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Antecedents to the effectiveness of Game-based learning environments for the Net generation: A Game Task Fit and Flow Perspective

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Abstract

Purpose: There is a general consensus that games are effective as learning tools. There is however, a lack of knowledge regarding what makes games effective as a learning tool. The purpose of this study is therefore to answer the question: what are the antecedents of an effective game-based learning environment for the Net generation? The Net generation comprises individuals who prefer to learn using games as a tool.

Aim: The aim of this dissertation is to develop a conceptual framework that reflects the antecedents of an effective game-based learning environment for the Net generation. The conceptual framework combines the IS Success Model, and the Task-Technology Fit and Flow theory.

Method: The study used a quantitative method. Data was collected using an online instrument. The study used 125 participants from mainly the United Kingdom, United States and South Africa. The model was validated using confirmatory factor analysis and tested using multiple regression analysis.

Key Findings: The identified antecedents of effectiveness are Game-Task Fit and Flow, where Flow consists of Clear Goals, Feedback and Concentration. Additionally, the Use factor in the model is replaced by Perceived Usefulness. The Conceptual Framework can be used as an evaluation tool for effective game-based learning environments for the Net generation.

Keywords: Game-Based Learning, Effectiveness, Learning, IS Success, Task-Technology Fit, Motivation, Challenge, Interactivity, Immersion, Feedback and Clear goal, Perceived Usefulness, Enjoyment, Flow, Enjoyment, Game Quality, Information Quality, Satisfaction, Use, Net benefits, Success.

CHAPTER ONE: INTRODUCTION

1.1. Background

The Net generation comprises individuals born after 1982 (Valtonen *et al*., 2011). The Net generation has a number of synonyms. Three of these are Millennials, Generation Y and Digital Natives (Roodt & Peier, 2013). This classification emerges from the idea that individuals born in this period have lifestyles that depend on technology and are fascinated with new technologies (Evans & Forbes, 2012).

These individuals differ from preceding generations, namely the Matures, Baby Boomers and Generation X who were born between 1900 and 1942, 1943 and 1960 and 1961 and 1981 respectively (Johnston, 2013). In contrast to these generations, these individuals use media more than any previous generation (Rosen, 2011).

There are, however arguments that the traits that define the Net generation do not completely depend on age and that the traits are not common throughout all the individuals born after 1982 (Gu, Zhu, & Guo, 2013). For this context, the Net generation will refer to individuals born after 1982 who depend on technology daily and will exclude individuals born before 1982 who are digital immigrants. Digital immigrants are people who were not born in a world driven by technology, but join the technology world to an extent that they become digitally fluent (Valtonen, Dillon, Hacklin, & Väisänen, 2010).

An individual who fall under the Net generation are of interest because of the manner in which they think and learn differs from that of other generations (Morris, 2011; So, Choi, Lim, & Xiong, 2012). These individuals prefer to learn by doing rather than listening (DeSilets & Dickerson, 2011). This creates a problem for higher education institutions concerned with accommodating the Net generation who make up most of the student population (Worley, 2011).

These learners require a relevant educational experience that traditional methods cannot offer (Green, 2012). Classroom learning generally consists of a teacher delivering face-to-face instruction (Wu, Tennyson, & Hsia, 2010). However, the convenient provisions of a large amount of information, due to the internet, leads to an increase in the use of technology (Margaritidis & Polyzos, 2001). This use of technology leads to the incorporation of internet

information into the school curriculum (Rye, 2009).

The use of the Internet and technology in learning environments creates an environment known as an e-learning environment (Chen, Su, Wu, Shieh, & Chiang, 2011). Learning environments consist of a time, place, and space (Khanlarian & Singh, 2014), but the constraints of time and space are overcome by e-learning with internet and technology (Joo, Joung, & Sim, 2011).

E-learning involves "training sessions or educational courses delivered electronically (Upadhyaya & Mallik, 2013, p1)". E-learning environments may also take the form of mobile learning, which is providing learning using devices such as laptops, smart-phones and tablets, by means of connecting to the Internet using wireless connectivity (Thinley, Reye, & Geva, 2014). E-learning environments can also use multimedia tools that can include still images, animation, video, and audio presentations (Moos & Marroquin, 2010).

One such learning environment that uses multimedia is a game-based learning environment, which uses games as learning tools (Hess & Gunter, 2013). Game-based learning environments will be the focus of this study because there is evidence that using games for learning is generally found to be more positive than traditional instruction (Chiu, Kao & Reynolds, 2012; Girard, Ecalle, & Magnan, 2013; Jung & Won-Hyung Lee, 2013). The concept of learning with games is particularly interesting to individuals who incorporate technology into their daily lives (Bekebrede, Warmelink, & Mayer, 2011; Girard *et al*., 2013; Gu *et al*., 2013). Consequently, the following section will discuss game-based learning environments in detail.

1.2. Game-based learning environments

A game is:

> *"a rule-based formal system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels attached to the outcome, and the consequences of the activity are optional and negotiable* (Aponte, Levieux, & Natkin, 2011, p205)*".*

The types of games that game-based learning environments use are educational games (Erhel & Jamet, 2013). Educational games are games that combine curriculum goals with gameplay, in order for individuals to reach a learning outcome (Nicholson, 2011). Educational games also refer to commercial games, known as serious games, which have the purpose of teaching a specific skill (Annetta, 2010). There are different types of game genres currently available on the market (Sherry, 2013). This study will consider different types of educational games.

Although games have proven to be as effective or more so, in some instances, than traditional classroom methods (Chin, Dukes, & Gamson, 2009), there are, however limited studies on the effectiveness of educational games (Kebritchi, Hirumi, & Bai, 2010; Fang & Strobel, 2011; Blanco *et al*., 2012; Dieckmann, Friis, Lippert, & Østergaard, 2012; Girard *et al*., 2013; Hess & Gunter, 2013). The studies that do exist are studies from several years ago (Bellotti, Kapralos, Lee, Moreno-Ger, & Berta, 2013). This leads to the problem statement of this study.

1.3. Problem Statement

There is currently disagreement on the definition of effectiveness, but it is clear that effectiveness pertains to achieving the desired outcome, which is synonymous with success (Ramezan, 2011). Considering that the objective of educational games is to transfer skills and knowledge to a player (Brom, Šisler, & Slavík, 2010; Girard *et al*., 2013), a lack of this knowledge transfer would defeat the purpose of game-based learning.

Additionally, technology-enhanced learning does not imply that transferring knowledge to the individual is automatic, even though these students enter a university with digital skills (Gros, Garcia, & Escofet, 2012; Oksanen & Hämäläinen, 2014). There is therefore, a need for some form of assessment. This is because the use of assessment can demonstrate that the educational game has met the intended learning goal or objective (Bellotti *et al*., 2013).

However, measuring the effectiveness of games as a learning tool is currently a problem because there is a lack of knowledge regarding what makes games effective as a learning tool (Vogel *et al*., 2006; Pivec, 2007; Guillén-Nieto & Aleson-Carbonell, 2012; Petter, DeLone, & McLean, 2013; Mayer *et al*., 2014). This leads to the purpose of this study.

1.4. Purpose of the study

The purpose of the study is to answer the question: What are the antecedents of an effective game-based learning environment for the Net generation? The aim of this study is to investigate the effectiveness of games as a learning tool. Conducting a comprehensive literature review to reveal the factors that comprise the effectiveness of game based learning will achieve this aim. The objective is to use the information to create a conceptual model that will allow for measuring the effectiveness of game-based learning environments for the Net generation. The dissertation will follow the layout below.

1.5. Layout of the dissertation

The dissertation will begin with a literature review. This review will detail what the current literature considers as the antecedents of an effective game-based learning environment for the Net generation. This chapter will introduce the conceptual framework. The next chapter will discuss the methodology that the research followed. The results and a discussion of the results will follow.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

The research and development of games as educational tools can advance through documenting factors that make educational games effective (Wong *et al*., 2007). Alas as per the problem statement, there is scarce research pertaining to the factors that makes games effective as educational tools. This section will therefore explore the antecedents to effective game-based learning environments.

Considering that effectiveness is synonymous with success, the effectiveness of a system comes with the success of a system. The definition of success does not have one definition, making it important to determine what success will be in each context (Thomas & Fernández, 2008). As aforementioned, the purpose of game-based learning will be an increase in skill, knowledge or performance for the Net generation, using games as a learning tool.

An appropriate model to measure effectiveness used by a number of researchers is the IS Success Model, which contains success as a dependent variable by DeLone and McLean (1992) (Wang, Wang & Shee, 2007; Khayun, Ractham, & Firpo, 2012). A discussion of this model will be under Section 2.2. There is however an issue with the measurement of effectiveness in game-based learning research.

A number of researchers investigated whether or not games are effective and concluded that there is evidence of effectiveness (Girard *et al*., 2013). One such study is by Hainey, Connolly, Stansfield, & Boyle (2011), who prove that games are effective as learning tools for higher education. Vogel *et al*. (2006) conducted a meta-analysis and concluded that game-based learning is more effective than traditional methods.

There are, however studies that prove that games are effective, but not more effective than traditional methods (Girard *et al*., 2013). An example is a study by Annetta, Minogue, Holmes and Cheng (2009), who studied the effectiveness of games in teaching genetics. The study concluded that the use of games did not increase the knowledge of the game user. There are also studies such as that by Brom, Šisler, & Slavík (2010), who state that games are effective, but not for long-term retention. Girard *et al*. (2013) conducted a meta-analysis that found that there is evidently a conflict in the studies pertaining to whether or not games are

effective. This concludes that there is disparity in whether or not games are effective learning tools.

This shows that in a game-based learning environment, the measurement of the success of the game as a learning tool alone is not sufficient. An additional reason is that there is a need for the technology to fit the task, in order to complete its purpose (Gebauer & Ginsburg, 2009; Ma, Chao, & Cheng, 2013; Shih & Chen, 2013; Lee & Lehto, 2013; Huscroft, Hazen, Hall, & Hanna, 2013). In e-learning environments, the fit between the task and technology leads to effectiveness (Lin, 2012). Particular to games, the fit between the goal and the game is important because tension between the goal of the game and the learning outcome decreases its learning effectiveness (Brom *et al*., 2010).

In addition to this, in order to ensure that pedagogical foundations are met, the goal of the educational game needs to match the learning task (Lee, Cerreto, & Lee, 2010; Blanco *et al*., 2012). The match between the game and task also leads to better performance (Fuller & Dennis, 2009; Gebauer, Shaw, & Gribbins, 2010; Gu *et al*., 2013; Yang, Kang, Oh, & Min, 2013; Avital & Te'eni, 2009). A match between the task and the game is therefore an antecedent of an effective game-based learning environment. This antecedent, in this context, will be Game-Task Fit.

