Exploring the Application of Gamification in the Software Development Process

by

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ABSTRACT

The purpose of this study is to investigate the use of game elements in software development teams and their impact on the software development process in South African financial institutions. The study was instigated by the numerous tools and procedures to administer software development entanglements, which is an ongoing challenge.

In recent years, many researchers have investigated the dynamics and issues pertaining to the development team's behaviour. Most organisations are challenged in their development teams and seek new creative methods and solutions to overcome the obstacles to enhance their software development process. A software development process is identified as a set of actions to generate software applications in which humans are a key factor. Considering that it involves human activity, challenges that arise are a user's engagement, collaboration, communication, and motivation may arise. Many researchers seek to enhance the software development process, and innovative research offers emerging practical concepts and techniques.

The study adopted a quantitative research design approach founded on the positivist paradigm followed by a deductive approach. A survey was developed to collect data from four selected South African institutions using a questionnaire of 95 respondents. The study's results contribute to knowledge by illustrating that although project teams are aware of the benefits of game elements, it does not necessarily translate into applying game elements. The study revealed that in the context of project team members, engagement, motivation, and performance positively impact the application of gamification in South African financial institutions.

Understanding the factors which impact the application of gamification among financial institutions is neglected. Therefore, this research study sought to address a gap in the literature on gamification. Gamification augments the software development process and subdues the challenges connected to human factors. Nevertheless, applying game elements in a software development team is not as straightforward as it may appear because it is a controversial issue that is yet to be investigated by researchers in this field. The outcome of this study brings forth practical recommendations for future research and industry.

Keywords: gamification; game elements; financial institutions; software development teams; software development process

DECLARATION

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Exact wording of the title of the thesis as appearing on the electronic copy submitted for examination:

EXPLORING THE APPLICATION OF GAMIFICATION IN THE SOFTWARE DEVELOPMENT PROCESS

I declare that the above thesis is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I submitted the thesis to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

(The thesis will not be examined unless this statement has been submitted.)

_____ _____2022-10-27___

SIGNATURE DATE

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DEDICATION

I will forever be grateful to my late grandmother, Priscilla Lesley. You fought a good fight gramz. We are because of you. This dissertation is dedicated to you.

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LIST OF ABBREVIATIONS AND ACRONYMS

Term	Acronym
Gamification Effectiveness Theory	GET
Human-Computer Interaction	HCI
Points, Badges, and Leader Board	PBL
Self-Determination Theory	SDT
Statistical Package for the Social Sciences	SPSS

CHAPTER 1

BACKGROUND TO THE STUDY

1.1 INTRODUCTION

Software engineering is a discipline that includes the structured design, production, and maintenance of a software product. Over recent years, software engineering has been noted as a positive evolution (García et al., 2017). The last decade has seen the development of new technologies, software, and hardware improvement, focusing on improving software processes, including agile development, or upholding product quality improvement (Gordieiev et al., 2014).

Compared to other disciplines, one of the most noticeable and significant advantages of software development is human factors; to this end, engagement, communication, collaboration, and motivation are considered key success factors for software development (DeMarco & Lister, 2013). The management of people in software projects is identified as the main problem (DeMarco & Lister, 2013); despite the identification of the main problem in software projects, software engineering tasks remain tedious (Humphrey et al., 2010). However, regardless of the noted efforts, software engineering tasks are known to be tedious. These main problems threaten a project team's motivation and engagement (García et al., 2017). To encourage engagement García et al. (2017) recommend using organised software projects as a set of challenges that can be well-ordered and accomplished, where specific skills such as shared effort are required. Furthermore, Romeike (2007) asserts that software processes can involve agility and discipline.

The application of gamification in software engineering appears to have potential. Although numerous definitions of gamification exist in the literature, Deterding et al. (2011) define it as "*the use of game design elements in non-game contexts*". Gamification uses game design philosophy, as well as game design elements, and mechanics in non-game settings to encourage specific human behaviour by enhancing the player’s motivation and engagement in an activity. Gamification uses specific attributes to make real games entertaining and inviting, and to improve the player's experience in a non-game environment, for example, in a workplace or school environment (Deterding et al., 2011). When applied to software development, gamification can provide several benefits. It encourages project teams and developers to learn about new software or technologies; greatly encourages and raises the

performance levels of project teams and developers; and influence the standard and quality of work if applied to motivate best practices (Dubois & Tamburrelli, 2013).
Furthermore, applying gamification to software development is not as straightforward as it may seem, given that gamification mechanisms and principles need to be further explored by the individualities of this field (Dubois & Tamburrelli, 2013). Therefore, this study seeks to explore the use of game elements in software development teams and their impact on the software development process.

Thus far, Chapter one has provided an outline and introduction of this study related to the concept of gamification; by exploring the use of game elements in software development teams and its impact on the software development process. In the next sections, the chapter provides the study's background and considers the research problem. After outlining the objectives and theoretical foundation of the study, the methodological approach along with the study's identified limitations and contribution, the chapter concludes with an outline of the thesis.

