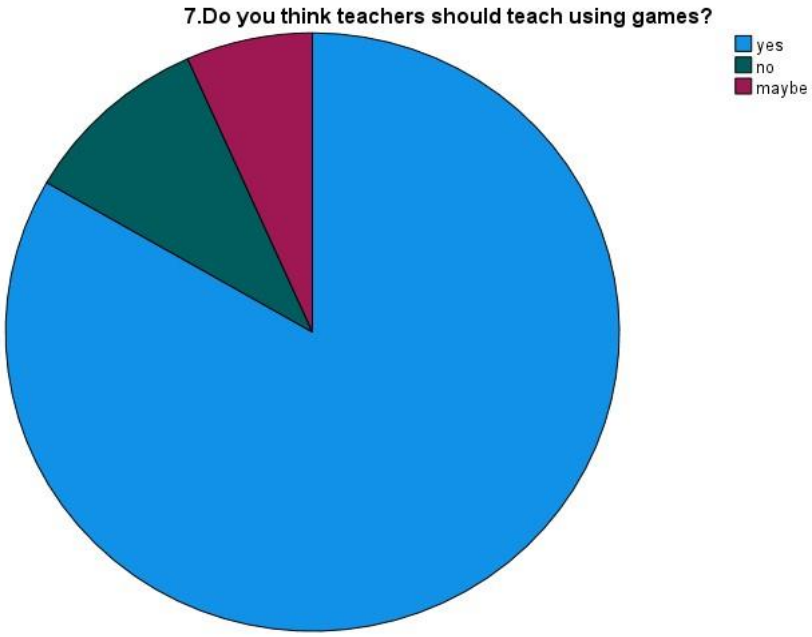

Figure 14: Report from learners on whether teachers should use games in teaching and learning.

4.5.8 Times that Teachers Should Devote on GBL

Table 17 indicates the number of learners participated, while Table 18 and Figure15; demonstrate the number of learners and how frequent teachers use games in teaching and learning.

- 36% of the learners said teachers should use games more often
- The following 23.3 % said teachers should teach with games often
- 16.7% said teachers should always use games in teaching and learning
- 3.3% said teachers should never use games in teaching and learning
- While 20% recommended that games should be used sometimes

Table 17: Statistical Sample on how often teachers use games in teaching and learning.

Statistics		
8. If yes, how often should they teach through games?		
N	Valid	30
	Missing	0

Table 18: If yes, how often should they teach through games?

8. If yes, how often should they teach through games?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	always	5	16.7	16.7	16.7
	Often	7	23.3	23.3	40.0
	More often	11	36.7	36.7	76.7
	Sometimes	6	20.0	20.0	96.7
	never	1	3.3	3.3	100.0
	Total	30	100.0	100.0	

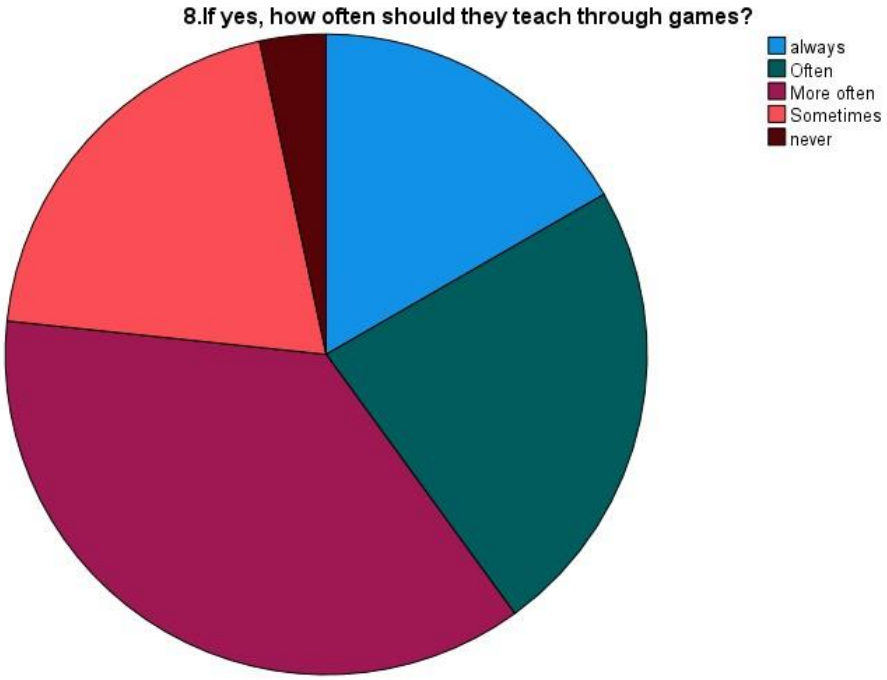

Figure 15: Report on the number of times that learners think teachers should use games.

4.5.9 Lessons

Table 19, indicates the number of learners who participated, while Table 20 and Figure 16 represent the data on the level of understanding learners gain from DGBL.

- A total of 96.7% of the learners said lessons are clear when using games - The remaining 3.3% were not sure

Table 19 Lessons

Statistics		
9. Are lessons clear; when learning through games or not?		
N	Valid	30
	Missing	0

Table 20: Are lessons clear; when learning through games or not?

9. Are lessons clear; when learning through games or not?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Maybe	1	3.3	3.3	3.3
	yes	29	96.7	96.7	100.0
	Total	30	100.0	100.0	

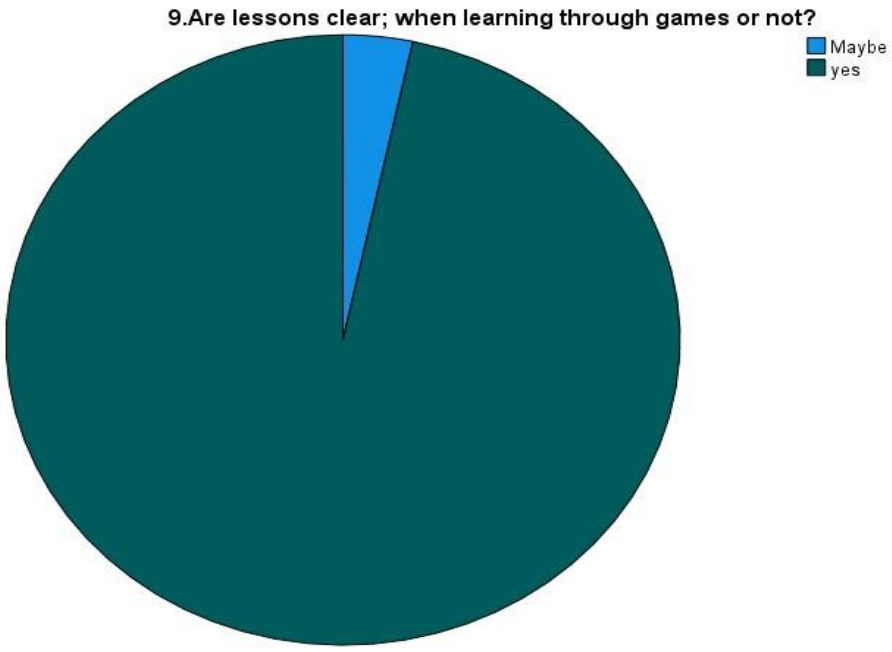

Figure 16: Report on whether learners find lessons easy with games or not?

4.5.10 Learners Were Asked to Measure If Lessons Were Clear Using Games or Not

Table 21 indicates the number of learners participated, while Table, 22 the number of learners that participated and represent the data collected to measure learners level of understanding when using games.

- About 10% said lessons are very clear through games
- Another 50% said they are clear
- The following 23.3% said they are slightly clear
- Another total of 16.7% of the group said they are not clear

Table 21: Statistical report on how they measure the rate of learners understanding.

Statistics		
10. If Yes, how can you rate your understanding scaling from (1-10)		
N	Valid	30
	Missing	0

Table 22:If Yes, how can you rate your understanding scaling from (1-10)

10. If Yes, how can you rate your understanding scaling from (1-10)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not clear	5	16.7	16.7	16.7
	Slightly clear	7	23.3	23.3	40.0
	clear	15	50.0	50.0	90.0
	very clear	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

4.5.11 Recommendation

Table 23 indicates the number of learners who participated, while Table, 24 and figure 17, the number of learners and further deals with learner's recommendation on the use of games in the classroom to teachers:

- A large 70% of the group of learners said they recommend the use of games in the classroom by teachers
- While 16.7% of the group was not sure
- With the remaining 13.3% said no

Table 23: Statistical Report on recommendation of games.

Statistics		
11. If other teachers are not using games when teaching; will you recommend games?		
N	Valid	30
	Missing	0

Table 24: If other teachers are not using games when teaching; will you recommend games?