Fit is "the degree to which a technology assists an individual in performing his or her portfolio of tasks (Robles-Flores & Roussinov, 2012, p.441)". In this context, fit refers to the degree that a game assists an individual in performing his or her learning task. An effective model to measure the fit between technology and tasks is a model by Goodhue (1995) named the Task-Technology Fit (Goodhue & Thompson, 1995).

The Task Technology Fit (TTF) is a framework with four constructs, which measures the level to which the technology fits the requirements of a task with the dependent variable in the framework being Task-Technology Fit (Goodhue, 1995). Task Technology Fit will be Game-Task Fit in this instance. This discussion of this model will take place under Section 2.3.

Alas, it is difficult to select one game that will reach the specific task, due to the wide variety of games available on the market (Liu & Lin, 2009). These different types of games fall

under different genres (Gros, 2007) and need to accommodate different types of platforms such as "PC, console systems, Websites, smartphones, cell phones, tablets, and handheld devices (Oswald, Prorock & Murphy, 2013, p1)".

This huge pool of games makes it important to consider the characteristics of the game. Additionally, the characteristics of the technology have to contribute positively towards the performance of the user, to increase the fit perception of the user (Goodhue, 1995). The user also needs to feel that the characteristics of the technology support the purpose of using the technology (Saeed & Abdinnour-Helm). The game characteristics need to support both the hedonic and utilitarian purpose. This is because educational games have a utilitarian and a hedonic purpose.

Utilitarian systems are systems that are purely for productivity and hedonic systems are systems that are purely for entertainment purposes (Wu & Lu, 2013). An element that is appropriate to add the utilitarian purpose is *Perceived Usefulness* and a factor that is appropriate to add the hedonic purpose is *Enjoyment* (Davis, Bagozzi & Warshaw, 1992; Agarwal & Karahanna, 2000; Yi & Hwang, 2003; Hess, McNab, & Basoglu, 2014).

Perceived Usefulness is the "user's belief that using the system will improve his or her performance (Lee & Lehto, 2013, p194)". *Enjoyment* is "the pleasurable aspects of the interaction described as being fun and enjoyable rather than boring (Lowry *et al*., 2013, p620)". The discussion of *Perceived Usefulness* and *Enjoyment* will take place under sections 2.4 and 2.5, respectively.

The inclusion of *Perceived Usefulness* and *Enjoyment* to the IS Success Model is beneficial. This is, however, not sufficient for educational games. This is because it is important to examine the external factors that enhance Perceived Usefulness (Hsu & Lu, 2004) and Enjoyment (Fang, Zhang & Chan, 2013) in games. Additionally, the incorporation of educational theory in educational games will ensure that the effectiveness of the game is significant (Hwang, Sung, Hung, Yang, & Huang, 2013).

There are characteristics listed by Norman (as cited in (Pivec & Kearney, 2007), p267) that are required for an effective game-based learning environment. A theory that correlates with these characteristics is the Flow theory. Flow theory is a theory by Csikszentmihalyi and

LeFevre (1989) that refers to the "process of optimal experience (Jin, 2012, p169)". The discussion of Flow will be under Section 2.6.

In summary, this study sets out to contribute to research with the addition of Game-Task Fit, Perceived Usefulness, Enjoyment and Flow to the IS Success Model. The purpose of this addition should increase the amount of research that agrees that games are effective as learning tools for the Net generation, while introducing antecedents that increase this effectiveness. The following sections discuss these antecedents in detail. The development of the hypotheses and research model will be included in the discussion, to avoid repetition (Webster & Watson, 2002).

2.2. Game-based Learning Effectiveness

The IS Success Model is one of the most influential frameworks that measure success (Freeze, Alshare, Lane & Wen, 2010). There is still, however, the issue of determining which constructs to include in the model (Rai, Lang & Welker, 2002). The model is appropriate due to the framework providing a synthesis of literature on the antecedents of system effectiveness that categorises the results into six constructs namely system quality, information quality, use, user satisfaction, individual impact and organisational impact (Ramezan, 2011).

Delone and McLean (2003) however, evolve the framework over time and the resulting framework still has system quality, information quality, user satisfaction, but adds service quality. This model suggests that use or intention to use can represent use and combine individual impact and organisational impact into a single construct called net benefits. Figure 1 depicts the relationship between the constructs in the updated framework.

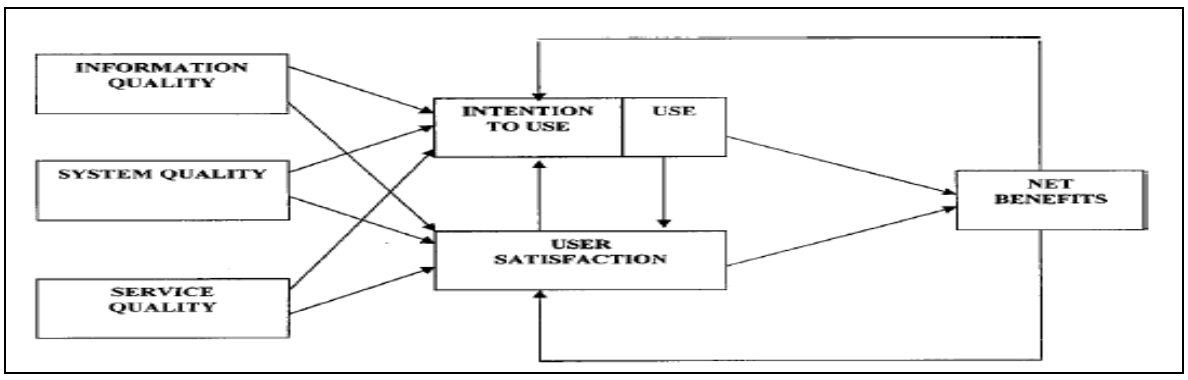

Figure 1: IS Success Model. Source: Delone and Mclean (2003)

2.2.1. Net Benefits

Net Benefits are a balance of positive and negative impacts (Khayun *et al*., 2012). Delone and McLean (2003) raise three questions that require an answer before using *Net Benefits*, which are: What qualifies as a benefit? For whom? At what level of analysis?

To answer the first question, since the impact of game-based learning environments is knowledge transference or learning, *Net Benefits* will measure the balance between the positive and negative impacts of educational games on knowledge transference or learning.

To answer the second question, considering that the evaluation of multimedia should focus on the user (Hamam & Saddik, 2013) and that games are multimedia technologies, the *Net Benefits* will be for the benefit of the user. More specifically, the *Net Benefits* are for users who are part of the Net generation and use games for learning.

To answer the third question, the level of analysis will be at an individual level, because the focus is on the user; and learning environments that use technology are unique to each user (Khanlarian & Singh, 2014).

2.2.2. Use

The measurement of *Use* of a system is the actual utilisation of the system or the *Intention to Use* a system (Delone & McLean, 2003). Playing a game is a system-use behaviour (Kuss, Louws, & Wiers, 2012), but in order for human beings to carry out a particular behaviour, they should intend to carrying out the behaviour (Park, Roman, Lee, & Chung, 2009). To assume intention to use, the study will only focus on individuals who voluntarily play the educational games.

Additionally, the confirmation of post-adoption usage of technology is necessary to consider technology use to be a success (Thong, Hong & Tam, 2006; Zhou, 2011). The measuring of the success of technology, after utilisation, proves to be more important than measuring intention to use (Agrifoglio, Black, Metallo & Ferrara, 2012). The *Use* construct in this context will therefore measure the post-adoption utilisation of a game, if the user intends to use the game.

Use has an influence on *Net Benefits* and on *Satisfaction* (Delone & McLean, 2003). This leads to the following hypotheses:

H1: The greater the use of a ***game for learning,*** the greater the *Net Benefits* gained.

H2: The greater the use of a ***game for learning,*** the greater the *Satisfaction* gained.

2.2.3. Satisfaction

Satisfaction measures the user experience with a system (De Oliveira, Cherubini, & Oliver, 2013). User experience is "a person's perceptions and responses, resulting from the use or anticipated use of a product (Takatalo, Häkkinen, Kaistinen, & Nyman, 2011, p657)". *Satisfaction* measures the extent to which the users of a system feel that the system meets their needs (Freeze *et al*., 2010).

Satisfaction has an influence on *Net Benefits* and on *Use* (Delone & McLean, 2003). This leads to the following hypotheses:

H3: The greater the satisfaction with a ***game for learning*** the greater the *Net Benefits* gained.

H4: The greater the satisfaction with a ***game for learning*** the greater *Use* increases.

2.2.4. Game Quality

System Quality takes cognisance of issues such as usability, availability, reliability, adaptability and response time of a system (Delone & McLean, 2003). In the context of game-based learning, *Game Quality* is the equivalent concept of interest. The characteristics of the game should promote *Game Quality* (Hamam & Saddik, 2013). A well-designed game is more likely to contribute towards learning effectiveness (Mwangi, Waweru, & Mwathi, 2011).

Game Quality has an influence on *Use* and *Satisfaction* (Delone & McLean, 2003). This leads to the following hypotheses:

H5: The greater the quality of a ***game for learning*** the greater the *Satisfaction* gained.

H6: The greater the quality of a ***game for learning*** the greater *Use* increases.

2.2.5. Information Quality

Information Quality is the precision, relevance, sufficiency, timeliness and currency of information (Delone & McLean, 2003). *Information Quality* ensures that the perception of the user is that the information in the system is necessary, correct, current, and up-to-date and that the information is appropriate (Setia, Venkatesh & Joglekar, 2013).

Information Quality has an influence on *Use* and *Satisfaction* (Delone & McLean, 2003). This leads to the following hypotheses:

> **H7:** The greater the quality of the information a ***game for learning*** the greater *Use* increases.
>
> **H8:** The greater the quality of the information a ***game for learning*** the greater the *Satisfaction* gained.

2.2.6. Service Quality

Service Quality relates to the support that a manufacturer, vendor or help desk may provide to the end user of an IS (Delone & McLean, 2003). *Service Quality* is beyond the scope of this study and will therefore not be included in the model for game-based learning.

In summary, the definition of effectiveness using this model is that effectiveness stems from the user receiving net benefits based on their usage of the system and the satisfaction the system provides. Game quality and information quality of the system are also a consideration.

2.3. Game-Task Fit

There are six perspectives of fit available, namely fit as moderation, mediation, matching, gestalts, profile-deviation and covariation, but fit as matching, which is the relationship between two variables (Cane & McCarthy, 2009) is the relevant perspective. The Task-Technology Fit Model is appropriate because the model views the fit between the task and the technology using the fit as matching perspective (Junglas, Abraham, & Watson, 2008; Liu, Lee, & Chen, 2011).