1.2 BACKGROUND

The term "*gamification*" can be defined as "a use of game design elements in non-game contexts" to increase participation and encourage a particular behaviour (Deterding et al., 2011). Although the term “gamification” became more prevalent around 2008, its use only became widespread in 2010 with increased interest in gamification (Cohen, 2011). In recent years, it has gained great attention in academia and commercial applications (Cohen, 2011). An example of gamification is StackOverflow (stackoverflow.com), a developer question-and-answer website whereby users receive points for executing various actions via Twitter and Facebook (Dubois & Tamburrelli, 2013). Owing to its effectiveness, StackOverflow has since contributed to the widespread use of gamification in other domains.

The examination of theories on human-computer interaction (HCI) were to determine where 'gamification' originated from and how it relates to other similar theories (Deterding et al., 2011). It was discovered that gamification is used to increase retention and user activity in online marketing, education, or software applications for mobile applications (Zichermann & Cunningham, 2011). According to Hamari et al. (2014), one of the key factors identified in this research field is the evidence around the effectiveness of gamification, which was assessed through a literature review. Consequently, it was determined that gamification does work, but some challenges persist (Pedreira et al., 2015).

Software development has especially attracted a lot of attention from organisations and researchers in the application of gamification. The potential for gamification to increase

engagement coupled with its motivational nature has positively impacted software development. Games provide advantages that could be useful in a software development process. The use of games has been around for many years, and their primary purpose has been to create pleasure and entertain people (Dhawale & Dubey, 2011). Mcgonigal (2011) contends that nowadays people are dedicating a significant amount of time to video games. However, gamification is likely to engage users to solve real-world problems, where activities and outcomes add value and are not just a waste of time (Dhawale & Dubey, 2011). Furthermore, several studies have reported that when people are engaged, they are more productive, thus resulting in a higher-quality outcome (Procaccino et al., 2005). Furthermore, research has demonstrated that gamification can be used in environments where it is difficult to improve people's engagement, motivation, and influence on their behaviour (Dubois & Tamburrelli, 2013).

This study will focus on the application of gamification within a development team and its effectiveness in tackling software development challenges in the software development process. As a developing field, gamification is expected to contribute to addressing human factors (i.e., engagement, human involvement, motivation, collaboration), as well as software development process challenges (Olgun et al., 2017).

Furthermore, a few software development process tools have begun integrating into game elements to profit from gamification standards (Olgun et al., 2017). Some examples of commonly known commercial tools of gamification mechanisms are JIRA Hero, SrumKnowsy, and MasterBranch, which are adopted in software development teams (Olgun et al., 2017). Whereas practitioners and researchers have found that game elements can be applied to software development teams, the application of gamification is not apparent (Olgun et al., 2017). For this reason, further research on the application of gamification in a software development process is required.

1.3 PROBLEM STATEMENT

For decades, the failure rates and challenges of software development projects' have remained a concern for many organisations globally (Platonova & Berzisa, 2017). This problem is exacerbated by the multiplicity of reasons for the failure of software development projects. The failure is usually a result of a combination of business decisions and a lack of skills among project management and technical and development teams (Dubois & Tamburrelli, 2013). However, the most common reasons for software development projects' failure are rooted in the project management process and the aligning of IT with organisational cultures (Kaur & Sengupta, 2011). These failures impact the software development teams not

meeting their expectations in terms of functionality, quality, cost, and delivery schedule (Kaur & Sengupta, 2011). The failure of software development projects affects the morale of the development team because project delays often result in developers having to endure long hours of unpaid overtime (Butler & Ahmed, 2016). This, in turn, affects their personal lives and leads to a loss of motivation, engagement, and performance and ultimately resulting in high costs and staff turnover. According to Platonova and Berzisa (2017), gamification in a software development process can enhance motivation and engagement within the development team. Therefore, a need exists to assess the impact of the gamification framework on project teams by applying game elements to the software development process with a view to enhance the software development process.

1.4 RESEARCH QUESTIONS

The study seeks to answer the following main research question:

> How does the use of game elements in software development teams impact the software development process?

The main research question is investigated through the following sub-questions:

- What are software development team members' perceptions of engagement, motivation, and performance in a software development process?
- What is the relationship between engagement, motivation, and performance in a software development process?
- What is the impact of engagement and motivation on performance in a software development process?

1.5 RESEARCH OBJECTIVES

To address the above research questions, the following research objectives are formulated.

- To assess the perceptions of software development team members on engagement, motivation, and performance in a software development process.
- To measure the relationship between engagement, motivation, and performance in a software development process.
- To determine the impact of engagement and motivation on performance in a software development process.

1.6 HYPOTHESES

The following hypotheses were proposed to investigate the research objectives founded on the literature reviewed and the theories examined.

Hypothesis 1

H_{01}: There is no relationship between engagement, motivation, and performance in a software development process.

H_1: There is a relationship between engagement, motivation, and performance in a software development process.

Sub-Hypotheses 1

H_{02}: There is no relationship between engagement and performance in a software development process.

H_2: There is a relationship between engagement and performance in a software development process.

H_{03}: There is no relationship between motivation and performance in a software development process.

H_3: There is a relationship between motivation and performance in a software development process.

1.7 RESEARCH METHODOLOGY

According to Melnikovas (2018), a methodology is a research strategy that outlines how research must be carried out. Therefore, the study is structured according to the research onion layers, with motivation provided for the selected choices of the model. It defines the proposed data analysis technique and the importance of ethical considerations and concludes with the research design.