11. If other teachers are not using games when teaching; will you recommend games?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	21	70.0	70.0	70.0
	no	4	13.3	13.3	83.3
	maybe	5	16.7	16.7	100.0
	Total	30	100.0	100.0	

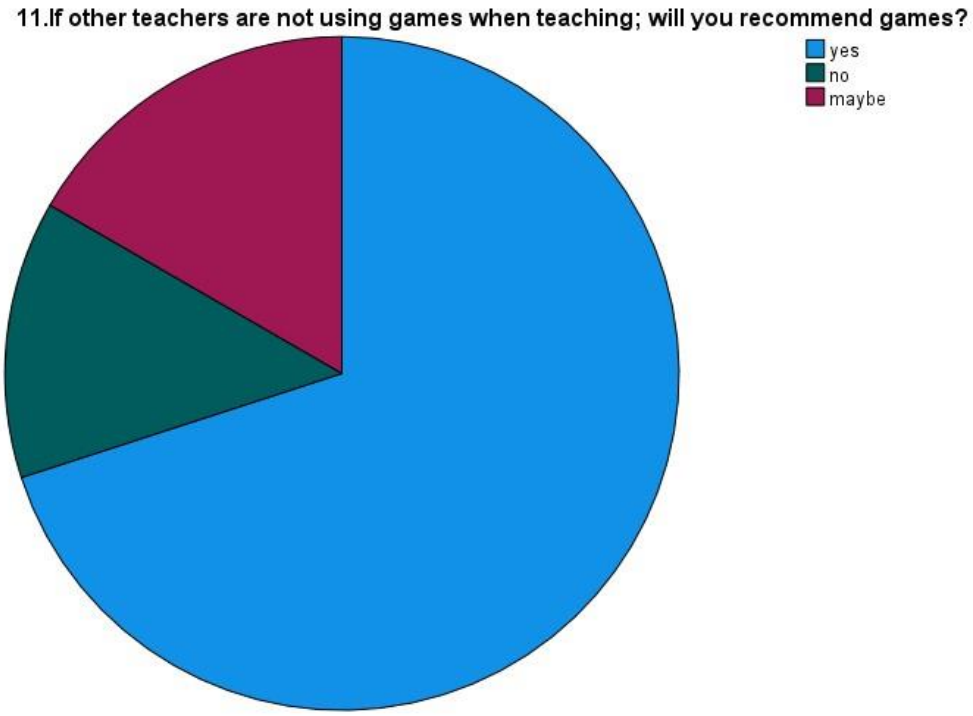

Figure 17: Report on whether leaners recommend games foe teachers not using games.

4.5.12 Enjoyment

Table 25 indicates the number of learners participated, while Table, 26 and Figure 18, show the number of learners and also describes whether these learners enjoyed learning with games or not. The responses showed that the greatest percentage of the group enjoy learning with games. The below report was pulled from this question:

- Out of the 100%, 80% of the group showed that they enjoy learning with games
- While 6.7% said no
- And another 13.3% reported that they were not sure

Table 25 Enjoyment

Statistics		
12. Do you enjoy learning with games or the old ways of teaching?		
N	Valid	30
	Missing	0

Table 26: Do you enjoy learning with games or the old ways of teaching?

12. Do you enjoy learning with games or the old ways of teaching?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	24	80.0	80.0	80.0
	no	2	6.7	6.7	86.7
	maybe	4	13.3	13.3	100.0
	Total	30	100.0	100.0	

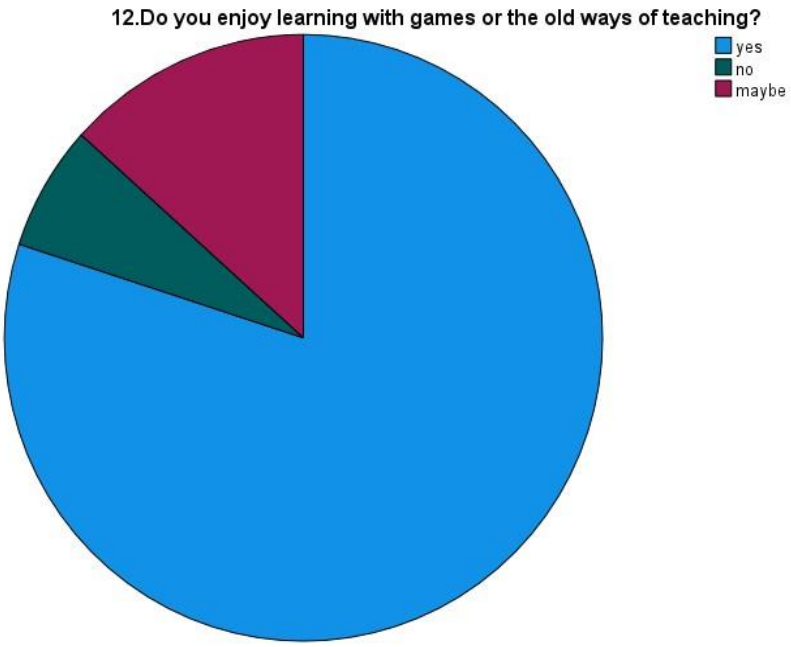

Figure 18: Report on whether enjoy learning with games or not?

4.5.13 Better Learning

Table 27 indicates the number of learners who participated, while Table 28 and Figure 19 demonstrate on whether learners that participated, believe that they learn better when learning with games or not. Learners highlighted that they learn better when using games as compared to the traditional ways of learning:

- A large 73.3% said they understand better when learning with games
- While 13.3% said that they do not understand when learning with games and another 13.3% said they were not sure

Table 27 Better Learning

Statistics		
13. Do you understand better when learning with games or not?		
N	Valid	30
	Missing	0

Table 28: Do you understand better when learning with games or not?

13. Do you understand better when learning with games or not?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	22	73.3	73.3	73.3
	no	4	13.3	13.3	86.7
	maybe	4	13.3	13.3	100.0
	Total	30	100.0	100.0	

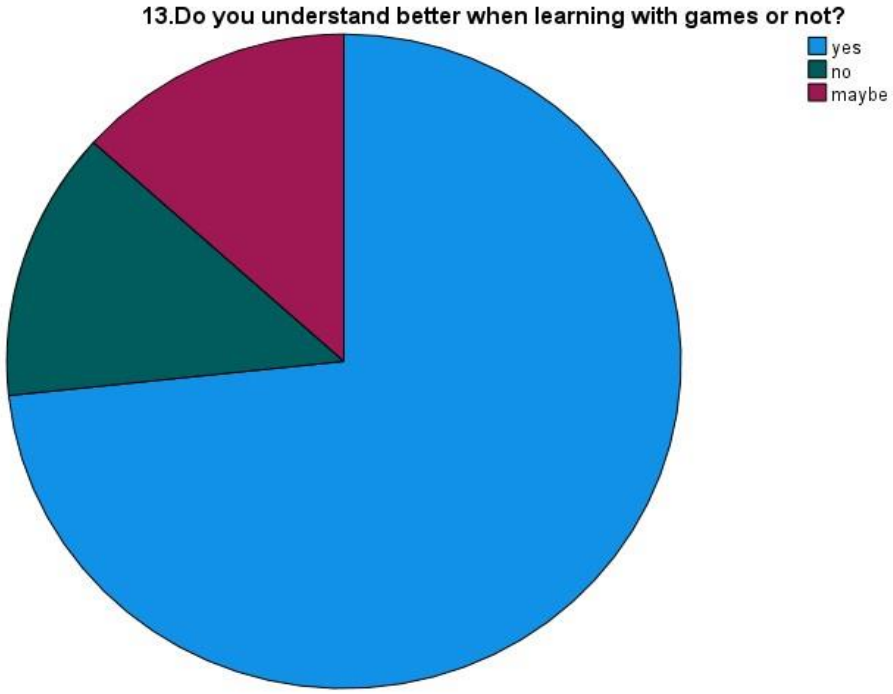

Figure 19: Reports on whether learners understand better when using games.

4.5.14 Interest

Table 29 indicates the number of learners participated, while table 30 and Figure 20, was to enquire about number of learner's interest on games. The tables and the figure demonstrated that learners are more interested in learning with games than some methods of learning.

Learners were asked if they find games interesting or not.

The report stated the below:

- A total of 86.7% of the group stated that they find games interesting
- While 3.3% of the group do not find them interesting
- And the remaining 10% reporting that they are not sure

Table 29 Interest on games

Statistics		
14. Do you find games interesting?		
N	Valid	30
	Missing	0

Table 30: Do you find games interesting?

14. Do you find games interesting?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	26	86.7	86.7	86.7
	no	1	3.3	3.3	90.0
	maybe	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

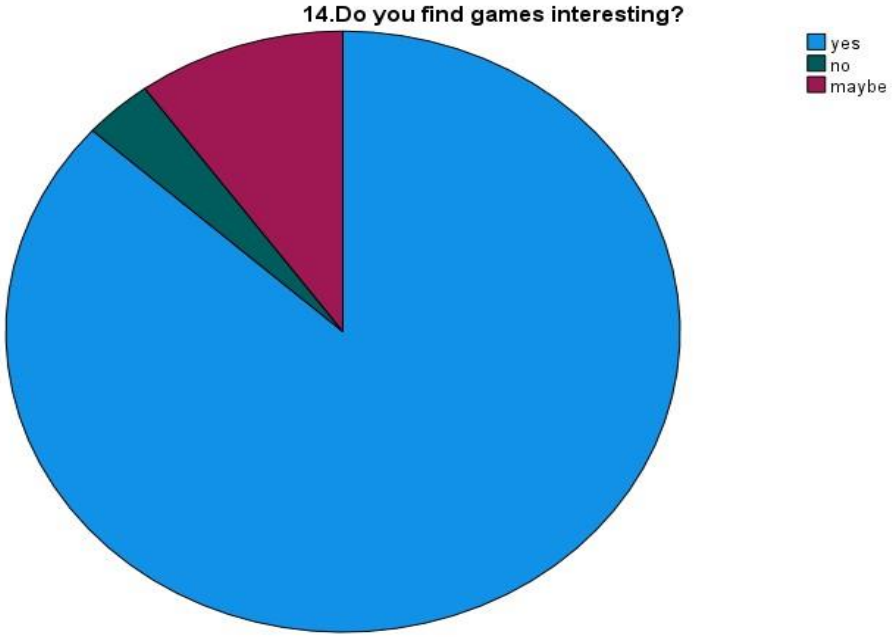

Figure 20 Report on whether learners find games interesting or not?