The use of the Task-Technology Fit Model is evident in a number of studies. Examples are learning management systems (McGill, Klobas, & Renzi, 2011), social networking (Lu & Yang, 2014), mobile locatable information systems (Junglas *et al*., 2008), question-answering technology (Robles-Flores & Roussinov, 2012), nursing information systems (Hsiao & Chen, 2012), blended e-learning systems (Ma *et al*., 2013), picture archiving and communication system (PACS) upgrade (Lepanto, Sicotte, & Lehoux, 2011), mobile commerce (Shih & Chen, 2013) and eBooks (D'ambra *et al*., 2013). This study will contribute to Task-Technology Fit research for games.

Task-Technology Fit has relationships with constructs in the effectiveness model. The relationships are that Task-Technology Fit contributes to *Use* (Goodhue, 1995), *Satisfaction*

(Kuo & Lee, 2011; Lin, 2012) and *Performance* (Goodhue, 1995). For this study, *Performance* is *Net Benefits*. This leads to the following hypotheses:

H9: The greater the fit between the task and a ***game for learning*** the greater *Use* increases.

H10: The greater the fit between the task and a ***game for learning*** the greater the *Satisfaction* gained.

H11: The greater the fit between the task and a ***game for learning*** the greater the *Net Benefits* gained.

2.4. Perceived Usefulness

The inclusion of *Perceived Usefulness* to the IS success model strengthens the model (Saeed & Abdinnour-Helm, 2008). As aforementioned, *Perceived Usefulness* accounts for the utilitarian purpose of educational games. The utilitarian purpose of educational games is for knowledge transfer or learning (Chen, Liao, Cheng, Yeh, & Chan, 2012; Al Sarhan *et al*., 2013; Jovanovic, Starcevic, Minovic, & Stavljanin, 2011; Brom, Preuss, & Klement, 2011). In this context, the utilitarian purpose is to increase *Net Benefits*. This leads to the following hypotheses:

H12: The greater the perceived usefulness with a ***game for learning*** the greater the *Net Benefits* gained.

Perceived Usefulness is also a known contributor to the intention to use technology (Yi & Hwang, 2003; Saeed & Abdinnour-Helm, 2008). In this context, *Perceived Usefulness* will therefore contribute to *Use*. This is valid because the addition of *Perceived Usefulness* in the success model is valid before or after the utilisation of the technology (Venkatesh & Davis, 2000; Saeed & Abdinnour-Helm, 2008). Therefore, *Perceived Usefulness* influences pre and post voluntary use of technology. This leads to the following hypotheses:

H13: The greater the perceived usefulness of a ***game for learning*** the greater **Use** increases.

Perceived Usefulness also contributes to *Satisfaction* (Hsu, Wu & Chen, 2012; Lee & Lehto, 2013). Game-Task Fit precedes this relationship by contributing to *Perceived Usefulness* (Lee & Lehto, 2013; Shih & Chen, 2013). This leads to the following hypotheses:

H14: The greater the perceived usefulness with a ***game for learning*** the greater the *Satisfaction* gained.

H15: The greater the fit between the task and a ***game for learning*** the greater the *Perceived Usefulness* increases.

Game Quality and *Information Quality* contribute to *Perceived Usefulness* (Seddon, 1997; Zhu, Lin & Hsu, 2012). This leads to the following hypotheses:

H16: The greater the quality of a ***game for learning*** the greater the *Perceived Usefulness* gained.

H17: The greater the quality of the information of a ***game for learning*** the greater the *Perceived Usefulness* gained.

2.5. Enjoyment

Enjoyment is a crucial factor to consider in hedonic systems (Heerink, Kröse, Wielinga & Evers, 2008). Particular to games, *Enjoyment* is the main reason why users play games (Shafer, 2012; Connolly *et al*., 2012). *Enjoyment* also has relationships with existing constructs.

Enjoyment leads to the intention to use technology (Heerink, Kröse, Wielinga & Evers, 2008; Lin, Wang & Chou, 2012). In this context, *Enjoyment* will therefore contribute to *Use*. The existence of this relationship between *Enjoyment* and *Use* is evident in other studies (Teo, Lim & Lai, 1999; Teo & Noyes, 2011). *Enjoyment* also contributes to *Perceived Usefulness* (Yi & Hwang, 2003; Teo & Noyes, 2011). This leads to the following hypotheses:

H18: The greater the enjoyment in a ***game for learning*** the greater *Use* increases.

H19: The greater the enjoyment in a ***game for learning*** the greater *Perceived Usefulness* gained.

2.6. Flow

The application of the flow theory extends to a number of fields including gaming research (Hsu & Lu, 2004). Previous studies on flow examined different dimensions of flow (Webster, Trevino & Ryan, 1993; Agarwal & Karahanna, 2000; Jung, Perez-Mira & Wiley-Patton, 2009). This study will however focus on the original nine dimensions of flow.

These dimensions are:

(1) A balance between the challenge of the task and skills of the individual,

(2) A merging of action and awareness

(3) Clear perceived goals,
(4) Unambiguous feedback,
(5) Focusing on the task at hand,
(6) A sense of control of the activity,
(7) A loss of self-consciousness,
(8) Time transformation, and
(9) An autotelic, intrinsically rewarding experience (Hamari, 2014, p134).

A challenging activity that requires skills is "activities that require the investment of psychic energy, and could not be done without the appropriate skills (Fang, Zhang & Chan, 2013, p457)". A challenging activity that requires skills matches the challenge effective game-based learning environment characteristic. The characteristic states that a continual feeling of challenge leads to learning (Pivec & Kearney, 2007).

2.6.1. Challenge

Challenge is where a player has to apply effort to reach an outcome (Sedano *et al*., 2013). *Challenge* is a necessary factor in learning environments, because tasks that provide challenges result in higher levels of learning (Hughes, 2010). Challenging tasks encourage individuals to go beyond the requirements of the task (Sedano *et al*., 2013).

The challenging characteristics of games cause the internalisation of knowledge (Chang, Peng, & Chao, 2010). These characteristics arise from hidden, interconnected and interwoven parts that are present in the game (Hong *et al*., 2009). *Challenge* also triggers the curiosity in a player and therefore leads to more exploration in the game, which leads to learning (Feng, 2011).

Engaging in challenging game tasks increases the motivation of individuals (Lowry, Gaskin, Twyman, Hammer, & Roberts, 2013). Nonetheless, players get bored if the game is too easy and feel frustration if the game is too hard (Alexander, Sear, & Oikonomou, 2013; Sedano *et al*., 2013). *Challenge* is an important factor for the Net generation who are curious and prefer exploration (Skiba & Barton, 2006). In conclusion, it is important to ensure that the game is challenging to reach the learning outcome for the Net generation.
Clear Goals are having an "objective that is distinctly defined (Fang, Zhang & Chan, 2013, p457)". *Clear Goals* match the clear goals effective game-based learning environment

characteristic. The characteristic states that having a specific goal leads to learning (Pivec & Kearney, 2007).

2.6.2. Clear Goal

Games are goal-oriented experiences (Bellotti *et al*., 2013) and game-based learning is a goal-directed process (Hong *et al*., 2009). *Clear Goals* in games are a necessary feature to facilitate high-quality education (Jovanovic *et al*., 2011). Games that lack clear objectives may result in individuals misinterpreting the actual goal of the game and therefore lead to negative learning outcomes (Charoenying, 2010).

Clear Goals are important, because having set goals leads to academic achievement (Diseth & Kobbeltvedt, 2010). *Clear Goals* also lead to the motivation to acquire new skills (Lu, Lin, & Leung, 2012). This motivation to pursue tasks leads to performance (Khanlarian & Singh, 2014). Goal-orientation in games is also good for the Net generation who are goal-orientated (Walter, 2013). It is therefore important to ensure that the game has clear goals to reach the learning outcome for the Net generation.

Feedback involves the user knowing "instantly how well one is doing (Fang, Zhang & Chan, 2013, p457)". Feedback matches the feedback effective game-based learning environment characteristic. The characteristic states that having high intensity feedback leads to learning (Pivec & Kearney, 2007).

2.6.3. Feedback

Feedback is information on the current and overall performance in terms of correct or incorrect answers and providing guidelines on how to make revisions to the performance (Serge, Priest, Durlach, & Johnson, 2013). *Feedback* can either let the student know what the correct answer is or help regulate learning (Guasch, Espasa, Alvarez, & Kirschner, 2013). In this context, *Feedback* will refer to any information whether it is corrective, regulatory or relates to performance.

Feedback is a "critical component of any learning process because it allows learners to reduce the discrepancy between actual and desired knowledge (Butler, Godbole, & Marsh, 2013, p.290)". The provision of *Feedback* leads to deep learning (Erhel & Jamet, 2013). Corrective feedback in particular fosters knowledge acquisition in the long term (Cornillie, Clarebout, & Desmet, 2012).

The *Feedback* that the player gets during a game allows them to track their progress towards achieving the goal of the game (Cornillie *et al*., 2012). The benefit with games is that the *Feedback* is instant (Lim *et al*., 2011). Instant feedback that games provide allow the learner to receive suggestions that assists them in correcting areas of weakness immediately (Jong, Lai, Hsia, Lin, & Lu, 2013).

Instant feedback is an advantage for the Net generation who prefer instant gratification (Walter, 2013) and demand real-time fast processing (Skiba & Barton, 2006). It is therefore important to ensure that the game provides *Feedback* to reach the learning outcome for the Net generation.

The paradox of control involves the user feeling "in control of his actions and of the environment (Fang, Zhang & Chan, 2013, p457)". *The paradox of control* matches the interactivity effective game-based learning environment characteristic. The characteristic states that having high intensity interaction leads to learning (Pivec & Kearney, 2007).

2.6.4. Interactivity

Interactivity describes "different ways in which the learner can navigate access and manipulate learning material within a specific learning environment (Domagk, Schwartz, & Plass, 2010, p1025)". One of the dimensions of *Interactivity* is the level of control that player possesses (Hong *et al*., 2009). The *Interactivity* in a game is directly proportional to the extent that a player can manipulate and alter the content of the game (Shafer, Carbonara, & Popova, 2011). This *Interactivity* allows the player to have control over the pace and content of the game (Domagk *et al*., 2010). Control is also important because enjoyment from a game stems from being in control, struggling to gain control or even the suspense of the potential of losing control (Poels, de Kort, & IJsselsteijn, 2012).

Interactive environments enhance the acquisition of knowledge as well as the learning motivation of a student (Kalet *et al*., 2012). Interacting also leads to active participation (Boa & David, 2013) and active participation leads to positive learning outcomes (Joo *et al*., 2011). *Interactivity* also allows the individuals to learn through experience by doing the tasks rather than just being an outside observer (Boa & David, 2013). The active exploration that takes place in games proves to be better than traditional instruction (Mayer *et al*., 2014).