The study adopted a quantitative approach to carry out the research. A questionnaire was developed using a survey method to gather data. In quantitative research, the emphasis is on measuring and analysing causal relationships between isolated variables through statistical analysis (Olgun et al., 2017). Quantitative research is about determining correlations between variables and reliable outcomes, which can be confirmed as valid and replicated by an independent researcher (Choy, 2014). A quantitative approach uses a variety of data collection and analysis techniques by collecting data from participants using tools such as checklists, surveys, and other instruments to produce numerical data (Choy, 2014).

A researcher considers research design as a blueprint to approach the research that defines a concise and logical plan to tackle an established research question; this is achieved through collecting, analysing, and discussing data. The deductive approach was selected as the most suitable for this research as it tests concepts and patterns obtained from the theory using new empirical data (Ormerod, 2006). The deductive approach aims to test the Gamification Effectiveness Theory (GET) in the software development process, which in this study will be done by conducting a survey. Also, this approach will assist to address the research questions that were developed based on the GET theory.

Saunders et al. (2019) claim that cross-sectional studies represent data collected from a selected population at a specific point as a once-off. This cross-sectional study was conducted at a particular point in time, thus making it suitable for the cross-sectional study.

The study adopted the stratified sampling technique, which entails the researcher utilizing a fixed number of participants from a previously selected population group (Imbens & Lancaster, 1996). A sample of 100 people from development teams with various job descriptions ranging from developers, system analysts, business analysts, and project managers, to test analysts was selected to participate in this study. All the development teams are based in South Africa, albeit from various departments within the financial institutions. Through the adoption of this method, every participant was offered an equal chance to participate in the study (Christofides, 2005). This technique was selected based on its suitability for this study. The researcher aimed to select a few job functions to use in the questionnaire survey; these job functions were extracted from the various development teams.

Marczyk et al. (2005) have suggested data collection, observation, questionnaires, and interviews as core methods in survey research. The study adopted the questionnaire method for the collection of the data for the research study. The questionnaire consisted of pre-formulated questions and well-defined alternatives that allowed respondents to select their answers. The preformat and selection options guarantee data collected from the respondents is quantifiable and unbiased. Marczyk et al. (2005) define questionnaires as an effective form of data collection, administered electronically, through postal services, or personally. The survey was administered using web-based records.

To ensure the validity of the questionnaire survey, the researcher will consult with game research experts, and consider their advice to ensure quality requirements and content validity (Braun & Clarke, 2006). Based on previous research, the instrument will then be tested through descriptive statistics and a gameplay scale (Olgun et al., 2017). The gameplay scale will consist of a 5-point Likert scale which allows the selected participants to express their level

of agreement or disagreement with specific statements typically in five points ranging from "strongly disagree" to "strongly agree" (Toprac, 2011). In this study, the statements were designed in the form of a questionnaire survey consisting of 10 questions.

1.8 THE IMPORTANCE OF THE STUDY

Since the study is aimed at determining the use of game elements in software development teams and its impact on the software development process, the study is valuable because it will:

- develop suggestions on improving the software development process's engagement, motivation, and performance issues;
- help identify which game elements can be applied to software development to increase the software development process's performance;
- create an understanding of how the applications of gamification impact the software development process; and
- contribute to research on the use of game elements in software development teams.

1.9 OUTLINE OF THE DISSERTATION

This study involves an investigation of the use of game elements in a software development environment and was described in more detail in chapter 1. The dissertation itself consists of 6 chapters, and the remaining chapters are structured as follows:

Chapter 2 reviews extant literature relevant to the study. Specifically, the following concepts are explained in detail: existing game elements used for improving engagement, motivation, and performance; game elements that can be applied in software development teams; and the application of game elements.

Chapter 3 delivers the theoretical view that supports this study. Furthermore, it details the study's key constructs and concepts and elaborates on how the literature relates to the study. The literature examined focuses on the use of game elements in software development teams and their impact on a software development process using the Gamification Effectiveness Theory (GET).

Chapter 4 discusses the research methodology adopted for the study. A quantitative approach was employed, and a questionnaire survey was used to obtain data for analysis. The research design spells out the instruments and analytical techniques adopted for the study.

Chapter 5 analyse the collected data and discusses the study’s findings.

Chapter 6 presents the conclusion derived from the study as well as the recommendations.

The chapter concludes by discussing the limitations of the study and outlining future research that can be carried out.

The reference section provides a list of all references cited in the main body of the dissertation.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 provided the background, the problem statement, research questions, objectives, research methodology, and the importance of the study. This chapter presents the literature review. The literature review will analyse and evaluate the current state of knowledge about a subject to extend the body of research in the area (Mathip & Gumbo 2015:73). In the context of this study, the literature review seeks to understand the use of game elements in software development teams and their impact on the software development process. The keywords used for the research were derived from the main research question and included “gamification”, “game elements”, “software development process”, and “software development teams”. The keyword searches were performed on the following electronic databases: Google Scholar, Unisa Library, and ResearchGate.

Chapter 2 begins with an introduction to software development, emphasizing the software development process. It presents a literature review on gamification, focusing on game elements in software development teams. The chapter discusses existing game elements used to improve engagement, motivation, and performance, game elements used in software development teams, and game elements.

2.2 SOFTWARE DEVELOPMENT

According to Deek et al. (2005), software development is a process of planning, describing, analysing, designing, developing, testing, and documenting software applications or other software components, as illustrated in Figure 2.1. Software development includes research about methodologies, new development techniques, modifications, and prototyping. It should support re-engineering and be reusable (Üsfekes, 2019).