4.4.15 Interest in Mathematics as a Subject

Table 31 indicates the number of learners participated, while table 32, and Figure 21 demonstrate how learners they find Mathematics as a subject; do they find it interesting or not interesting, the highest percentage showed no interest at all, the survey revealed the following:

- About 53.3% are not interested in Mathematics as a subject
- While a large 43.3% of the group is interested in Mathematics - And 3.3% is not sure

Table 31 Interest in Mathematics as a subject

Statistics		
15. Do you find Mathematics interesting?		
N	Valid	30
	Missing	0

Table 32: Interest on Mathematics as A Subject?

15. Do you find Mathematics interesting?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	16	53.3	53.3	53.3
	yes	13	43.3	43.3	96.7
	maybe	1	3.3	3.3	100.0
	Total	30	100.0	100.0	

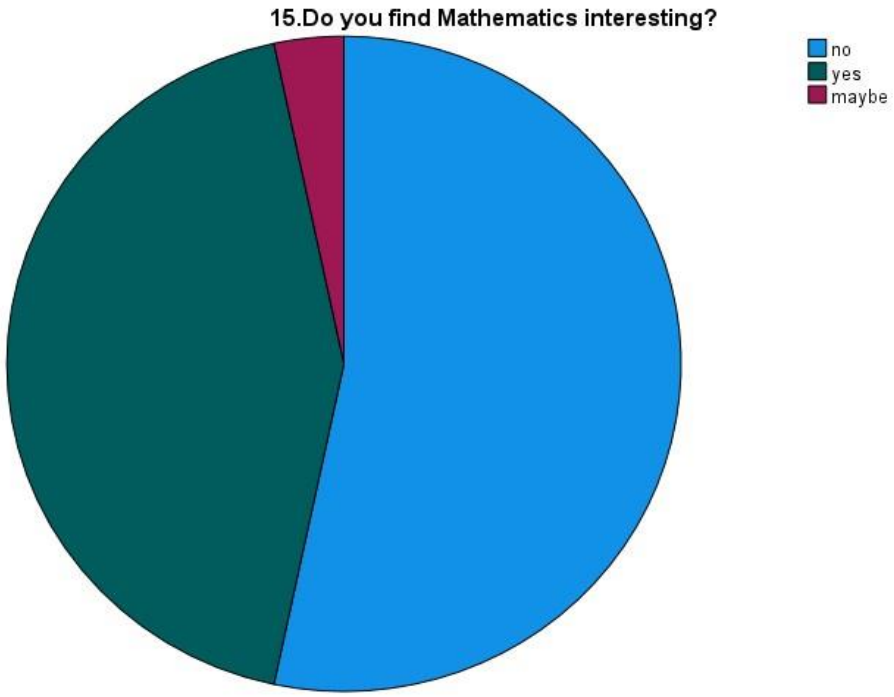

Figure 21: Report on whether Mathematics interesting?

4.5.16 Better Learning

Table 33 indicates the number of learners participated, while table 34 and Figure 22 indicates the whether learners believe that they will learn Mathematics and English better, if using games as compared to the traditional ways of learning:

- A high 80% thought that they will learn Mathematics and English better when using games as compared to the traditional classroom methods
- While 13.3% said they may not learn better with games
- And the remaining 6.7% reporting that they were not sure

Table 33: Statistical report on whether learners learn better when using games in learning or not?

Statistics		
16. Do you think you will learn mathematics or English better when using games or not?		
N	Valid	30
	Missing	0

Table 34: Do you think you will learn mathematics or English better when using games or not?

16. Do you think you will learn mathematics or English better when using games or not?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	24	80.0	80.0	80.0
	no	4	13.3	13.3	93.3
	maybe	2	6.7	6.7	100.0
	Total	30	100.0	100.0	

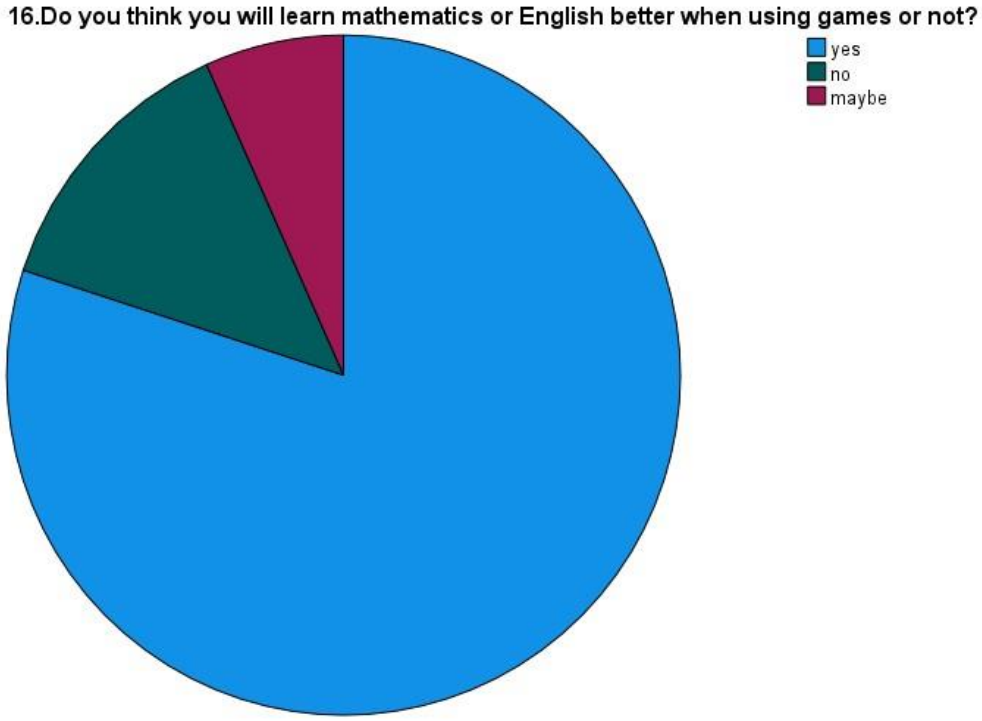

Figure 22: A report on whether learners find it better to learn Mathematics and English using games.

4.5.17 Schools and Games

Table 35 indicates the number of learners participated, while table 36 and figure 23 indicates the learner's thoughts on the use of games, whether schools will do better when using games in teaching and learning as compared to the traditional ways of learning and teaching:

- A high 80% of the learners said yes to school games in teaching and learning
- While 13.3% said no, games should not be used in teaching and learning
- And the remaining 6.7% said they are not sure
-

Table 35: A statistical Report on learners thoughts on the use of games in learning Mathematics and English.

Statistics		
17. Do you think schools should use games in teaching or learning, in all Grades especially in Primary schools?		
N	Valid	30
	Missing	0

Table 36: Do you think schools should use games in teaching or learning, in all Grades especially in Primary schools?

17. Do you think schools should use games in teaching or learning, in all Grades especially in Primary schools?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	24	80.0	80.0	80.0
	no	4	13.3	13.3	93.3
	maybe	2	6.7	6.7	100.0
	Total	30	100.0	100.0	

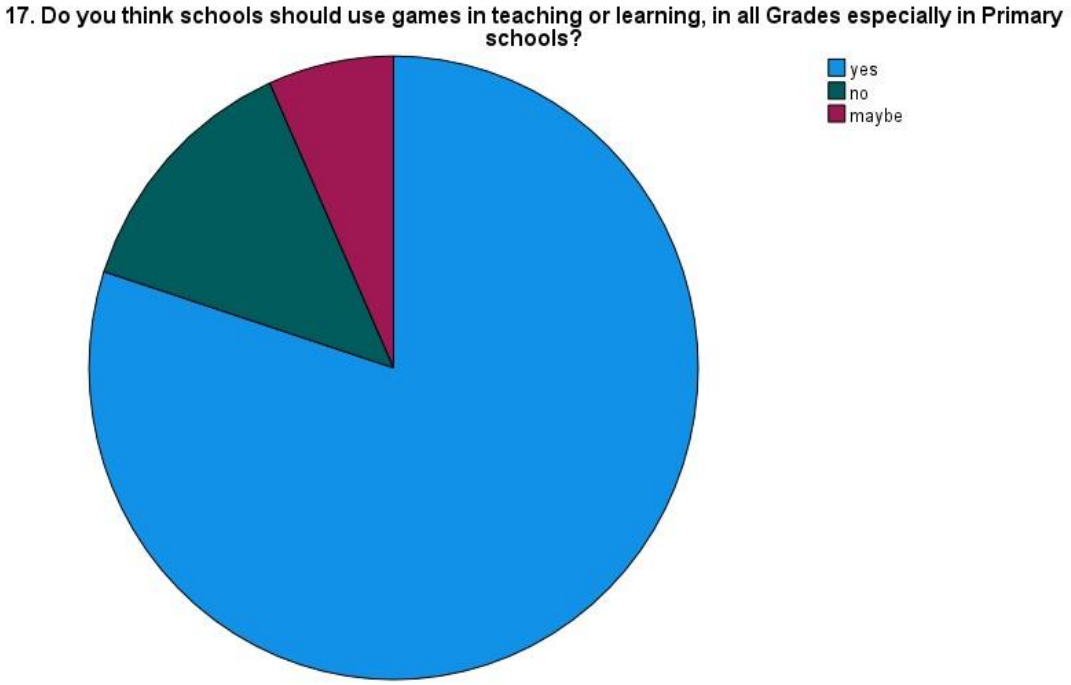

Figure 23: Thoughts on whether games should be used in teaching and learning.