Interaction with games allows individuals to transform knowledge into practice better than using traditional teaching methods (Chang *et al*., 2010). Interacting with a game also allows the player to practice a task and therefore gain a deeper understanding of the task (Sitzmann, 2011), because practice is essential for achievement (Khanlarian & Singh, 2014). In general, a higher level of interaction with games leads to higher learning levels (Sitzmann, 2011). As aforementioned, doing rather than listening is an advantage for the Net generation. In conclusion, it is important to ensure that the game is interactive to reach the learning outcome for the Net generation.

Autotelic experience is "the key element of an optimal experience that is an end in itself. The activity consumes and becomes intrinsically rewarding (Fang, Zhang & Chan, 2013, p457)". *Autotelic experience* matches the motivation effective game-based learning environment characteristic. The characteristic states that *Motivation* leads to learning (Pivec & Kearney, 2007).

2.6.5. Motivation

Motivation refers to the forces within the person, which affects the amount of effort an individual is willing to allocate towards completing a goal and the amount of time the individual sustains this effort (Mcshane & Von Gilnow, 2007). The definition of academic motivation is the "physiological processes involved in the direction, vigour, and persistence of behaviour (Moos & Marroquin, 2010, p266)". There are different varying motivation types from intrinsic motivation, where internal regulations such as interest, enjoyment and satisfaction govern behaviour, to a *Motivation* where there is no *Motivation* at all (Garn, Matthews, & Jolly, 2012). However, intrinsic and extrinsic *Motivation* drives behaviour (Hess, McNab, & Basoglu, 2014).

Intrinsic motivation is an "internal desire to engage in behaviour due to pleasure, interest, enjoyment, and/or challenge (Moos & Marroquin, 2010, p267)" and *Extrinsic motivation* is an "internal desire to engage in a behaviour due to external incentives, such as money, grades, and praise (Moos & Marroquin, 2010, p267)". The definition of *Motivation* will therefore be the intrinsic and extrinsic forces within the person, which affects the amount of effort an individual is willing to allocate towards completing a goal and the amount of time the individual sustains this effort.

There is evidence that there is a strong correlation between *Motivation* and *Academic Achievement* (Liu *et al*., 2011). *Motivation* increases the interest that individuals have in completing tasks (Cerasoli & Ford, 2014). One of the benefits of educational games is that they increase motivation (Hess & Gunter, 2013). The increase in *Motivation* is due to the nature of games being fun and entertaining (Adachi & Willoughby, 2013). The fun in games triggers *Motivation* to pay attention and engage in the educational material (Peng, 2009).

The *Motivation* to complete the game can however lessen if the game is a compulsory part of the school curriculum, it is therefore essential for games to be voluntary to improve *Motivation* (Sedano *et al*., 2013). There may also be other factors that influence the motivation of the student such as the teacher, parents and peers (Wentzel, Battle, Russell, & Looney, 2010; Garn *et al*., 2012; Molloy, Gest, & Rulison, 2010). These influences are however beyond the scope of this study. The *Motivation* to complete tasks is particularly important to the Net generation who get bored easily (Walter, 2013). In conclusion, it is important to ensure that the game is motivating to reach the learning outcome for the Net generation.

The loss of self-consciousness involves the user feeling "the loss of the sense of a self-separate from the world around it and a union with the environment (Fang, Zhang & Chan, 2013, p457)". *The merging of action and awareness* involves the user becoming "involved in what they are doing that the activity becomes spontaneous, almost automatic (Fang, Zhang & Chan, 2013, p457)". *The transformation of time* involves "time no longer seeming to pass the way it ordinarily does (Fang, Zhang & Chan, 2013, p457)". The loss of self-consciousness, the merging of action and awareness and the transformation of time combine into a construct called *Immersion* (Fang, Zhang & Chan, 2013). *Immersion* matches the avoiding distractions effective game-based learning environment characteristic. The characteristic states that avoiding distraction and disturbances leads to learning (Pivec & Kearney, 2007).

2.6.6. Immersion

Immersion is the "extent to which the individual is absorbed in the activity (Whitton, 2011, p605)". *Immersion* in a task increases the motivation to learn (Annetta, 2010). Additionally, the more *immersion* that takes place during a game, the more the level of engagement takes place (Li, Jiang, Tan, & Wei, 2014). Engagement is important to improve achievement and

decrease boredom (Feng, 2011; Sedano *et al*., 2013). Engagement is also one of the effective game-based learning environment characteristics (Pivec & Kearney, 2007).

Games cause the players to be emotionally committed and involve themselves cognitively therefore leading to *immersion* (Besharat, Kumar, Lax, & Rydzik, 2013). Games also allow players to experience an alternative reality (Calleja, 2007). The *immersion* of players in an alternate reality leads to learning (De Freitas & Oliver, 2006; Dalgarno & Lee, 2010) and increases the enjoyment of the player (Poels, de Kort, & IJsselsteijn, 2012). *Immersion* is an advantage for the Net generation because this generation possess a short attention span (Walter, 2013). In conclusion, it is important to ensure that the game cause immersion to reach the learning outcome for the Net generation.

As aforementioned, *immersion* increases engagement and engagement occurs when a user is completely focused on a task (Webster & Ho, 1997; Webster & Ahuja, 2006). This links to the concentration on the task-at-hand dimension of flow. *Concentration on the task-at-hand* means that "irrelevant stimuli disappear from consciousness; worries and concerns are temporarily suspended (Fang, Zhang & Chan, 2013, p457)".

2.6.7. Concentration

Concentration on a particular topic influences the learning process of a student (Khanlarian & Singh, 2014). *Concentration* decreases if there are distracting stimuli outside of the focus area (Pace, 2004). This is because human memory can provide full attention to one item rather than more than one (Janczyk & Grabowski, 2011).

Games increase the attention that the player commits to the task (Hess & Gunter, 2013). *Concentration* is also an advantage to the Net generation because, similar to *immersion*, it assists with the short attention span. In conclusion, it is important to ensure that the game promotes concentration to reach the learning outcome for the Net generation.

To summarise, Flow consists of *challenge, clear goal, feedback, interactivity, motivation, immersion and concentration*. These elements are characteristics of an effective game-based learning environment. Additionally, Flow is a contributing factor to learning using games (Fu, Su, & Yu, 2009; Cheng, She & Annetta, 2015). This element will be appropriate to increase the utilitarian purpose of games. In this context, Flow influences *Net Benefits*. This leads to

the following hypotheses:

H20: The greater the level of flow in a ***game for learning*** the greater *Net Benefits* gained.

Flow also has a hedonic outcome (Agarwal & Karahanna, 2000; Nah & DeWester, 2011). Previous studied show that flow leads to enjoyment during game play (Fang, Zhang & Chan, 2013; Liu, Li, & Santhanam, 2013). Game characteristics that enhance flow will therefore satisfy both the hedonic and utilitarian purpose of game based learning. This leads to the following hypothesis:

H21: The greater the level of flow in a ***game for learning*** the greater *Enjoyment* gained.

2.7. Summary

In summary, a game succeeds if its voluntary use meets the objectives of the user by having a fit between the task and game, being of high quality and the user is satisfied with the system. The game characteristics of the game should be useful for learning as well as enjoyable. The game should also consist *of challenge, a clear goal, feedback, interactivity, motivation, immersion and concentration* to enhance flow. According to the literature, these success factors are beneficial to the Net generation.

Figure 2 provides a graphical representation of the conceptual framework that summarises the results of the literature review.

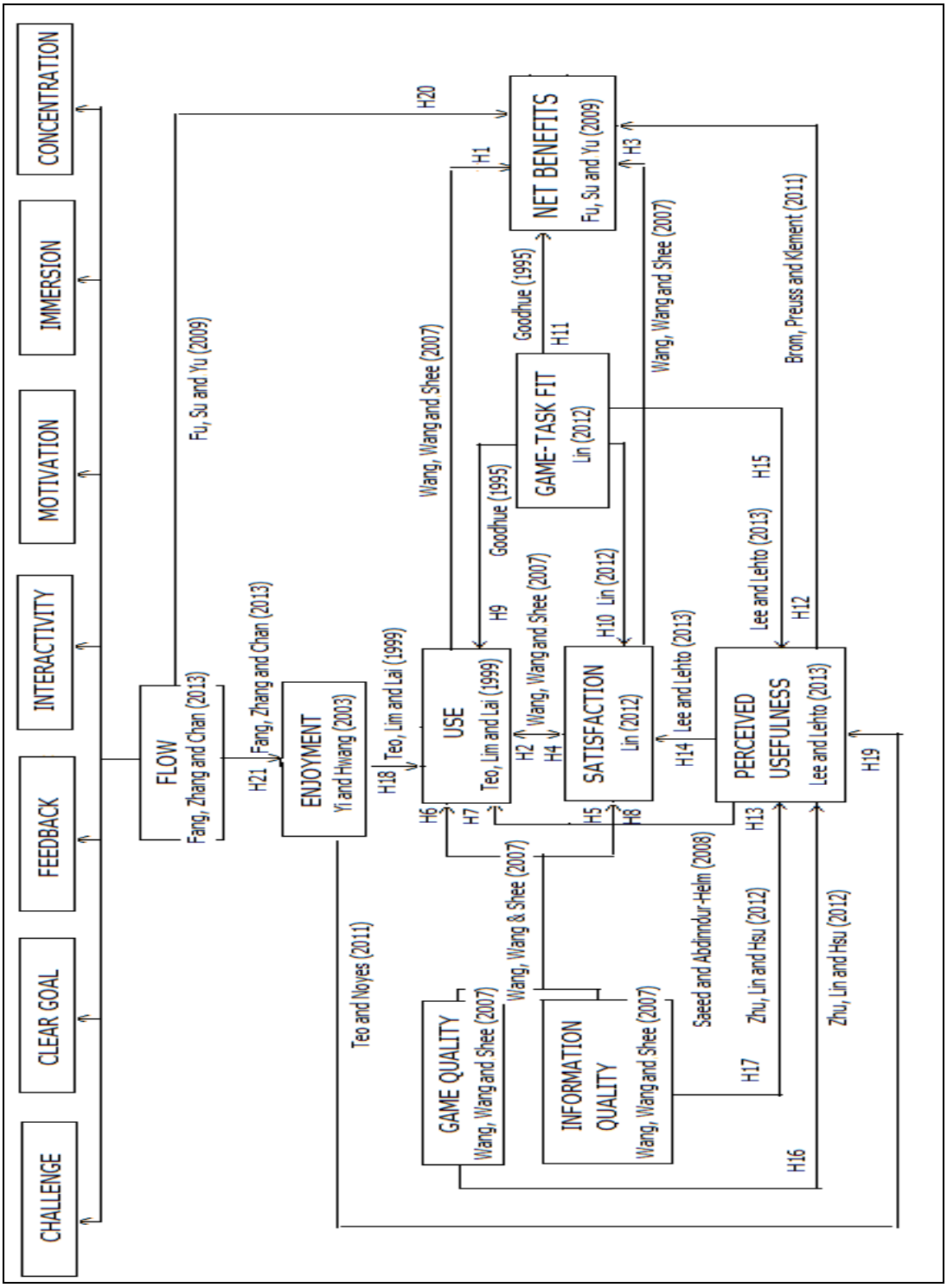

Figure 2: Proposed Conceptual Model

CHAPTER THREE: RESEARCH METHODOLOGY

3.1. Introduction

This section will begin with an explanation of the research design. This will lead to an explanation on the data collection and data analysis method of the study.