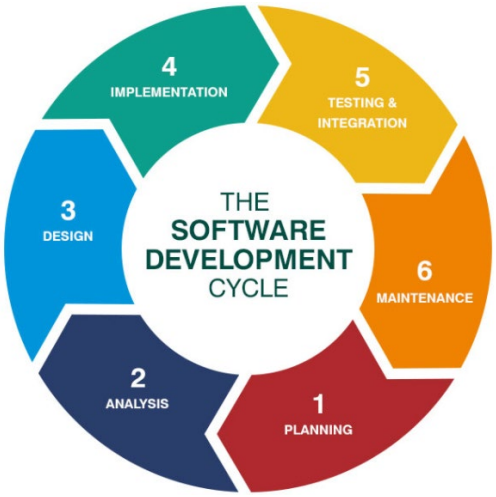

Figure 2.1: Software Development Lifecycle (Sami, 2012)

The software development process defines the process for creating software products and services (Yilmaz et al., 2011). These processes are usually utilized by individuals or software organisations. A software development process entails dividing software development work into subprocesses or smaller parts to improve the design, product management, and project management (Muñoz et al., 2019). The software development process is comprised of related activities. These activities assist in developing products that provide a guideline for software development within a given budget. Each identified activity includes a task as small as a work unit (Al-Qutaish, 2009). Software development companies are generally considered social organisations built on employees' skills. Yilmaz et al. (2011) justified this by stating that software organisations' skills, goals, and resources directly use a process regarding their needs.

The improvement methods of the software development process should involve different activities to enhance the quality of the software project (Conradi & Fuggetta, 2002). These activities should take into consideration factors that affect the software activities (e.g., social relationship issues and coding). Dittrich (2002) reckon that, in a software development process, software practitioners rarely work on their own; in most cases, software practitioners work in various project teams and the operational activities can therefore be considered an activity of social relationships. A software developer who works in several development teams is affected by multiple social factors. The factors are not restricted by their working conditions, rationality, and interdependencies (Grechanik & Perry, 2004). Enhancing the quality of software projects and completing the project within the planned budget is essential for enhancing a software process (Üsfekes, 2019). A coordination mechanism from development to maintenance and management is required to meet quality and budget requirements. For example, while the scope of a project is expanding, technical documentation readability is

decreasing. Therefore, software development team members must coordinate while growing the project team (Clarke & Connor, 2015). The level of coordination of the project team affects the software product quality. The software development problems can be allocated to the correct team members (Üsfekes, 2019).

Having explained the intricate activities involved in software development, it is essential to note that the main challenges in the software development process require innovative approaches to improve the software development process. Such challenges include, but are not limited to business decisions, project management, and technical and development teams. One of the innovative approaches that can be used to enhance the software development process is gamification, and it is discussed in more detail in the next subsection.

2.2.1 Gamification and the software development process

Using game elements in software development contributes to employee motivation as well as improved work environment productivity, and interest in a task. Parizi (2016) stated that employee motivation is a key benefit of gamification. Further to this, the authors stated that an improvement in the quality of claims contributes to the improvement of a process.

As mentioned in the preceding paragraphs, the software development process has several phases, and these are depicted in Figure 2.1. A software project development process depends on these phases, each of which has a chain-like structure. The definition of the requirements phase includes eliciting business requirements, analysis and design, requirement reviewing, requirement clarification when there is uncertainty, and supplementation. Gamification is applied in the requirement definition phase to elicit more requirements and improve quality (Platonova & Berzisa., 2017). The design phase involves defining the system's fundamental properties and designing a software project (Platonova & Berzisa., 2017). The coding phase involves developing software that shapes the predefined business requirements and the software's design (Platonova & Berzisa., 2017). Gamification motivates developers to create tasks and compare results with other teams (Biegel et al., 2014). Testing can be seen as a software validation and verification phase that give specific principles defined during the recovery and documentation phases (Mäntylä & Smolander, 2016). The testing phase takes place after documentation by considering non-functional and functional requirements. Gamification assists in testing at a better quality and motivates testers (Mäntylä & Smolander, 2016).

Apparently, 55% of gamification cases indicate that gamification is primarily used in the development phase (Gasca-Hurtado et al., 2016; de Melo et al., 2014; Rojas & Fraser, 2016).

Game elements are used as a motivator for developers (Steffens et al., 2015). Similarly, Singer and Schneider (2012) stated that most developers are interested in gamification because it encourages them to do their work better, stimulates communication between the project team, and increases the quality improvements of their contribution. Üsfekes (2019) stated that gamification could be used in defect tracking because game elements motivate developers to resolve more defects. Moreover, project team members have noticed an increase in motivation based on the feedback on the work done (Orta & Ruiz, 2016).

As reported by Passos et al. (2011), in the software development lifecycle, the testing phase is the second step. Areas of common concern in the testing phase are testing traceability improvement and automatic testing by Passos et al. (2011). The testing phase chronicles improvement in product quality, the quality of the code, and any peer-learning taking place. Various researchers have listed improved communication among project team members, great motivation, the ability to track work progress, and the ability to have sight of project teams' achievements by using specific game elements such as badges, points, or leader boards (Swacha, 2016; Kumar and Krishnamurthi, 2016); deMelo et al., 2014; Herranz et al., 2015).