4.5.18 Clarity on Games and Teaching

Table 37 indicates the number of learners participated, while table 38 and Figure 24 indicated that learner's views on whether doe they find games are interesting or not and they were asked to rate their interest on games:

- A total of 66,7% viewed games to be clear
- While the remaining 33.3% viewed them to be slightly clear

Table 37: Statistical sample on whether games are interesting to learners or not.

Statistics		
18. If you find games interesting according to question 14, how can you rate them?		
N	Valid	30
	Missing	0

Table 38: If you find games interesting according to question 14, how can you rate them?

18. If you find games interesting according to question 14, how can you rate them?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly clear	10	33.3	33.3	33.3
	clear	20	66.7	66.7	100.0
	Total	30	100.0	100.0	

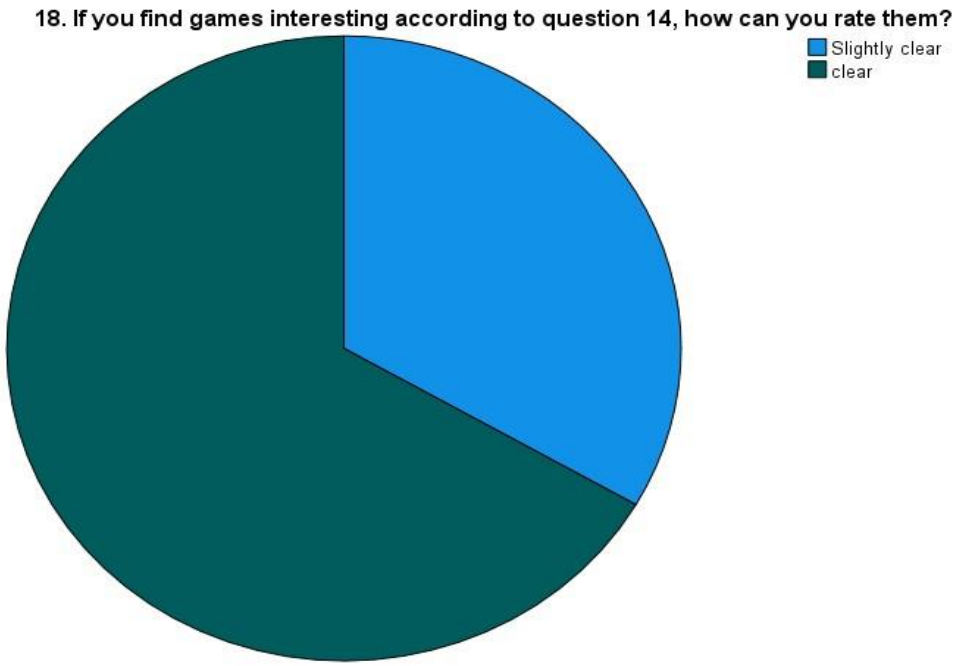

Figure 24: Report on whether learners find games interesting or not?

4.5.19 Teachers Training

Table 39 indicates the number of learners participated, while table 40 and Figure 25 determines on whether teachers need training, learners were asked a question on whether they think teachers need training on the use of games or not. Obviously, learners work very close to teachers and they can determine on whether teachers need to be trained on certain issues.

- A high 80% of the learners said that teachers need training; meaning that learners are of the view that teachers are not sufficiently trained to use games
- While 13.3% think that teachers are sufficiently trained
- The remaining 6.7% stating that they are not sure on whether teachers need training or not

Table 39: Statistical sampling on whether teachers need training on how to use games.

Statistics		
19. Do you think teacher need training on how to use games?		
N	Valid	30
	Missing	0

Table 40: Do you think teacher need training on how to use games?

19. Do you think teacher need training on how to use games?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	24	80.0	80.0	80.0
	no	4	13.3	13.3	93.3
	maybe	2	6.7	6.7	100.0
	Total	30	100.0	100.0	

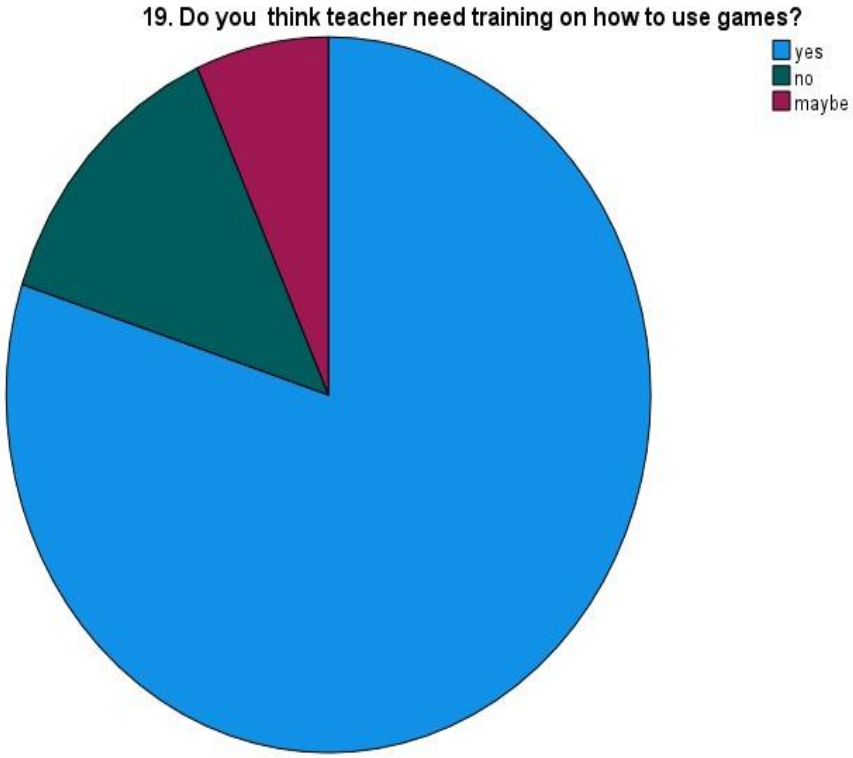

Figure 25: learners view on whether teachers should get training or not?

4.5.20 Training Periods

Table 41 indicates the number of learners participated, while table 42 as well as figure 26 surveyed on the learner's thoughts about teachers, whether they need continuous training or not, the following results were found:

- Majority of the learners, 53.3% suggested that teachers training should be more often
- While 30% of the group said that training should be sometimes
- And another 16.7% suggested that teachers do not need any training

Table 41: Statistical sampling on how often teachers need training.

Statistics		
20. If they need training, how often should they be trained		
N	Valid	30
	Missing	0

Table 42: If they need training, how often should they be trained?

20. If they need training, how often should they be trained?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	never	5	16.7	16.7	16.7
	sometimes	9	30.0	30.0	46.7
	more often	16	53.3	53.3	100.0
	Total	30	100.0	100.0	

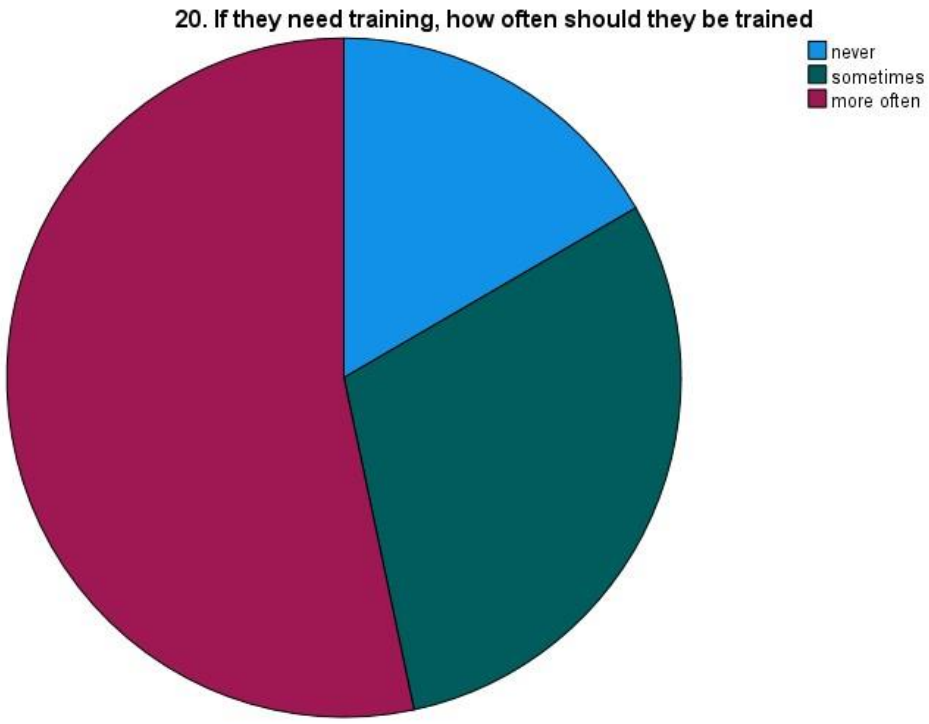

Figure 26: Learners view on how frequently do they think teachers need training.