3.2. Research design

The study used a combination of theories to create a framework. The research approach was therefore deductive. The research philosophy was positivistic. This is because this philosophy according to Healy and Perry (2000) involves verifying hypotheses. Additionally, the ontology is that the reality is understandable and the epistemology involves objectivity.

The period of the study was cross-sectional. This is because the goal of research that evaluates the effectiveness of education focuses on solving a "particular problem in a specific place within a relatively short time frame (Beck & Perkins, 2014, p3)". The procedure followed the example by Brown and Jayakody (2008). The first phase involved the development of items for an instrument.

3.2.1. Instrument development

This phase involves creating measurement items for each construct (Fang *et al*., 2013). The first step involved conducting a literature review. The outcome of this review was existing measurement items used to create the instrument. The second step was to remove items that were not relevant. The final step involved changing the wording on the items to be more relevant to the online gaming context.

Brown and Jayakody (2008) suggest using items that already exist. This process is useful in ensuring content and context validity (Fang *et al*., 2013). Content validity refers to "what extent a sample of items taken together represents a sufficient operational definition of a latent construct (Vadlin, Åslund, & Nilsson, 2015, p459)". Construct validity is "a condition whereby items measuring on particular construct are considered together and provide a reasonable operationalization for the particular construct (Tojib & Ly-Fie Sugianto, 2011, p39)". Table 1 provides the number of items for each construct and the sources used to measure the construct.

Table 1: Measures, number of items and measurement sources

Measures	Number of Items	Source
Goal Oriented	3	Fang, Zhang and Chan (2013)
Feedback	3	Fang, Zhang and Chan (2013)
Motivation	2	Fang, Zhang and Chan (2013)
Challenge	4	Fang, Zhang and Chan (2013)
Interactivity	2	Fang, Zhang and Chan (2013)
Immersion	2	Fang, Zhang and Chan (2013)
Concentration	2	Fang, Zhang and Chan (2013)
Enjoyment	3	Yi and Hwang (2003)
Perceived Usefulness	4	Lee and Lehto (2013)
Game Quality	6	Wang, Wang and Shee (2007)
Information Quality	7	Wang, Wang and Shee (2007)
Game-Task Fit	6	Lin (2012)
Use	4	Teo, Lim and Lai (1999)
Satisfaction	1	Lin (2012)
Net Benefits	5	Fu, Su and Yu (2009)

The actual instrument is available under Appendix A. The outcome of this phase was a 54-item instrument. The items, with the exception of items to measure Use, used a 5-point Likert scale anchored by Strongly Agree to Strongly Disagree. The measures for Use used interval scales.

The measurement of flow is difficult (Fang *et al*., 2013). The measurement in this study will use the multidimensional method, which measures "constituent constructs individually, and employ structural models to test whether these constituent constructs reliably define a higher-order factor that can be interpreted as flow (Hoffman & Novak, 2009, p26)".

The instrument also includes demographic data of the participants. These items were age, gender, level of education, geographical location, gaming skill level and information on how recently game the participant played the game. The following phase was receiving ethical approval to distribute the instrument. The ethical approval included the following ethical considerations.

3.2.2. Ethical Considerations

There was no plagiarism in the study as per the plagiarism declaration at the beginning of this dissertation. The protection of the participants from harm during the study took place. The questions on the data collection instruments were not of a sensitive nature and did not promote prejudice in any way. The data was for the context of this study only and was not distributed or shared elsewhere.

The participants decided whether to participate, because participation was voluntary. The participants had full knowledge about the research objectives. All the participants were 18 years and older. The following phase was to define the participants.

3.2.3. Sample definition

The sample size was 10 participants per independent variable in the theoretical framework (Bartlett, 2012). This yields a minimum of 150 participants. The actual number of respondents is under Section 3.3. The selection method of the participants was non-probability sampling.

The participant selection was random from the population. The research population consisted of individuals who are a part of the Net generation. Section 4.2 discusses the locations of the participants. The participants had voluntarily played a game for learning prior to participation. They were required to answer the instrument based on the game they had played. The next phase involved collecting data.

3.3. Data collection

The distribution of the instrument was online. This is because according to Steelman, Hammer and Limayem (2014), the use of online platforms is beneficial. The participants will use the instrument hosted online by Qualtrics Panels, LLC (Cardella, Ewing & Williams, 2016). The use of Qualtrics is valid because it does not alter the study in any way (Lowry, D'Arcy, Hammer & Moody, 2016).

Qualtrics sources and invites participants to fill out the instrument after completing a pre-screening (Pennington & Kelton, 2016). The conditions to participate in this study were that the age of the participant falls within the Net generation and that the participant recently played a game for learning voluntarily.

Brown and Jayakody (2008) suggest that a pilot study is useful for checking the "basic soundness of the instrument and to check for any problems related to wording and ambiguity in measurement items (Brown & Jayakody, 2008, p173)". The data collection therefore began with a pilot study. The initial instrument is available under Appendix A. The pilot study involved distributing the instrument to masters and doctoral students at the University of Cape Town. The pilot study had five participants. There was a change in the wording of the items in the instrument based on the comments by the participants.

The main data collection process used the final instrument. This instrument was a result of the adjustments during the pilot study. This instrument is available under Appendix B. The data collection process took approximately one week. The total number of participants was 152. 27 of these responses were excluded from the data. There were three criteria used to decide which responses were invalid. The first was if the response did not have a valid game purpose or learning outcome. The second was if the game purpose or the learning outcome was unclear. The final criterion was if the game does not support the given game purpose or learning outcome.

There were two games, which have an element of violence, but still contain educational value. These games are Call of Duty (Kapp, 2012) and Counter Strike (Greenfield, 2009). There was an inclusion of these games even though violent games may have effects such as inciting aggression and decreasing pro-social behaviour (Boyle, Connolly & Hainey, 2011). The decision to include the games was because the effects of violence were beyond the scope of the study. The study was only concerned with educational value. The final number of valid responses was 125. The next section discusses the validity and reliability of the valid data.

3.4. Validity and Reliability

As aforementioned, the use of previously defined items is to ensure validity. This section verifies if the data is indeed valid. There will also be tests to confirm the reliability of the items.

3.4.1. Construct validity

Brown and Jayakody (2008) use confirmatory factor analysis to verify validity. The extraction method was principle component, using a minimum eigenvalue of 1 as a cut-off value for extraction. The factor rotation method was varimax-normalised rotation. The

excluded items were those with factor loadings of less than 0.5 on all factors or greater than 0.5 on two or more. The exclusion of the *Satisfaction* construct from the factor analysis was due to *Satisfaction* being a single item factors. The factor analysis involved an iterative process of which resulted in the removal of items until seven distinct factors remained. Table 2 displays the factor analysis results.

Table 2: Confirmatory Factor Analysis results

Variable	**Factor Loadings (Varimax normalized) Extraction: Principal components (Marked loadings are >,500000)**						
	GTF	**GOFE**	**USE**	**PEU**	**GQ**	**CON**	**NB**
GO2	0,13	0,66	0,21	0,12	0,08	-0,02	0,33
GO3	0,04	0,69	0,07	0,18	0,17	0,21	0,17
FE1	0,11	0,79	-0,01	0,02	0,04	0,09	0,11
FE2	0,13	0,73	-0,05	0,16	0,26	0,11	0,03
CON1	0,31	0,14	0,04	0,15	0,17	0,81	0,12
CON2	0,11	0,21	0,11	0,17	0,07	0,86	0,12
PEU1	0,28	0,20	0,06	0,72	0,09	0,10	0,18
PEU2	0,10	0,18	0,03	0,84	0,06	0,14	0,07
PEU3	0,24	0,18	0,20	0,60	0,14	-0,03	0,29
PEU4	0,17	-0,06	0,10	0,77	0,08	0,14	0,18
GQ1	-0,07	0,19	0,03	0,30	0,73	0,12	-0,05
GQ2	0,16	0,18	0,00	0,05	0,79	0,00	0,03
GQ3	0,06	0,09	0,13	-0,02	0,79	0,15	0,32
GTF1	0,60	0,03	-0,02	0,19	0,24	0,04	0,41
GTF2	0,74	0,05	0,05	0,07	0,19	0,22	0,03
GTF4	0,76	0,19	0,04	0,24	0,03	0,12	-0,05
GTF5	0,68	0,04	0,07	0,26	-0,11	0,01	0,20
GTF6	0,76	0,13	0,13	0,05	-0,01	0,10	0,26
IUSE1	0,00	0,01	0,71	0,09	-0,12	0,04	0,15
IUSE2	0,16	0,35	0,77	0,04	0,15	0,03	-0,06
IUSE5	0,08	-0,10	0,79	0,11	0,14	0,06	-0,03
NB1	0,41	0,21	0,09	0,15	-0,03	0,03	0,63
NB2	0,10	0,19	0,02	0,19	0,09	0,23	0,80
NB3	0,17	0,20	0,01	0,29	0,18	0,03	0,70
Expl.Var	3,11	2,63	1,88	2,72	2,18	1,68	2,29
Prp.Totl	0,13	0,11	0,08	0,11	0,09	0,07	0,10

The factor analysis resulted in the elimination of the *Motivation, Challenge, Interactivity, Immersion, Information Quality and Enjoyment* constructs. The remaining factors were *Clear Goal/Feedback, Concentration, Game Quality, Perceived Usefulness, Game-Task Fit, Use and Net Benefits*. The Flow construct in the factor analysis has three remaining constructs.

These factors are *Clear Goal, Feedback and Concentration*. This is valid since it is not necessary to have all factors for a user to experience flow (Chen, 2007).