One study recorded the application of gamification in project management (Ribeiro et al., 2014). Applying gamification simplifies work and enhances the software process by improving motivation, engagement, collaboration, and performance, providing feedback on the completed work, and comparing work productivity over time. According to Platonova and Berzisa (2017), 55% of articles they reviewed on the use if gamification in development projects attest to using gamification during the development phase. Figure 2.2 depicts the full classification of these articles according to where gamification occurs in software development. Overall, the use of gamification positively impacted the results of a project team in the software development process.

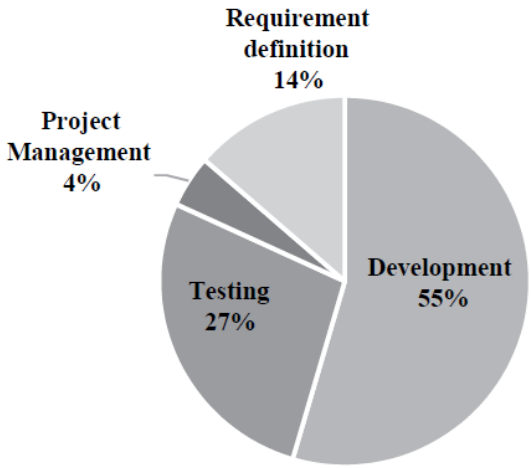

Figure 2.2: Gamification in a project development phase (Platonova & Bersiza, 2017)

In contrast, Herranz et al. (2019) drew attention to the challenges of gamification, such as increased pressure and stress in a work process where gamification is applied. When a project team is working together, the project team feels pressure, which could badly affect the entire team's productivity (Herranz et al., 2019). Another disadvantage Louridas et al. (2008) identified is the implementation of gamification in a project. Gamification is apparently a time-consuming process involving deciding on the right tool, employee engagement, and the ability to implement it. In most cases, standard tools are not chosen, but specific solutions for a particular process are complex in implementation and development. Further to this, Platonova and Berzisa (2017) added that before gamification is implemented, it requires specific analysis, the ability to participate, awareness of employees, a suitable tool selection, and time to adjust to the development process. Louridas et al. (2008) shared their experiences on how teams have encountered challenges in introducing tools into a real project setting. However, they could only investigate the effects of gamification on a test group in the short term by simulating the software development process amongst two project teams. One project team performed their work using playing elements while the other did not use game elements. A comparative analysis of the two teams revealed that the productivity and motivation of the team which used game elements were higher (Butler & Ahmed, 2016).

This section provided an overview of the software development process. Literature attests that gamification is mainly applied in the testing and development phases of the software development process (de Melo et al., 2014). For each work process, special software is developed (Gasca-Hurtado et al., 2016). The challenging approach is introducing game elements into a project and the readiness of the project team to change their ways of working by adapting it to this tool. The introduction of gamification into the working group motivates and influences developers to adopt behaviours that raise their interest, focus on monotonous

and time-consuming tasks, and foster good teamwork, resulting in an improved standard of work and, ultimately, high-quality software products (Rojas & Fraser, 2016; Parizi, 2016). On the contrary, applying the use of game elements in a software development team is not as straightforward as it may appear; it is still a controversial issue that needs further interrogating.

2.2.2 Software development process and collaboration

There is a correlation between a software development process and collaboration. According to Steffens et al. (2015), individuals working on software development projects as teams is the most effective way to yield quality products and services. Kozlowski and Ilgen (2006:6) defined teams as two or more people who interact and collectively perform tasks adaptively towards a common goal and are tasked with specific roles to achieve, maintain, and manage boundaries. Project teams are assembled in an organisational context to; (i) engage with other business units; (ii) capitalize on the skills; knowledge and abilities; and (iii) set limits in the broader entity.

Since software development is knowledge-based and requires human interaction, researchers have studied how human factors such as motivation and engagement impact the development of the software development process (Steffens et al., 2015). As far as Beecham et al. (2008) are concerned, motivation significantly impacts software quality management and practitioner productivity. Furthermore, Steffens et al. (2015) is of the view that many companies are relooking their strategies to understand what motivates employees to engage with the organisation. Other than motivation which will be discussed later, another human factor identified as key to the success of a software development process is collaboration. Most organisations require employees to establish collaborative relationships to accomplish organisational goals (Sprague et al., 2009). Kusumasari et al. (2011) described coordination and collaboration in a software development process as essential in defining the success of a software project. Research has highlighted matters about collaboration, communication, and coordination, which increased remarkably over the past decade because academia and industry acknowledge the importance of teamwork in software development (Treude & Storey, 2009). Fuks et al. (2005) indicated that collaboration combines cooperation, communication, and coordination. Cooperation can be seen as production in a shared space (Steffens et al., 2015). While communication involves exchanging information amongst people, coordination relates to managing people, resources, and events (Steffens et al., 2015). These concepts are related and connected with awareness, that is, comprehending the activities of others by providing context for one's activities (Steffens et al., 2015).

Research has revealed collaboration and motivation as essential contributors to software development teams affecting project productivity, quality, and success (Steffens et al., 2015).