4.5.21 Learners Views on Teacher's Attitude Towards Games

Table 44 indicates the number of learners participated, while table 45 and Figure 27 indicates the results that learners came up with after an observation of a lesson. Learners were requested to observe teachers behaviour and attitude when teaching

using games and when they teach without games during lesson. They were therefore asked to give their opinion on their observation towards teacher's behaviour, attitudes and moods when using games in teaching.

- A large 76.7% of the group think that teachers find games interesting
- While 13.3% do not find games interesting
- And the remaining 10 % are not sure on whether they find games interesting or not

Table 43: Statistical sampling on whether teachers need to use games or not.

Statistics		
21. Do you think teachers find teaching with games interesting?		
N	Valid	30
	Missing	0

Table 44: Do you think teachers find teaching with games interesting?

21. Do you think teachers find teaching with games interesting?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	23	76.7	76.7	76.7
	no	4	13.3	13.3	90.0
	maybe	3	10.0	10.0	100.0
	Total	30	100.0	100.0	

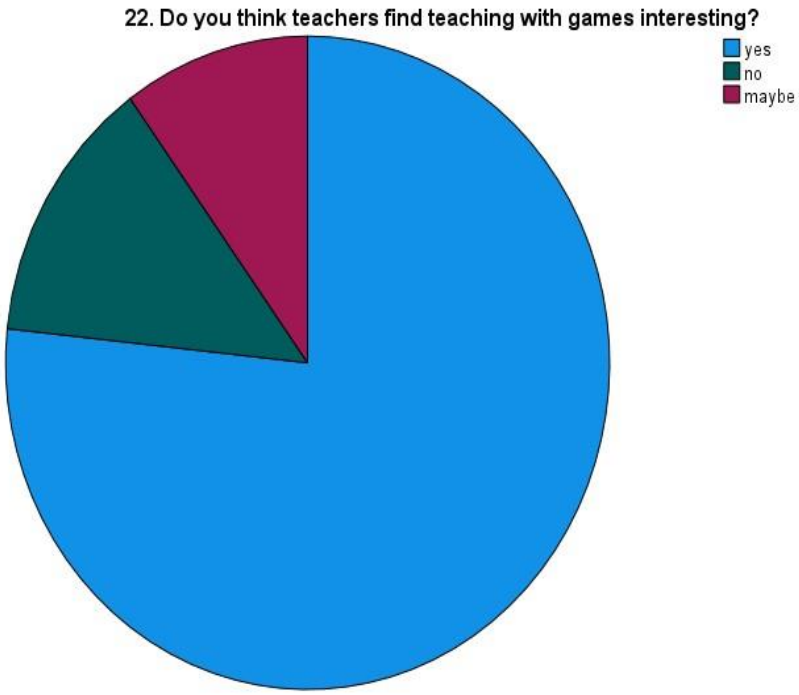

Figure 27: Learners view on whether they think teachers find games interesting or not?

4.6 Reliability of the Study

4.6.1 Reliability Coefficient/Measurements

Table 45 and 46 indicates the reliability report that was pulled from SPSS. Cronbach's Alpha is the test of the reliability of a scale in the survey; there are 30 participants or 30 cases, and there were no missing values and the participants responded to 22 questions. There are at least 3 possible responses and at most five possible responses given by participants. Cronbach's Alpha was used to determine the reliability of 18 items in this survey. Variables in this case were loaded as nominal. The scale is at .700 and therefore it is not questionable. A total of 18 of the 22 items were used in this analysis, for the analyses survey item 6, 10, and 20 were deleted to increase the overall reliability of this survey, and because they had a higher mean and a higher standard deviation, that affected the reliability of the scale. Cronbach's Alpha is simply a measure of a construct reliability.

Table 45: Statistical sampling on the reliability of the report.

Case Processing Summary			
		N	%
Cases	Valid	30	100.0
	Excluded	0	.0
	Total	30	100.0
a. List wise deletion based on all variables in the procedure.			

Table 46: Reliability of the research

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.700	.743	18

Table 47: Itemise statistical report

Item Statistics			
	Mean	Std. Deviation	N
1. What is your gender?	1.47	.629	30
2. Which Grade are you in?	2.03	.615	30
3. How old are you?	2.40	.894	30
4. Do you have access to computers /Cell phone /Tablet?	1.27	.450	30
5. Do you learn through games in your school?	1.30	.651	30

7. Do you think teachers should teach using games?	1.23	.568	30
8. If yes, how often should they teach through games?	2.70	1.088	30
9. Are lessons clear; when learning through games or not?	2.93	.365	30
11. If other teachers are not using games when teaching; will you recommend games?	1.47	.776	30
12. Do you enjoy learning with games or the old ways of teaching?	1.33	.711	30
13. Do you understand better when learning with games or not?	1.40	.724	30
14. Do you find games interesting?	1.23	.626	30
15. Do you find Mathematics interesting?	1.50	.572	30
16. Do you think you will learn mathematics or English better when using games or not?	1.27	.583	30
17. Do you think schools should use games in teaching or learning, in all Grades especially in Primary schools?	1.27	.583	30
18. If you find games interesting according to question 14, how can you rate them?	1.67	.479	30

19. Do you think teacher need training on how to use games?	1.27	.583	30
22. Do you think teachers find teaching with games interesting?	1.33	.661	30

Table 48 Scale Statistics

Scale Statistics			
Mean	Variance	Std. Deviation	N of Items
29.07	23.237	4.820	18

Table 47 indicates the itemise report of the data, while table 48 above gives a descriptive-level information about aspects of data. The descriptive statistics selected is the mean, variance and standard deviation. The table describes the central theme of the data and it also summarises the characteristics of the entire mass of data. The mean of 29.07 measure the central tendency and dispersion, it used the centre of the numeric data set. The standard deviation of 4.820 measures the tendencies and dispersion on how far and how near are the values to the average. Mean is the sum of all items of a variable divided by total number of items in a sample. Variance of 23.237 is a measure of dispersion; it measures how far a set of numbers is spread out from their average values. It also measures how far each number is set from the mean. In table 48, the mean is 29.07, while variances are 23.237 and standard deviation is represented by 4.820.

4.7 Conclusion

The chapter has demonstrated the research report acquired using the quantitative as well as the qualitative method. The qualitative dwelt more on the teachers' side as they were interviewed and responded to the research question. While the quantitative data was drawn from the learners' side and they were asked straight forward questions by completing the questionnaires whereby a selection of the answer was made. A collaborative report was drawn as we realised that the participants that is teachers and learners are of the same view that DGBL should take place, and viewed this method of learning and teaching to be interesting and encourage teacher training.

CHAPTER FIVE

DISCUSSION AND INTERPRETATION

5.1 Chapter overview

This chapter seeks to answer the three empirical question and the overall research question of this study. This will be achieved through triangulation of data, which will acknowledge DGBL as a pedagogical tool to stimulate the learning of Mathematics and English as compared to traditional way of teaching. The chapter further presents the summary of the research findings. Generation of data was through interviews and structured questionnaires. Prior to the presentation of data, it found imperative to present tools utilised with the aim of helping the reader.

5.2 Introduction

The findings suggest that GBL has affordances that may not be experienced in other learning environments; for example, the “chalk and talk approach to learning and teaching”. Outcomes propose that DGBL advances ranges of intellectual abilities. Additionally, there are indications of positive transmission of knowledge in and outside the classroom. Teachers’ attitudes towards DGBL were found to be positive to a greater extent. To enable collaboration, technologically independent and for designing suitable computer based and computer mediated discourse; a constructivist approach has been used in this research. These computers based and computer mediated discourse includes digital-games designed, to enable affordances.

5.3 Discussion and Interpretations

The objectives of this study were to determine the benefits and affordances gained from DGBL, to assist in improving results in SA schools especially in previously disadvantaged groups, create some form of interest and stimulate learning on subjects such as Mathematics and English.

The first question was posed to teachers as well learners: To what extent are DGBL used as pedagogical tools to stimulate learning in selected schools? The purpose of the question was to enquire on the use of DG by teachers in the classroom. 30 learners completed questionnaires and 4 teachers responded to this question. The main focus

of this question was to establish on whether teachers uses games in teaching and learning.

The second question was posed also posed to the two groups: What are teachers' attitudes towards the use of game-based learning in teaching Mathematics and English? Learners were expected to observe teachers, while they teach to answer this question, with the aim of answering the question from their side. The aim of this question was to determine the educators' attitudes towards games, that is important for the research; as we know that "the attitude determines the altitude".

The third question was also posed to the two groups: To what extent do teachers use game-based learning in their practice? This was looking at the time that is spent on teaching with games and or time spent in utilising games in teaching. The time measures the frequency in using games.

The fourth question was looking at pedagogical value that can be gained if teachers teach using games and on the other side learners learning progress was also considered. What are pedagogical affordances of game-based learning in and outside the classrooms?

5.3.1 Pedagogical Tools

DGBL are viewed as a pedagogical tool, in the sense that teachers view DG to be learner centred as well as allowing learners to create knowledge. With DG, learners become constructivist. Learners goes beyond the information given, while constructing their own knowledge, through DG. Learners are able to assess their performances during the process of playing game. While learning, learners get rewards for completing certain levels and they also get immediate feedback. That helps them set measurable and achievable goals, that encourage sustainable learning.