The *Clear Goal* and *Feedback* construct loaded as one construct. Over the years, the measurement of flow has evolved (Moneta, 2012). *Clear Goal* and *Feedback* can be separate constructs, but the original measurement of flow viewed *Clear Goal* and *Feedback* as one construct (Csikszentmihalyi & LeFevre, 1989). This loading is therefore valid. Table 3 displays the number of items that of the refined instrument.

Table 3: Comparison of original and refined items per construct

Construct	Number of Items (Original)	Number of Items (Refined)
Goal Oriented/Feedback	6	4
Concentration	2	2
Perceived Usefulness	4	4
Game Quality	6	3
Game-Task Fit	6	5
Use	4	3
Net Benefits	5	3

3.4.2. Reliability

Reliability testing assesses the level of consistency of the measure (Ramayah, Yusoff, Jamaludin, & Ibrahim, 2009). The calculation of the Cronbach alpha for each of the construct measured reliability. Table 4 displays the Cronbach alpha results with those higher than 0.7 highlighted. The detailed results are available under Appendix D.

Table 4: Reliability tests results

Construct	Number of Items	Cronbach alpha
Goal Oriented/Feedback	4	0,78
Concentration	2	0,82
Flow	N/A	0,79
Perceived Usefulness	4	0,83
Game Quality	3	0,76
Game-Task Fit	5	0,82
Use	3	0,65
Net Benefits	3	0,77

The reliability of *Use* construct was under 0.7. The removal of *Use* from the model is however possible. This is because *Use and Perceived Usefulness* can be interchangeable in the IS Success model (Seddon & Kiew, 1995; Floropoulos, Spathis, Halvatzis & Tsipouridou, 2010). *Perceived Usefulness* is in fact appropriate to replace both *Use and Satisfaction* in the IS Success model (Seddon, 1997; Floropoulos, Spathis, Halvatzis and Tsipouridou, 2010). Additionally, Game Quality and Game-Task Fit influence *Use, Satisfaction and Perceived Usefulness*.

3.5. Summary

This chapter explains the methodology of the research. The research approach was deductive and the research philosophy was positivistic. The process began with the creation of measurement items for each construct. This resulted in an instrument that was distributed online using Qualtrics.

The data collection involved conducting a pilot and a main study. The number of respondents was 152, but after the removal of invalid data, the resulting number was 125. The validity and reliability testing of the data resulted in the removal of eight constructs. These constructs were *Motivation, Challenge, Interactivity, Immersion, Information Quality, Enjoyment, Satisfaction and Use*.

The remaining seven constructs are valid and reliable. These constructs were *Clear Goal/Feedback, Concentration, Flow, Game Quality, Perceived Usefulness, Game-Task Fit and Net Benefits*. The items that measured the refined constructs are available under Appendix C. The deleted items are marked with a *. The next chapter discusses the results of the study.

CHAPTER FOUR: RESULTS

4.1. Introduction

This chapter lists the results of the study. It includes the demographic data results and the descriptive data of the study. Additionally it will list the results of the hypothesis tests.

4.2. Demographic Data

The age group of the participants was in two groups. The first group are older than 18, but younger and equal to 25. The second group is older than 25, but younger than 33. The second group has slightly more participants with 65, where the first group has 60 responses. These individuals fall within the Net generation, which is of interest in this study. There were slightly more males than females in the participant sample. There were 63 males and 62 females.

The largest group of responses came from participants with undergraduate degrees with 54 responses. The second largest group came from participants with a high school qualification with 48 responses. The third largest was from postgraduate degree graduates with 17 responses. The smallest group was from those with some high school qualification with 6 responses.

The majority of the participants were from the United Kingdom with 39 participants. The second largest group was from South Africa and the United States with 37 participants each. The remaining 12 were from different parts of the world.

The collection of data on the gaming experience of the gamers was included. Additionally, the basis of the instrument was on games that the participants already played. Therefore, the participants answered a question about how recently they played the game. Figure 3 displays these results as well as the other demographic results.

Age (Mean=2,52)	Frequency	Percentage
18-25	65	52
26-33	60	48

Gender (Mean=1,50)	Frequency	Percentage
Male	63	50,4
Female	62	49,6

Education (Mean=2,66)	Frequency	Percentage
Some high school	6	4,8
High school graduate	48	38,4
Undergraduate degree	54	43,2
Postgraduate degree	17	13,6

Country	Frequency	Percentage
United Kingdom	39	31,2
South Africa	37	29,6
United States	37	29,6
Other	12	9,6

Period since playing game (months) (Mean=4,91)	Frequency	Percentage
Currently using	32	25,6
Less than 1	10	8
1	11	8,8
1-2	7	5,6
2-3	3	2,4
3-4	1	0,8
4-5	8	6,4
More than 5	53	42,4

Gaming Experience (Mean=5,75)	Frequency	Percentage
Never	0	0
Less than Once a Month	6	4,8
Once a Month	5	4
2-3 Times a Month	14	11,2
Once a Week	12	9,6
2-3 Times a Week	40	32
Daily	48	38,4

Figure 3: Demographic data results

The participants played different games with different tasks. Content analysis grouped the games purpose into the categories in Table 5 (Hsieh & Shannon, 2005). The table lists the categories from the most number of results to the least. The table also lists the sub-categories that make up the main category.

Table 5: Game purpose categories

Category name	Sub-categories	Number of results
Mind/Brain	Focusing, concentrate, stay alert, general knowledge, multi- tasking, strategy, puzzle, quiz/trivia	53
Languages	Grammar, reading, communication, spelling, pronunciation	34
Stem	Maths, Science, Chemistry	21
Programming	Computer programming	5
Business	Management, Sales, Economics, Time Management	5
Other	Medicine, Geography, History, Music	4
Typing	Typing skills	3

4.3. Descriptive statistics

Table 6 lists the correlation and mean scores for *Flow*, *Perceived Usefulness*, *Game Quality*, *Game-Task Fit* and *Net Benefits*. The measurement scale was from 1 to 5, with 1 being strongly agree and 5 being strongly disagree. The mean scores are indicating that the majority of participants viewed these antecedents of game-based learning as successful. *Game Quality* has the lowest mean score and *Game-Task Fit* with the highest. The correlation of all the constructs was significant at $p < 0.05$. The following section involves testing the hypotheses.

Table 6: Descriptive data for refined constructs

Variable	Correlations Marked correlations are significant at p < ,05000					
	Means	**FLOW**	**PEU**	**GQ**	**GTF**	**NB**
FLOW	1,86	1,00	0,47	0,43	0,45	0,52
PEU	1,92		1,00	0,32	0,50	0,54
GQ	1,70			1,00	0,23	0,30
GTF	2,20				1,00	0,53
NB	1,92					1,00

4.4. Data Analysis

The hypothesis testing used Multiple Linear Regression (Brown & Jayakody, 2008). Figure 4 shows the relationships that will be included in the tests. The relationships in the model formed the following two equations:

NB= H12*PEU +H20*FLOW+H11*GTF
PEU =H15*GTF+H16*GQ

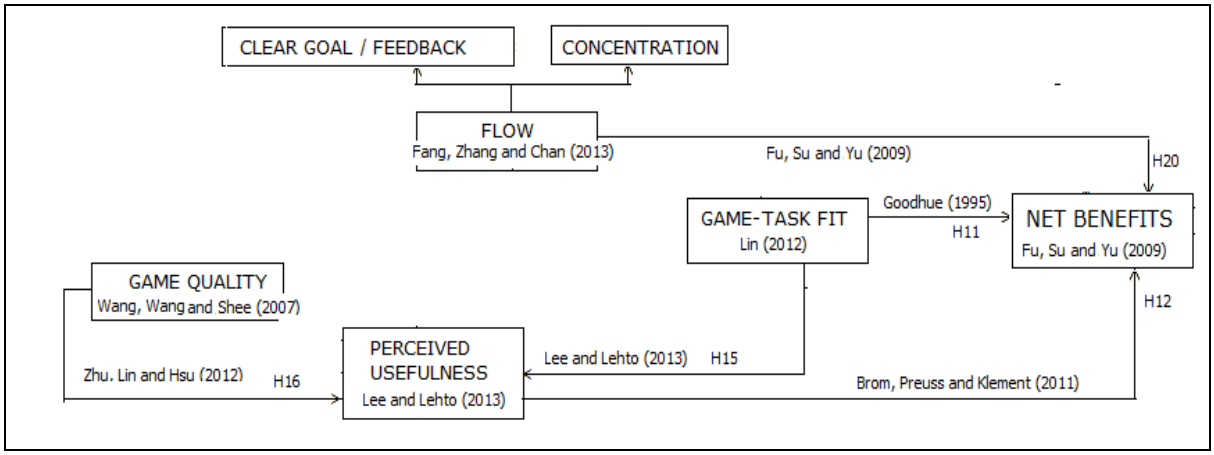

Figure 4: Revised Conceptual Model

Table 7 displays the results of hypotheses testing. The results show that all the hypotheses passed the regression test. The removal of *Use, Satisfaction, Information Quality and Enjoyment* constructs in the validity and reliability section lead to some untested hypotheses. Table 8 displays these hypotheses as well as the constructs that caused the lack of testing. A detailed discussion of these removed constructs is available under Section 5.2.

Table 7: List of tested hypotheses

Hypothesis	Independent Variable	Dependent Variable	Beta value	p level (*p<0.05)	Hypotheses Supported?
H11	GTF	NB	0,271	0,001	Yes
H12	PEU	NB	0,273	0,001	Yes
H15	GTF	PEU	0,452	0,000	Yes
H16	GQ	PEU	0,213	0,007	Yes
H20	FLOW	NB	0,271	0,001	Yes

Table 8: List of untested hypotheses

Hypothesis	Independent Variable	Dependent Variable	Beta value	p level (*p<0.05)	Hypothesis Supported?	Removed Construct(s)
H1	USE	NB	-	-	Not tested	USE
H2	SAT	USE	-	-	Not tested	USE, SAT
H3	SAT	NB	-	-	Not tested	SAT
H4	USE	SAT	-	-	Not tested	USE, SAT
H5	GQ	SAT	-	-	Not tested	SAT
H6	GQ	USE	-	-	Not tested	USE
H7	IQ	USE	-	-	Not tested	IQ
H8	IQ	SAT	-	-	Not tested	IQ, SAT
H9	GTF	USE	-	-	Not tested	USE
H10	GTF	SAT	-	-	Not tested	SAT
H13	PEU	USE	-	-	Not tested	USE
H14	PEU	SAT	-	-	Not tested	SAT
H17	IQ	PEU	-	-	Not tested	IQ
H18	ENJ	USE	-	-	Not tested	ENJ, USE
H19	ENJ	PEU	-	-	Not tested	ENJ
H21	FLOW	ENJ	-	-	Not tested	ENJ

4.5. Summary

This chapter listed the results obtained from the study. It listed the demographic data, the descriptive data and the results of the hypotheses. The following chapter discusses the findings in the study.