Motivation relates to driving the genuine need of project teams to complete their tasks while meeting productivity and quality requirements; the following section discusses this in detail. Collaboration, cooperation, communication, coordination, and awareness are functional dimensions for detecting and evaluating collaboration matters (Steffens et al., 2015).

2.3 THE CONCEPT OF GAMIFICATION

The concept of gamification is pertinent to studies of social aspects of software development which has received a lot of attention among researchers (Üsfekes et al., 2019). Several researchers have investigated the potential use of game elements in software development activities to determine their effect on software product health (Huotari & Hamari, 2012). The authors explained game elements as a unique social activity highlighting engagements or interactions that could offer various quantifiable social outcomes.

According to Cohen (2011), the past decade has witnessed the transformation brought about by games when reshaping communication with the assistance of social media to encourage competition and cooperation. Serious games are utilised for game-based social skills training that assists individuals to improve their social responsibility through creating excitement and engaging settings (Üsfekes, 2019). Apart from this, Wang and Huo (2019) discussed the emerging trends that are enhancing the popularity of practitioners' and researchers' who have redefined the concept of game elements in non-gaming contexts. Consequently, gamification has become an emerging topic for enhancing software development. Gamification has been demonstrated to align individuals' motivation with software development activities and assist in pointing out various information technology-related issues (Üsfekes et al., 2017).

2.3.1 Gamification

On the authority of Salen and Zimmerman (2003), gamification has recently included systematic game elements in services. Huotari and Hamari (2012) posit a game as a system in which players participate in an artificial conflict that is well-defined by rules, resulting in a quantifiable outcome. Although The term “gamification” came into use in 2002, it became more prevalent around 2008. In a blog, Brett Terrill labelled gamification as ‘taking game mechanics and applying them to other social platforms to increase engagement’ (Huotari & Hamari, 2012). This saw the implementation and widespread use of the term in 2010 which led to the term gaining greater attention in academia and commercial applications in recent years (Cohen, 2011).

Deterding et al. (2011:2) have described gamification as “a use of game design elements in non-game contexts” to increase participation and encourage a particular behaviour. This definition distinguishes gamification from other associated disciplines such as game-based learning, design for playful interactions, and serious games. These authors strongly attest to systems of affordance absorbed in gamification which should be the same and used in games regardless of the outcomes.

Gamification is a subject matter of interest, and due to its capacity to increase engagement, the extension of game methods into different environments is receiving attention in diverse research areas such as banking (Baptista & Oliveira, 2017), marketing (Wolf et al., 2020), education (Deterding et al., 2011; Glover, 2013; Hamari et al., 2016) medical science and software engineering (Fleming et al, 2017) where its use is growing (Swacha, 2016; Jurado et al., 2015; Mora et al., 2018). At the time, Zichermann and Cunningham (2011) predicted gamification as the next-generation customer engagement and marketing technique. Furthermore, it was predicted that by the end of 2015, over 50% of organisations adopting innovation would apply gamification to most of their operations (Gartner, 2011). Gartner (2011) has also noted that the prediction of gamification's future success is on the rise; conversely, there are also predictions about its failures.

Houtari and Hamari (2012) have concluded that gamification is a process for improving services with affordance for gameful experiences to assist the user's value concept. In contrast to other definitions stating that gamification is based on game elements, Houtari and Hamari (2012) argued that gamification occurs by applying game mechanics to non-game services. The authors dispute that no defined game elements can be considered unique to games. They further added that it is important to consider that game elements do not warrant the formation of a gameful experience. As a result, the authors are opposed to basing the definition of gamification on a technique. They argue that gamification should be understood as increasing the tendency for gameful involvement and introducing the service with affordances. Furthermore, in the holistic definition presented, the authors indicate that, as an essential requirement to create a gameful experience, users of the service should be allowed to volunteer due to being drawn by their intrinsic motivation (Dawud & Nikolic, 2020). Considering this, if the voluntary part of a gamified service is eliminated where users are controlled, users are denied a free choice, and the service lacks the underlying gameful experience.

According to Dawud and Nikolic (2020), there are four providers of gamification, namely a third-party service provider, the core service provider, the customer, and another customer.

Hamari et al. (2014) postulate that gamification works, even though efficiency is not deprived of some cautions. The authors added that it is an essential antecedent for gamification in the

context of software development. The authors further suggested that user qualities impact the behaviour towards gamification, which explains why gamification may have experienced substantial impacts on users in specific environments. In contrast, the same impacts may not be detected in other environments. Furthermore, Dawud and Nikolic (2020) posit that external pressure such as extrinsic reward undermines intrinsic motivations and gamification.

Several recent gamification applications suggest a reward-based system that motivates current or potential users to promote competition and progress (Dawud & Nikolic, 2020; Jipa & Martin, 2014). Üsfekes (2019) describes motivational factors as comparing an individual's performance to their peers, which results in increased attitudinal intention and system usage. Research has also highlighted that gamification is used to compare decision-making, thus influencing a specific action in the decision process and choices (Wang et al., 2003).

Gulec et al. (2019) furthered the discussion by mentioning that gamification can be used in marketing events to increase attendees' participation and achieve an event's expected result. The authors declared that by merging gamification and marketing events, the players and attendees are connected while their loyalty increases by encouraging them to adopt the organisation's behaviour. Cruceru and Moise (2014) explained that a more efficient and straightforward approach to applying gamification is using the internet and focusing on social media platforms. However, the authors addressed the extant knowledge gap existing in the numerous types of users who participate in social media games (Moise & Cruceru, 2014).