5.3.2 Affordances

Digital games are viewed as conveyers of affordances, which may not be obtainable in the traditional learning and teaching environment. The immediacy affordance is regarded as a scarce affordance in a traditional learning environment, because teachers are expected to mark the scripts first before giving feedback to learners in a traditional learning environment. Whereas with DG games, they get immediate feedback while playing. The collaborative nature of DGL fosters for diversity and

connectivity. Learner can connect with each other and play games even outside the classroom boundaries, and they may not even know each other or their opponents, through online games learning platforms, which gives learners the competency affordance, that allows them to compete virtually, with other learners from different cultural diversities and gender. The immediacy in this research highlights that learners are able to get feedback immediately from this GBL platform and teachers are not oing through the marking process before they can give feedback.

5.3.3 Attitudes

About 3 out of 4 teachers had a very positive attitude towards the use of games. The seventy-five percent said that, if games are used appropriately and efficiently, correctly matched, with content, they will yield or have a positive impact on results. Therefore, the general attitude of teachers towards DGBL are viewed as positive and educators are ready to utilise or teach using games. On the other hand, only one out of the 4 interviewed teachers viewed games as having little or no impact on results. In this context the DBE should continue train, facilitate, support and develop teachers towards DGBL. From the research, it was realised teachers are ready to use DG in teaching and learning, provided they get sufficient support from DBE. The ever increasing changes in technology and the global world require teachers and learners that are at par with changes.

1. ***To What Extent Are DGBL Used as Pedagogical Tools to Stimulate Learning***

   From the report drawn, DG are used as pedagogical tools to stimulate the learning of Mathematics and English. Looking at the teacher's responses, one can realise that DG have a way of stimulating learning, teachers highlighted that when learners learn through games, they turn to focus more on games and they do not loose concentration, unlike in the traditional classroom. They further pointed out that when learners are learning through games; learners usually want to win the game and move to next level of the game or they want to accumulate points, that encourage them to practice more and study more, so that they might move fast and beat their peers. One other thing that teachers view it as a stimulation is the fact that learners get excited, and when learners get excited, they are not lazy to do the work, and in mathematics they practice more. The point of learner

centeredness was also raised by the educators to say that, DG are learner centred and that is most important in the classroom and pedagogy. Teachers view DG as supplements or sometimes view them as substitute for textbooks and highlighted that game learning created a paradigm shift of traditional learning to active learning. Teachers also said that games can be repeated over and over again, and that in itself afford learners an opportunity to practice sufficiently. Teachers further revealed that learner's level of understanding seems to be improving when learning through games.

2. What Are Teacher's Attitudes Towards the Use of Game-Based Learning in Teaching Mathematics and English?

Seventy-five percent of the teachers agree that DG have a positive impact on results and further agree that DG may help improve the current results; especially in subjects such as Mathematics and English. Whiles the twenty-five percent argue and believe that DG has no impact on results. Most of the teachers said, they believe that if they were trained appropriately on how to use DG in teaching and learning, they will achieve tremendous results. They twenty-five percent said teachers can hardly match content to DG and how will they therefore produce results. The small unit of teachers said DG do not and have an impact on the lesson, because teachers spend a lot period of time trying to set up games in the classroom, and they could have used the time to teach traditionally and would have achieved the same results. Learners said that they believe that DG may help to improve their results; and that DG may assist them to understand subjects such as Mathematics, because they find DG games more interesting. Learners presumed that if teachers were to use games in teaching and learning, it might improve their results as many of the learners enjoy playing and prefer playing games in learning more than the traditional ways of learning and the traditional environment of teaching. According to my view, one of reasons for educators not to prefer using games, is the difficulty to match content with DG. Figure 28, demonstrates the teachers' attitude towards games:

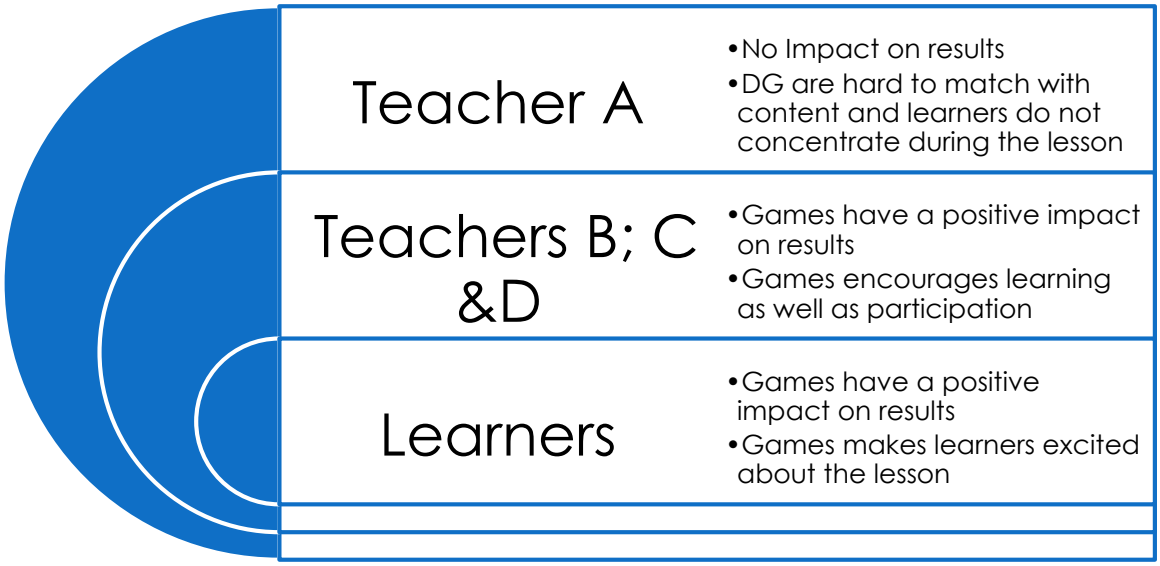

Figure 28 Teachers attitude towards games Created by NE Seabi

3. **To what extent do teachers use game-based learning in their practice?**
   Though DG have an impact on teaching and learning, it was found that teachers are not using DG in teaching and learning as often they should especially in the SA.

Looking at the learner's respond from the quantitative report, it was found that 43.3 percent of learners agree that educators do not use games often, teachers only use DG during lessons sometimes. While on the other side, 23.3 percent of the learner's population highlighted that educators never use DG in teaching and learning. Educators from the qualitative report, when they were interviewed did not in any way denied that they do not use DG in teaching and learning often. 50 percent said they were using DG often and while the other 50 percent do not use DGBL as often as they should. The teachers highlighted that; though it is believed that DG have positive impact as well as affordances on teaching and learning, it is however difficult for them to use DG in teaching and learning, because most of the time they experience some challenges with regards to games utilisation in the classroom. Challenges like continuous changes in DG software that are on Smartboards as well as learner's Tablets. The image below demonstrates how often do teachers and learners utilize DG in a classroom;

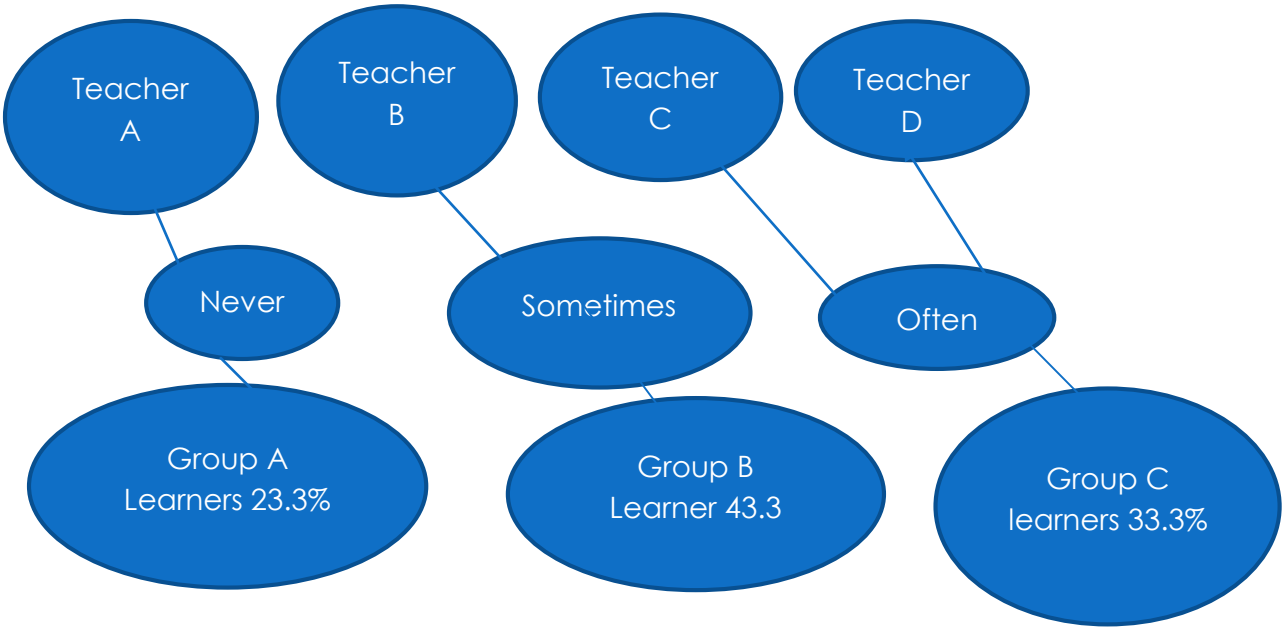

Figure 29 Utilization of DG in a classroom by teachers and learners Created by NE Seabi

4. What are the pedagogical affordances of DG in and outside the classroom?

All educators agreed that DG has affordances that cannot be found in other method of teaching and learning environments. The greater percentage of the teachers agree that; though they experience challenges in DG teaching they cannot be able to deny the affordances that are found in DG. Affordances such as immediacy, competency, collaboration, communication as well as connectivity were highlighted. The teachers highlighted that there a lot more affordances in DG as compared to the traditional learning environments. Learners alluded that games makes them have more interest in learning, especially mathematics, because games such as candy crush help them match similar items that they may not be able to match, when using pen and paper. Learners further said there is an element of enjoyment in DG, that makes them practice more and the rewards that they get in the form of badges and stars, that help them to compete more so that they can be better than their peers.