CHAPTER FIVE: DISCUSSION

5.1. Introduction

This chapter summarises the results from the previous chapter. It also lists the limitations that the study encountered. Additionally, it will list the contributions that this study will provide.

5.2. Summary of Findings

The study began with a literature review, which yielded in a conceptual framework with sixteen constructs. These constructs were *Flow*, which had seven dimensions namely *Challenge, Clear Goal, Feedback, Interactivity, Motivation, Immersion and Concentration*. These construct stem from the Flow theory. The other constructs were *Game Quality, Information Quality, Use, Satisfaction, and Net Benefits*. These constructs stem from the IS Success model. There was the addition of two construct to extend this model namely *Enjoyment and Perceived Usefulness*. An additional construct was *Game-Task Fit*. This construct stems from the Task technology Fit model.

The validity test resulted in eight constructs. These constructs are the combined *Clear goals/Feedback, Concentration, Flow, Perceived Usefulness, Game Quality, Game-Task Fit, Use and Net Benefits*. The removed constructs were *Motivation, Challenge, Interactivity, Immersion, Satisfaction, Information Quality and Enjoyment* constructs.

The removal of *Motivation, Challenge, Interactivity and Immersion* decreased the items that make up Flow. The remaining items were *Clear Goals, Feedback and Concentration*. *Clear Goals, Feedback* loaded as one item, which meets the design of the original flow theory. As aforementioned, flow leads to enjoyment, but flow also accounts for the hedonic purpose of games. Flow can therefore account for the hedonic purpose of games. This means that the removal of enjoyment is not discouraging.

The removal of *Satisfaction* was due to the construct being a one-item measure construct. The reliability test resulted in the removal of the *Use* construct. This is not surprising, since the measurement of the *Use* construct remains a challenge (Burton-Jones & Straub, 2006). *Perceived Usefulness* can however compensate for *Use* and *Satisfaction* in the IS Success model.

Information Quality in e-commerce systems differs from other systems in that the feedback received from the system is an element of information quality (Freeze *et al*., 2010). The *Feedback* construct exists in the final research model meaning that an element of *Information Quality* is available in the research model.

The testing of relationships between the remaining constructs resulted in the following results. *Perceived Usefulness* positively influences *Net Benefits*, *Flow* with the combined *Clear goals* and *Feedback* construct and *Concentration* as dimensions positively influences *Net Benefits, Game-Task Fit* positively influences *Net Benefits, Game-Task Fit* positively influences *Perceived Usefulness* and *Game Quality* positively influences *Perceived Usefulness*. There were however limitations to the study.

5.3. Limitations

The constructs in this model cannot cover all the antecedents of an effective game-based learning environment for the Net generation. This is a limitation of any complex behavioural model (Yi & Hwang, 2003).

The study was cross-sectional, which could yield different result in longitudinal studies. This is due to the duration, frequency, and intensity (or extent) of use changing over time (Venkatesh, Brown, Maruping & Bala, 2008).

The knowledge level of the players, pertaining to the task, before and after playing the game is necessary to measure in game-based learning research. There should be an inclusion of this measure in the future (Hainey, Connolly, Stansfield & Boyle, 2011).

The majority of the study took place in the United Kingdom, United States and South Africa. The results could vary in other parts of the world. Although the study has limitations, there are contributions that the study provides.

5.4. Research Contribution

The main contribution that this research makes is towards research on the effectiveness of learning environments. This is a response to a claim that “the effectiveness of game-based learning is a significant issue, and many researchers have stressed the importance of establishing a theoretical foundation for developing educational computer games and assisting game-based learning (Wu, Hsiao, Wu, Lin, & Huang, 2012, p266)”.

The research also contributes to the evaluation of the effectiveness in general as a contribution to the information systems body of knowledge because effectiveness is important to the information systems field in both research and practice (Petter, DeLone, & McLean, 2013). Particular to games, there is a need for empirical studies that examine the effectiveness of instructional games (Chang *et al*., 2010).

The research also contributes to educational game research in general, since there is not enough research on the evaluation of serious games (Mayer *et al*., 2014) and there is a need to apply the IS Success framework to specific fields (Petter, DeLone, & McLean, 2012). This research will apply the IS Success model to the educational gaming research body of knowledge.

The final contribution is to other theories such as Flow and especially the Task-Technology Fit theory (TTF) research. This is because there are a number of studies that use of the Task-Technology Fit theory to measure the fit between the task and other technologies other than games.

5.5. Summary

This chapter provided a summary of the results from the previous chapter. It also explained the limitations that the study encountered. Additionally, it listed the contributions that this study will provide. The following chapter provides a summary of the entire study.

CHAPTER SIX: CONCLUSION

The problem that sparked this study was the lack of knowledge regarding what makes games effective for learning. In response to this, the study aims to answer the question: what are the antecedents of an effective game-based learning environment for the Net generation. The creation of a conceptual model stemmed from the pursuit of answering the question.

The study used a deductive approach and a positivistic philosophy. The data collection began with pilot study and continued with a main study that took place mainly in the United Kingdom, United States and South Africa. The final number of valid responses was 125. The validity and reliability test of these responses resulted in the reduction of constructs from sixteen to seven. The data analysis involved the testing of hypotheses. All of the tested hypotheses passed the test. The conclusion pertaining to the relationships in the model is that:

1. *Perceived Usefulness* positively influences *Net Benefits*.
2. *Flow* with the combined *Clear Goals* and *Feedback* construct and *Concentration* as dimensions positively influences *Net Benefits*.
3. *Game-Task Fit* positively influences *Net Benefits*.
4. *Game-Task Fit* positively influences *Perceived Usefulness*.
5. *Game Quality* positively influences *Perceived Usefulness*.

In summary, the antecedents to an effective game-based learning environment for the Net generation or *Net Benefits* are *Flow,* with *Clear Goals/Feedback* and *Concentration* as dimensions, *Game Quality, Game-Task Fit and Perceived Usefulness*. These antecedents increase effectiveness by ensuring there is a fit between the task and technology and ensures that pedagogical foundations are met, which leads to game-based-learning effectiveness.

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Default Question Block

Dear Participant

I would like to invite you to participate in an academic research study on factors affecting the effectiveness of game-based learning. This research has been approved by the University of Cape Town (UCT)'s Commerce Faculty Ethics in Research Committee.

The aim of this study is to gain understanding and insight into the factors that make games effective for learning, by distributing an online survey questionnaire to participants across the world.

Your participation in this research is voluntary. All information will be treated in a confidential manner and used exclusively for the purpose of this study. No individual names will be recorded or published. You will not be requested to supply any identifiable information, ensuring anonymity of your responses. You can choose to withdraw from the research at any time for whatever reason, in accordance with ethical research requirements. Please note that in order to participate you should have recently played a game that is intended for learning. Playing this game should have been voluntary.

The survey questionnaire will take approximately 10 to 20 minutes to complete. If

you are willing to participate in this study, kindly select yes in the participation box. Should you have any questions regarding this research, please feel free to contact me.

My details:
Name: Segomotso Mosiane
Email: myresearch@sgee.co.za

Supervisor details:
Prof. Irwin Brown
Email: irwin.brown@uct.ac.za

Thank you for your time and participation.

I have read and understood the above consent form and desire of my own free will to participate in this study.

Yes

No

Have you recently played a game for learning?

Yes

No

Did you play the game voluntarily?

Yes

No

How old are you?

Under 18

18-25

26-34

35-54

55-64

65 or over

prefer not to answer

1. What is your gender?

Female | prefer not to answer | Male

How often do you play games?

Never

Less than Once a Month

Once a Month

2-3 Times a Month

Once a Week

2-3 Times a Week

Daily

What is your highest level of education?

Some high school

High school graduate

Some college

College graduate

Postgraduate/professional

In which country do you reside?

▼

Which game did you play for learning?

What was the purpose of the game?

What was the game teaching you?

I knew clearly what I wanted to do in this game.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I knew what I wanted to achieve in this game.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

My goals were clearly defined.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

While playing this game, I had a good idea about how well I was doing.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I was aware of how well I was performing in this game.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I received immediate feedback on my actions.

Strongly Agree | Agree | Neither Agree nor | Disagree | Strongly Disagree

Disagree

Playing this game was rewarding in itself.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I want to capture the feeling of my performance again.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

Playing this game challenged me.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

Playing this game provided a good test of my skills.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I found that playing this game stretched my capabilities to my limits.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I was challenged by this game, but I believed I was able to overcome these challenges.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

When playing this game, I felt in control over what I was doing in the game.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I felt comfortable with the controls of this game.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

My attention was focused entirely on the game that I was playing.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

When playing this game, I totally concentrated on what I was doing.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

When I played this game, I sometimes felt like things were happening in slow motion.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

When I played this game, I lost track of time.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I found using the game to be enjoyable.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The actual process of using the game was pleasant.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I had fun using the game.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I think that learning with the game improved my ability to perform the task.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I think that learning with the game improved my outcome in regards to performing at the task.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

Learning with the game increased my understanding of how to perform the task.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

Using the game made it easier to learn how to perform the task.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game provides high availability.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game was easy to use.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game was user-friendly.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game provided interactive features between myself and the system.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game provided personalized information.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game had attractive features that were appealing.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game provided high-speed information access.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game provided information that was needed.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game provided information at the right time.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game provided information that was relevant to the task.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game provided sufficient information.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game provided information that was easy to understand.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game provided up-to-date information.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

By using this game, it fit well with the way I like to improve my learning.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

By using this game, it fit well with the way that I can upgrade the efficiency of my study.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

This game provided good functions to help me complete my learning task.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

The game was compatible with all aspect of my study.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

By utilizing the game I could concentrate more on my other studies.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

I learned better with this game than without it.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

The frequency of use of the game was high.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

The game usage was voluntary.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I depended upon the game.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I was satisfied when using the game as a learning tool.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I was satisfied when using the game for the learning task.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game increased my knowledge.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I caught the basic ideas of the knowledge taught.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I tried to apply the knowledge in the game.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The game motivated me to integrate the knowledge taught.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I want to know more about the knowledge taught.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

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The aim of this study is to gain understanding and insight into the factors that make online games effective for learning, by distributing an online survey questionnaire to participants across the world.

Your participation in this research is voluntary. All information will be treated in a confidential manner and used exclusively for the purpose of this study. No individual names will be recorded or published. You will not be requested to supply any identifiable information, ensuring anonymity of your responses. You can choose to withdraw from the research at any time for whatever reason, in accordance with ethical research requirements. Please note that in order to participate you should have recently played an online game that is intended for learning. Playing this online game should have been voluntary.