Gamification's primary aim is configured with the three most important marketing concepts, namely: brand awareness, engagement, and brand loyalty (Lucassen & Jansen, 2014). Using interviews with marketing executives, the author identified gamification as a rising concept in the marketing sector and is likely to increase in other business sectors in the foreseeable future. Dawud and Nikolic (2020) described gamification as not the end goal but as a means of achieving the marketing purpose. The interviewed marketing executives identified a common objective which is increasing engagement through gamification (Lucassen & Jansen, 2014). The authors added the necessity for further research to comprehend gamification's impact on marketing campaigns.

Software development gained special attention from organisations and researchers in the application of gamification (Platonova & Berzisa, 2017). The potential of gamification's increasing engagement and its motivational nature positively affects software development (Platonova & Berzisa, 2017). Games provide advantages that could be useful in a software development process. The use of games has been around for many years, and their primary purpose has been identified to create pleasure and entertain people (Dhawale & Dubey, 2011). In addition, Mcgonigal (2011) has expounded that nowadays people are dedicating a

significant amount of time to video games nowadays. However, gamification will likely engage users in solving real-world problems, where activities and outcomes add value and are not just a waste of time (Dhawale & Dubey, 2011). Furthermore, several researchers have reported that they are likely to be more productive when people are engaged, resulting in a higher quality outcome (Procaccino et al., 2005). Also, gamification can be used in environments where it is difficult to improve people's engagement, motivation, and influence of their behaviour through a software process.

In this subsection, it has been shown that current studies have not adequately addressed the use of game elements to improve the software development process. Therefore, this study will investigate how project teams use the game elements and how they enhance their engagement, motivation, and performance.

2.3.2 Gamification in the workplace

Shavab et al. (2021) reckon, organisations constantly seek new ways to engage their employees, improve productivity, and motivate a positive behavioural outcome. As alluded to by Deterding et al. (2011), gamification takes its roots from the word "game", and organisations are gamifying their departments to engage their employees. For instance, Desai and Nagaraju (2018) stated that gamifying marketing activities convert gamification into a more rewarding and active customer-business engagement. The author also believes the sales department aims for high revenues by encouraging healthy competition among employees using scoreboards. By the same token, the human resource department uses gamification to keep employees motivated and satisfied for improved work performance (Desai & Nagaraju, 2018). An IT department uses gamification within a development team to tackle the challenges in software projects (Olgun et al., 2017). Olgun et al. (2017) further stated that few software development process tools have begun integrating into game elements to profit from gamification standards. Some commonly known commercial tools examples of gamification mechanisms are JIRA Hero, SrumKnowsy, and MasterBranch, which are adopted in software development teams (Olgun et al., 2017). Practitioners and researchers have identified that game elements can be applied to software development teams because they assist in overcoming challenges associated with human factors, including engagement, human involvement, motivation, and collaboration, throughout the software development process (Olgun et al., 2017).

To mitigate project failure, it is important to assess the impact of a gamification framework by applying game elements to the software development process.

2.3.3 Positive value for the business

Organisations adopting gamification gain multiple advantages, such as productivity improvement and increased competitiveness (Pavlova, 019). Desai and Nagaraju (2018) have compiled the following list of essential benefits for organisations that decide to implement gamification:

Increasing motivation and engagement

In most organisations, gamification is usually applied through different reward systems (Pavlova, 2019). The implementation of a rewards system assumes that employees have goals that they should achieve. When a task is completed successfully, the employee, in return, receives some form of bonus. Research by De Marcos et al. (2014) and Hamari et al. (2016) submit that engagement and motivation can result from gamification. Additional literature evidence suggests that gamification is responsible for increasing motivation and engagement in an organisation (Silic & Back, 2017; Brigham, 2015; Armstrong & Landers, 2018). As far as Desai and Nagaraju (2018) are concerned, rewarding employees encourage them to be more productive, resulting in job satisfaction and performance and ultimately improving their motivation.

Improving productivity

Motivation translates into higher productivity. Gamification assists in creating a relaxed and collaborative environment in an organisation, thus promoting collaboration amongst workers. Games also help increase employees' skills, resulting in increased productivity (Desai & Nagaraju, 2018).

Strengthening communication processes

Gamification usually involves employees from different departments. As claimed by Desai and Nagaraju (2018), game elements unite people through participation in game activities, thus improving communication between departments.

Facilitating employee engagement

A significant organisational commitment can be achieved through gamification training programs (Pavlova, 2019). Game-based learning makes it easier for employees to identify themselves with the organisation and achieve a feeling of belonging to a team (Desai & Nagaraju, 2018).

This section reported on the concept of gamification and its impact on the workplace. Houtari and Hamari (2012) concluded and agreed that gamification service with affordance for gameful experiences was enhanced to assist the user's value concept better. As such, it increased employee motivation and engagement, improved productivity, strengthened communication processes, and facilitated employee engagement. This created a positive value for the business by adopting gamification to enhance the software development process.

2.4 GAME ELEMENTS

2.4.1 Game elements background

The history of game elements stretches as far back as a few decades ago. In the early 1930s, the game element theory made its first appearance. As mentioned by Yilmaz and O'Connor (2011), game elements highlight interactions among teams, individuals, or units.