5.4 Conclusion

As already pointed in the research learners are more apt to recall their learning experience if learned through enjoyable delivery of a lesson (Smith & Clark, 2010). It has been proven that games have the ability to deliver an enjoyable lesson and should be used often in the classroom**.**

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Chapter overview

The aim of this chapter is to give a recommendation on the use of DGBL as a pedagogical tool to stimulate the learning of mathematics and English. It has become clear that educators in SA do not receive sufficient training, support and resources required to make DGBL a reality. Recommendations such as continued research, teacher development, allocation of resources and teacher support by either management or SMT were made.

6.2 Introduction

There is a collaborative factor between the quantitative and qualitative research conducted. It is realised that from both research methods, DGBL is regarded as the preferred method of learning by learners and teachers. It was detected, from the learners' side that DGBL encourages learning. Learners mostly enjoy learning through games. Learners further stressed that they enjoy learning Mathematics through games as well as English. They pointed out that, when learning through games, they turn to concentrate more because they are willing to explore and win the games with minimum supervision from the teachers.

From the qualitative research method, teachers viewed games as intrinsically motivating, as well as a tool that foster for sustainable learning and caters for multiple learning styles and intelligences that stimulates the learning of Mathematics and English. Teachers noted that learners reward themselves vicariously. That showed the collaborative factor between the two methods of research that is, qualitative and quantitative methods.

6.3 Recommendations and discussion

It is clear that SA education system is still lacking in ensuring that teachers uses DGBL in teaching and learning. It is very clear that educators recognises the importance of DG but yet that are using hem in the education practice. From the survey it is found that only a handful of educators uses games in teaching and learning. The use of this games are to a limited extend. They partially use games in

teaching and learning. Reasons highlighted on partial use of games was, most of the teachers have limited experience require, their level of competence to a certain extent is not appropriate. Educators skills on the use of ICT was another factor highlighted, it was raised that they are not competent enough to use ICT tools. The attitude that educators have towards games is positive, however another group believes that if they experience challenges in using the tool and not getting support towards the use of the tool. It will drain them to use such instrument.

In this section practical recommendations are given by the researcher amongst others.

6.3.1 Research

On the surface, DGBL might seem to be an easy pedagogical process for learners as well as teachers. It is critical that in depth research should be conducted on GBL in the teaching of Mathematics and English especially in SA schools. This might lead to a better understanding of the true impact that GBL have on lessons; and also, the impact of such tools on the learning process as well as the teaching process. It is assumed that GBL, if used efficiently and effectively, it might bring out positive results that were not expected and learning might be easier than the normal traditional learning. The analysis may also assist in exploring the interactions between learning with games and learners' thinking processes such as concentration or alertness and the ability to travel in different learning spaces, working memory as well as metacognitive variables.

6.3.2 Teacher Development

Continuous teacher development might be one of the key factors, in ensuring that teachers are more confident in using the tools. Tools like GBL may be profitable, provided educators have the confidence in using such tools. There is a strong indication from the study that teachers lack confidence in using DGBL. It is empirical that sufficient and continuous training need to be implemented in schools, with the goal to enable educators to confidently use GBL tools. This will help in improving knowledge, as well as creation of an environment that is learner centred and also the ability to match DG with content. To marry DG to learning content and to match it with

the relevant content, educators need continuous training and support. That may lead to an improvement in results for Mathematics and English. One more factor for the requirements of consistent training is an ever expanding and continuous innovations in the digital world.

6.3.3 Resources

Resources such as DGBL software should consistently be updated to afford educators with continued opportunities in using such tools; without worrying about barriers of accessibility and lack of backup that may be encountered during implementation of a lessons. Backup and accessibility are crucial for learners as well as educators, to avoid redundancy in case of load shedding.

6.3.4 Support from School Management Teams (SMT)

It is very crucial that SMT be empowered in a way that they should appreciate the benefits of GBL as well as the effective use of such tool; so that they may be able to transfer knowledge; create an environment of learning with GBL tools as well as encouraging and support educators to use the tools in schools. Training might afford SMT members; not to resist implementation of digital platforms that are offered by the DBE. Moreover, DBE should make it compulsory for SMT members to attend trainings and to submit periodic reports on operational levels.

6.4 Conclusion

For effective use of DGBL tools, teachers have needs for broad in-depth training and development. Technological transfer in the form of exchange programmes, is required for the effective use of games. A guideline for teachers on how to integrate DG in teaching and learning is recommended. The DBE may send delegates (especially teachers, teaching in the same environment) to other countries, to advance themselves, and to facilitate this program upon return for the benefit of the department.

It is also recommended that, whenever software is updated or replaced, training for teachers and SMT should be conducted upfront, to assist educators to confidently use such tools and look forward to operate the program with confident. Continuous capacity building for effective use, content matching, as well as statistical reports on

results of schools using DGBL as compared to schools that are not using games in teaching and learning should be published.

Professional learning Groups for teachers are also advised at all levels. That will encourage teachers to seek help from the groups in case they face challenges. Learners can also compete in those cluster, as well teachers, to make learning interesting and existing.

Looking at the objectives in chapter 1, I might say research objectives were partially achieved, looking at theoretical objective. However, considering the general objectives of the study like to assist in improving results in SA schools especially in previously disadvantaged groups, create some form of interest and stimulate learning of subjects such as Mathematics and English. It will take an intense support, commitment and training from relevant stakeholder (DBE, SMT, researchers, game- designers, as well as educators) to fully achieve these objectives.

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APPENDIX A - INFORMATION SHEET PRINCIPALS

The Letter to the Principal

Dear Principal

My name is Nthabiseng Seabi. I am a Masters student in the school of Education at the University of Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project and the topic of my study is, **Digital-Game Based Learning as a pedagogical tool to simulate the learning of Mathematics and English in two township schools in Gauteng South Africa** under the supervision of Dr. Reuben Dlamini.

The aim of this research is to determine the benefits and affordances gained from digital-game based learning and how they add a pedagogical value in the learning of Mathematics and English. To assist in improving results in SA schools especially the previously disadvantaged groups, create some form of interest and stimulate learning of subjects such as Mathematics and English. As a result, I will make use of observations as a method of data collection in order to gain a situational experience of how these technologies are used in practice to enhance teaching and learning. The teacher interview will also be conducted in order to understand what informs the teachers' use of these technologies in their classrooms.

As part of this project, I am requesting permission for the participation of your school in this project. The reason I have chosen your school is because there are teachers and learners who use digital games for teaching and learning. The research will focus on teachers who is teaching Mathematics and English subjects in the senior phase or foundation phase. The teachers will be invited to take part in an interview, and I will observe their lessons while teaching using digital games. With your permission, I would also like to videotape the use of digital games in the classroom. In order to capture all data related to this study, audio recording for interviews and video recording will be done in order to ensure detail in the descriptions of the use of digital games is captured for analysis purposes.

While this study will focus on the teacher teaching during lesson presentation, the teacher's and learner's faces will be blurred in the presentation of data and focus will be on what they do with their hands as to learn in they interact with the tools during the lesson so that they are not identifiable. The interview with the teacher will not affect the daily routine of teacher's duties at the school because they will be conducted before the lesson observation whenever the teacher is available, and it will not last more than 30 minutes per session. One lesson per subject identified will be observed in this study. The lesson to be observed will be taught as

per school's teaching load and timetable. During the lesson observation, I will assume the role of a passive participant while the teacher teaches with digital games in their learning.

At this stage, permission from the Gauteng Department of Education (GDE) has been sort through the submission of an ethics application and I am awaiting approval. I intend carrying out the research as soon as permission is granted by the GDE and yourself as the principal. The teachers participating in this study will be issued with the information sheet that I will brief them on and give them to read. Secondly, I will ask them to complete the consent forms which they will sign. In the case of learners, I will seek permission from the parents first. Learners will be given information sheets and consent forms to give to their parents and request that they sign to consent their child's participation in this study. Learners of parents who would not have signed the forms will be identified and will be excluded from all data presentations.

There are no foreseeable risks in participating in this study and participants will not be advantaged or disadvantaged in any way. Your school and the participant's confidentiality will be preserved as data collected will not be shared with anyone except my supervisor. Pseudo names for the participants and your school will be used in the presentation of this report. I will also assure them that their participation in this research is voluntary and they may withdraw their involvement at any time without affecting their reputation as employees in this school. I will make this report available to you for scrutiny before it is published. In the event that you wish to have a copy, a copy on its publication will be presented to you. All data will be destroyed after 5years after completion of the project.

If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0)11 717 1408, email hrec-medical.researchoffice@wits.ac.za. Please let me know if you require any further information. I look forward to your response as soon as is convenient.

I enclose two copies of this letter. Please keep one for your files.