The survey questionnaire will take approximately 15 to 20 minutes to complete. If you are willing to participate in this study, kindly select yes in the participation box. Should you have any questions regarding this research, please feel free to contact me.

My details:

Name: Segomotso Mosiane
Email: myresearch@sgee.co.za

Supervisor details:
Prof. Irwin Brown
Email: irwin.brown@uct.ac.za

Thank you for your time and participation.

I have read and understood the above consent form and desire of my own free will to participate in this study.

Yes

No

Have you recently played an online game for learning?

Yes

No

Did you play the game voluntarily?

Yes

No

How old are you?

Under 18

18-25

26-33

33 or over

prefer not to answer

1. What is your gender?

Male Female prefer not to answer

How often do you play online games?

Never

Less than Once a Month

Once a Month

2-3 Times a Month

Once a Week

2-3 Times a Week

Daily

What is your highest level of education?

Some high school

High school graduate

Undergraduate degree

Postgraduate degree

In which country do you reside?

Which online game have you recently played for learning?

How recently (months)?

Currently using

Less than 1

1

1-2

2-3

3-4

4-5

More than 5

What was the purpose of the online game?

What was the online game teaching you?

Please respond to the following questions with regards to the game most recently played as mentioned above.

Because of the online game instructions, I knew clearly what I wanted to do in this online game.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Because of the online game instructions, I knew what I wanted to achieve in this online game.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Because of the online game instructions, my goals were clearly defined.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

While playing this online game, I had a good idea about how well I was doing.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

I was aware of how well I was performing in this online game.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

I received immediate feedback on my actions.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Playing this online game was rewarding in itself.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

I like the feeling of elation I get when playing the game.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Playing this online game challenged me.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Playing this online game provided a test of my skills.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

I found that playing this online game stretched my capabilities.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

I was able to overcome the challenges presented by the online game.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

When playing this online game, I felt in control over what I was doing in the game.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

I felt comfortable with the controls of this online game.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

My attention was focused entirely on the online game that I was playing.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

When playing this online game, I totally concentrated on what I was doing.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

When I played this online game, I sometimes felt like things were happening in slow motion.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

When I played this online game, I lost track of time.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

I found using the online game to be enjoyable.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

The process of using the online game was pleasant.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

I had fun using the online game.

Strongly Agree Agree Neither Agree nor Disagree Disagree Strongly Disagree

Learning with the online game improved my ability to perform the task.

Strongly Agree Agree Neither Agree nor Disagree Strongly Disagree

Disagree

Learning with the online game improved my outcome in regards to performing the task.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

Learning with the online game increased my understanding of how to perform the task.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

Using the online game made it easier to learn how to perform the task.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The online game is available when I need to play it.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The online game was easy to use.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The online game was user-friendly.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The online game provided interactive features between myself and the system.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The online game provided personalized information.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The online game had attractive features that were appealing.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

The online game provided high-speed information access.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

The online game provided information that was needed.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

The online game provided information at the right time.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

The online game provided information that was relevant to the task.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

The online game provided sufficient information.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

The online game provided information that was easy to understand.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

The online game provided up-to-date information.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Using this online game fits well with the way I like to improve my learning.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

Using this online game fits well with the way I like to study.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

This online game provided good functionality to help me complete my learning task.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

The online game was compatible with all aspect of my study.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

By utilizing the online game I could concentrate more on my other studies.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

I learned better with this online game than without it.

Strongly Agree | Agree | Neither Agree nor Disagree | Disagree | Strongly Disagree

On average, I used the online game for ____ months.

Less than 1

1

1-2

2-3

3-4

4-5

More than 5

On average, I used the online game ____.

Rarely

Once a month

Few times a month

Once a week

Few times a week

Once a day

Few times a day

On an average working day, I used the online game ____.

Rarely

Less than 1/2 hour

1/2 hour to 1 hour

1 - 2 hours

2 - 3 hours

3 -4 hours

More than 4 hours

Please indicate the extent to which you used the functionality of the online game (A small extent=1;A great extent=7)

1

2

3

4

5

6

7

I was satisfied when using the online game for the learning task.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

The online game increased my knowledge.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

I caught the basic ideas of the knowledge taught.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

I tried to apply the knowledge in the online game.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

The online game motivated me to integrate the knowledge taught.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

I want to know more about the knowledge taught.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree

Please provide your comments on the survey.

Default Question Block

Dear Participant

I would like to invite you to participate in an academic research study on factors influencing the effectiveness of online game-based learning. This research has been approved by the University of Cape Town (UCT)'s Commerce Faculty Ethics in Research Committee.

The aim of this study is to gain understanding and insight into the factors that make online games effective for learning, by distributing an online survey questionnaire to participants across the world.

Your participation in this research is voluntary. All information will be treated in a confidential manner and used exclusively for the purpose of this study. No individual names will be recorded or published. You will not be requested to supply any identifiable information, ensuring anonymity of your responses. You can choose to withdraw from the research at any time for whatever reason, in accordance with ethical research requirements. Please note that in order to participate you should have recently played an online game that is intended for learning. Playing this online game should have been voluntary.

The survey questionnaire will take approximately 15 to 20 minutes to complete. If you are willing to participate in this study, kindly select yes in the participation box. Should you have any questions regarding this research, please feel free to contact me.

My details:

Name: Segomotso Mosiane
Email: myresearch@sgee.co.za

Supervisor details:
Prof. Irwin Brown
Email: irwin.brown@uct.ac.za

Thank you for your time and participation.

I have read and understood the above consent form and desire of my own free will to participate in this study.

Yes

No

Have you recently played an online game for learning?

Yes

No

Did you play the game voluntarily?

Yes

No

How old are you?

Under 18

18-25

26-33

33 or over

prefer not to answer

1. What is your gender?

Male Female prefer not to answer

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I want to know more about the knowledge taught. *

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Please provide your comments on the survey.

Appendix D

variable	Summary for scale: Mean=7,18400 Std.Dv.=2,26254 Valid N:125 Cronbach alpha: ,783236 Standardized alpha: ,787174 Average inter-item corr.: ,481288				
	Mean if (deleted)	Var. if (deleted)	StDv. if (deleted)	Itm-Totl (Correl.)	Alpha if (deleted)
GO2	5,472000	3,273216	1,809203	0,580502	0,736509
GO3	5,464000	3,240704	1,800196	0,601084	0,727249
FE1	5,288000	2,781056	1,667650	0,596652	0,730911
FE2	5,328000	2,956416	1,719423	0,596528	0,726848

variable	Summary for scale: Mean=3,96800 Std.Dv.=1,63597 Valid N:125 Cronbach alpha: ,819304 Standardized alpha: ,819536 Average inter-item corr.: ,694248				
	Mean if (deleted)	Var. if (deleted)	StDv. if (deleted)	Itm-Totl (Correl.)	Alpha if (deleted)
CON1	1,976000	0,759424	0,871449	0,694249	
CON2	1,992000	0,807936	0,898853	0,694249	

variable	Summary for scale: Mean=7,68000 Std.Dv.=2,23823 Valid N:125 Cronbach alpha: ,831148 Standardized alpha: ,831707 Average inter-item corr.: ,555099				
	Mean if (deleted)	Var. if (deleted)	StDv. if (deleted)	Itm-Totl (Correl.)	Alpha if (deleted)
PEU1	5,760000	2,982400	1,726963	0,693036	0,772661
PEU2	5,776000	2,813824	1,677446	0,713030	0,761702
PEU3	5,808000	3,067136	1,751324	0,603308	0,811347
PEU4	5,696000	2,947584	1,716853	0,631306	0,799766

variable	Summary for scale: Mean=5,08800 Std.Dv.=1,75525 Valid N:125 Cronbach alpha: ,758324 Standardized alpha: ,759842 Average inter-item corr.: ,514106				
	Mean if (deleted)	Var. if (deleted)	StDv. if (deleted)	Itm-Totl (Correl.)	Alpha if (deleted)
GQ1	3,360000	1,446400	1,202664	0,576827	0,693097
GQ2	3,376000	1,594624	1,262784	0,564424	0,703002
GQ3	3,440000	1,526400	1,235476	0,628051	0,633292

variable	Summary for scale: Mean=11,0000 Std.Dv.=3,46643 Valid N:125 Cronbach alpha: ,820336 Standardized alpha: ,823881 Average inter-item corr.: ,485220				
	Mean if (deleted)	Var. if (deleted)	StDv. if (deleted)	Itm-Totl (Correl.)	Alpha if (deleted)
GTF1	9,088000	8,944257	2,990695	0,588447	0,796524
GTF2	8,920000	8,009600	2,830124	0,599800	0,788707
GTF4	8,616000	7,356544	2,712295	0,646514	0,775692
GTF5	8,592000	7,825536	2,797416	0,586737	0,793606
GTF6	8,784000	7,721344	2,778731	0,668133	0,768331

variable	Summary for scale: Mean=12,2960 Std.Dv.=3,98389 Valid N:125 Cronbach alpha: ,650899 Standardized alpha: ,672516 Average inter-item corr.: ,411139				
	Mean if (deleted)	Var. if (deleted)	StDv. if (deleted)	Itm-Totl (Correl.)	Alpha if (deleted)
IUSE1	8,312000	7,20666	2,684522	0,404281	0,672161
IUSE2	8,952000	7,38970	2,718400	0,557178	0,415437
IUSE3	7,328000	10,06042	3,171816	0,474662	0,571549

variable	Summary for scale: Mean=5,76000 Std.Dv.=1,82014 Valid N:125 Cronbach alpha: ,774508 Standardized alpha: ,782016 Average inter-item corr.: ,549112				
	Mean if (deleted)	Var. if (deleted)	StDv. if (deleted)	Itm-Totl (Correl.)	Alpha if (deleted)
NB1	3,776000	1,581824	1,257706	0,544059	0,778929
NB2	3,896000	1,709184	1,307358	0,680808	0,633266
NB3	3,848000	1,584896	1,258927	0,623009	0,680989

variable	Summary for scale: Mean=11,1520 Std.Dv.=3,27024 Valid N:125 Cronbach alpha: ,785729 Standardized alpha: ,793095 Average inter-item corr.: ,399432				
	Mean if (deleted)	Var. if (deleted)	StDv. if (deleted)	Itm-Totl (Correl.)	Alpha if (deleted)
GO2	9,440000	8,246400	2,871655	0,513939	0,759876
GO3	9,432000	7,957376	2,820882	0,604775	0,741531
FE1	9,256000	7,598464	2,756531	0,519137	0,757585
FE2	9,296000	7,696384	2,774236	0,558285	0,747946
CON1	9,160000	7,302400	2,702295	0,514326	0,761372
CON2	9,176000	7,297024	2,701300	0,542141	0,752701