Yours sincerely,

Researcher
Name: Nthabiseng Seabi, 2289665@students.wits.ac.za, +27 73 106 8683

Supervisor
Dr. Reuben Dlamini, Reuben.Dlamini@wits.ac.za, +27 11 717 5539

PRINCIPAL CONSENT LETTER

TITLE: **DIGITAL-GAME BASED LEARNING AS A PEDAGOGICAL TOOL TO STIMULATE THE LEARNING OF MATHEMATICS AND ENGLISH IN TWO SELECTED SCHOOLS IN GAUTENG.**

Dear Ms. Nthabiseng Seabi

I, …… (Principal) give permission to Ms. Nthabiseng Eunice Seabi to conduct her research project in this school in the topic. I understand that the research involves the participation of my teachers and learners in the school. I agree to the following:

(Please circle the relevant options below).

I agree that the participation of my teachers and learners will remain anonymous	YES NO
I agree that the researcher may use anonymous quotes in his / her research report	YES NO
I agree that the interview and lesson observations may be video or audio recorded	YES NO
I agree that the information collected may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	YES NO

…… (signature)
…… (name of participant)
…… (date)

Researcher
Name: Nthabiseng Seabi, 2289665@students.wits.ac.za, +27 73 106 8683

Supervisor
Dr Reuben dlamini, Reuben.dlamini@wits.ac.za, +27 64 002 6661

APPENDIX B – INFORMATION SHEET TEACHERS

Letter to the Teacher

Dear Sir/ Madam

My name is Nthabiseng Seabi and I am a Masters student in the School of Education at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and the topic of the study is, **DIGITAL GAME BASED LEARNING AS A PEDAGOGICAL TOOL TO STIMULATE THE LEARNING OF MATHEMATICS AND ENGLISH IN TWO SELECTED SCHOOLS IN GAUTENG** under the supervision of Dr. Reuben. Dlamini. The aim of this research project is to find out if their use of digital games has any pedagogical value in teaching and learning of Mathematics and English.

As part of this project, I would like to invite you to take part in an interview and seek your permission to also observe your lessons while you teach. This is activity involve a single interview and will take around 15 minutes. Lesson observation will take around 30 minutes. With your permission, I would also like to record the interview and the lesson observations using a cellphone. Because of the complexity of data collection of this practice, the use of videos is used to understand the value of the use of these games and come up with a thick description. Please be assured that during video recording your face and the face of the learners will be blurred.

There will be no personal costs to you if you participate in this project. Also, you will not receive any direct benefits from participation but there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. There are no foreseeable risks in participating in this study and participants will not be advantaged or disadvantaged in any way. Your school and the participant's confidentiality will be preserved as data collected will not be shared with anyone. Pseudo names for the participants and your school will be used in the presentation of this report. You may withdraw at any time or not answer any question if you do not want to. I will make this report available to you for scrutiny before it is published. In the event that you wish to have a copy, a copy on its publication will be presented to you. All data will be destroyed after 5years after the completion of the project.

If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0)11 717 1408, email hrec-medical.researchoffice@wits.ac.za. Please let me

know if you require any further information. I look forward to your response as soon as is convenient.

I enclose two copies of this letter. Please keep one for your files.

Yours sincerely
Nthabiseng Seabi

Researcher
Name: Nthabiseng Seabi, 2289665@students.wits.ac.za, +27 73 106 8683

Supervisor
Dr. Reuben. Dlamini, Reuben.dlamini@wits.ac.za, +27 11 717 5539

TEACHER CONSENT LETTER

TITLE: Digital-game based learning as a pedagogical tool to stimulate learning of Mathematics and English in two selected schools in Gauteng.

Dear Nthabiseng Seabi

I, _____ (teacher), agree to participate in the research project. The research has been explained to me and I understand what my participation will involve, I agree to the following.

(Please circle the relevant options below).

I agree that my participation will remain anonymous	YES NO
I agree that the researcher may use anonymous quotes in his / her research report	YES NO
I agree that the interview and lesson observation may be video and audio recorded	YES NO
I agree that the information I provide may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	YES NO

…… (signature)

…… (name of participant)

…… (date)

Researcher Name: Nthabiseng Seabi, 2289665@students.wits.ac.za, +27 73 106 8683

Supervisor

Dr Reuben. Dlamini, Reuben.dlamini@wits.ac.za, +27 11 717 5539

APPENDIX C – INFORMATION SHEET FOR PARENTS

Letter to the Parent

Dear Parent

My name is Nthabiseng Seabi. I am a Masters student in the school of Education at the University of Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating on **DIGITAL GAMEBASED LEARNING AS A PEDAGOGICAL TOOL TO STIMULATE THE LEARNING OF MATHEMATICS AND ENGLISH IN TWO SELECTED SCHOOLS IN GAUTENG** under the supervision of Dr. Reuben. Dlamini. The aim of this research project is to find out if their use of digital games has any pedagogical value in teaching and learning of Mathematics and English.

As part of this project, I am seeking permission for the participation of your child in this research project. I will be doing lesson observations, video and audiotaping during their class lessons on the use of Smartboards and Tablets. The focus will be on the tablets and the learners' hands as they use them, otherwise their faces will be blurred also. No names and faces will be revealed. The reason I have chosen your child is because he/she is doing the subject that I am targeting in this research, Physical Science and its taught using Smartboards and Tablets.

Your child will not be advantaged or disadvantaged in any way. S/he will be reassured that s/he can withdraw his/her permission from participating in this project without penalty. There are no foreseeable risks in participating and your child will not be paid for this study.

Your child's name and identity will be kept confidential at all times and in all academic writing about the study. His/her individual privacy will be maintained in all published and written data resulting from the study.

All research data will be destroyed after 5years after the completion of the project.

If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrec-medical.researchoffice@wits.ac.za

Please let me know if you require any further information.
Thank you very much for your support.

Yours sincerely
Nthabiseng Seabi

Researcher
Name: Nthabiseng Seabi, 2289665@students.wits.ac.za, +27 73 106 8683

Supervisor
Dr. Reuben Dlamini, Reuben.dlamini@wits.ac.za, +27 11 717 3359

PARENT CONSENT FORM

Please fill in and return the reply slip below indicating your willingness to allow your child to participate in this research project.

TITLE: DIGITAL-GAME BASED LEARNING AS A PEDAGOGICAL TOOL TO STIMULATE THE LEARNING OF MATHEMATICS AND ENGLISH IN TWO SELECTED SCHOOLS IN GAUTENG.

Dear Nthabiseng Seabi

I_____, the parent of _____

Circle one

Permission to allow your child sit in class as I observe his/her teacher teach

I agree that my child may be observed in class. YES/NO

Permission to be audiotaped

I agree that my child may be audiotaped during observations. YES/NO

I know that the audiotapes will be used for this project only YES/NO

Permission to be videotaped

I agree my child may be videotaped in class. YES/NO

I know that the videotapes will be used for this project only. YES/NO

Informed Consent

I understand that:

- My child's name and information will be kept confidential and safe and that my name and the name of my school will not be revealed.
- He/she does not have to answer every question and can withdraw from the study at any time.
- he/she can ask not to be audiotaped, photographed and/or videotape
- All the data collected during this study will be destroyed within 3-5 years after completion of my project.

Signature_____ Date

_____

Researcher
Name: Nthabiseng Seabi, 2289665@students.wits.ac.za, +27 73 106 8683

Supervisor
Dr. Reuben Dlamini, Reuben. Dlamini@wits.ac.za, +27 11 717 5539

APPENDIX D- INFORMATION SHEET FOR LEARNERS

Letter to the Learner

Dear Learner

My name is Nthabiseng Eunice Seabi and I am a Masters student in the School of Education at the University of Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, and I am investigating on **DIGITAL GAMEBASED LEARNING AS A PEDAGOGICAL TOOL TO STIMULATE THE LEARNING OF MATHEMATICS AND ENGLISH IN TWO SELECTED SCHOOLS IN GAUTENG** under the supervision of Dr. Reuben. Dlamini. The aim of this research project is to find out if their use of digital games has any pedagogical value in teaching and learning of Mathematics and English.

This letter is to seek your consent to allow me to observe your Physical Science lesson. I will be observing on how you use your tablets together with the teacher's instruction on the smartboard. During observations I will be a passive learner sitting at the back learning about the use of Smartboards and Tablets. During the observation, video recordings and audiotaping will be done only be used for data collection so that I will be able to further understand how the class went. Please be informed that the recordings will not be published anywhere after concluding the research.

I will not be using your name but I will make some mock names one to identify you. Your faces will not be visible in the video recordings. A cell phone video recording will be used in instances where data cannot be quickly captured. The focus will be on the tablets and your hands as you use them, otherwise your faces will be blurred also. All information about you will be kept confidential in all my writing about the study. Also, all collected information will be kept safely and destroyed after 5years after I have completed the project.

If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrec-medical.researchoffice@wits.ac.za I look forward to working with you.

Please feel free to contact me on the numbers below if you have any questions.

Yours sincerely

Ntthabiseng Seabi
Researcher
Name: Nthabiseng Seabi, 2289665@students.wits.ac.za, +27 73 106 8683

Supervisor

Dr Reuben Dlamini, Reuben.dlamini@wits.ac.za, +27 11 717 3359

LEARNERS ASSENT FORM

TITLE: **DIGITAL GAMEBASED LEARNING AS A PEDAGOGICAL TOOL TO STIMULATE THE LEARNING OF MATHEMATICS AND ENGLISH IN TWO SELECTED SCHOOLS IN GAUTENG.**

Dear Nthabiseng Seabi

I, ……., agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous	YES NO
I agree that the researcher may use anonymous quotes in his research report	YES NO
I agree that the interview may be audio recorded	YES NO
I agree that the information I provide may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	YES NO

…… (signature)

…… (name of participant)

…… (date)

Researcher

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