After researching a hundred gamification implementation projects, Werbach and Hunter (2012) discovered that the most used game elements are points, badges, and leader boards, which are often referred to as PBLs. PBLs are so common that they are usually defined and viewed as gamification (Werbach & Hunter, 2012). Be that as it may, PBLs are not the only elements that form gamification (Werbach & Hunter, 2012). Other game elements are characterized by dynamics, mechanics, and components. Figure 2.3 below illustrates these game elements.

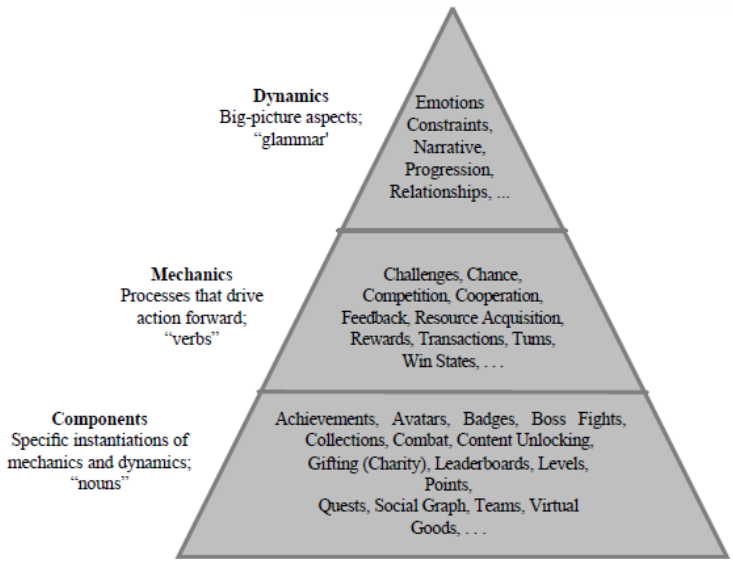

Figure 2.3: The Game Element Hierarchy (Werbach and Hunter, 2012)

Werbach and Hunter (2012) expounded that although dynamics and mechanics are closely related and sometimes used interchangeably, dynamics concerns the general structure and game elements that meet the users' needs, and mechanics refers to the fundamental process that directs players' engagement and is used to attain one or more of the dynamics of the existing one. Correspondingly, Sereno (2021) added that components are more detailed than dynamic or mechanical methods, which is why users consider them more manageable since they have a lower concept level than dynamics and mechanics. Employing this categorization, Table 2.1 exhibits the game elements examined by researchers. The table lists the most commonly explored game elements among research articles as being points, badges, and leader boards, validating what was previously mentioned (Werbach & Hunter, 2012; Hamari et al., 2013). Concerning dynamics, a study by Werbach and Hunter (2012) labelled emotions, constraints progression, relationships, and narrative as the most important to be applied in gamification.

Table 2.1: Research on key game elements for gamification (Sereno, 2021)

	Research Articles	Werbach and Hunter (2012)	Nicholson (2015)	Dicheva et al. (2015)	Wolf et al. (2020)	Morschheuser et al. (2015)	Hamari (2017)	Deterding and Dixon et al. (2011)	Simoes et al. (2015)
Components	Points	*	*	*	*	*			*
	Badges	*	*		*	*	*		*
	Leaderboards	*			*	*		*	*
	Avatars	*						*	
	Levels	*	*		*				*
	Teams/Groups	*						*	*
	Clear rules							*	*
	Make-believe							*	
	Achievements	*							
	Quests	*			*				
	Items		*						
	Goals								*
Mechanics	Fun								*
	Feedback	*			*			*	*
	Social enabled				*				*
	Competition	*						*	
	Cooperation	*							
	Challenges	*	*						
	Rewards	*				*			*

The base level of the Game Element Hierarchy illustrated in Figure 2.3 is the Components level which refers to the specific representation of mechanics and dynamics known as “nouns” and is made up of elements including avatars, badges, level points, quests, and collections. At the Component level, an individual completes a task and receives a badge, which addresses challenges or rewards as game mechanics and progression or emotions (Werbach & Hunter, 2012). The middle level is called the Mechanics level, which involves the processes that drive the action forward, known as “verbs,” which keep a person engaged. The Mechanics level comprises challenges, competition, feedback, rewards, and turns.

Using game mechanics makes it possible to influence participants' feelings about the gamification system. It arouses their interest in doing and increases their task involvement (Werbach & Hunter, 2012). At the apex of the game elements hierarchy is Dynamics, the big picture aspects referred to as “glammar,” where elements such as emotions, constraints, narrative, progression, and relationships are found. Dynamics may be compared to employee development (Werbach & Hunter, 2012). To create a desired dynamic, it is mandatory to move

in the right direction using applicable practices, same as with employees, to develop staff, employees must be pushed towards performing required activities (Pavlova, 2019).

On the other hand, Table 2.1 is not a decisive list of game elements by researchers, and neither is it a definite concept for gamification. An analysis by Sailer et al. (2017) insinuates that a lack of standardization, resulting in distinctive configurations; however, this lack of understanding depends on the game elements used and the implementation. In addition, Sailer et al. (2017) pronounced that the presented collection of game elements is founded on how noticeable they are to players, the ease of activating them through an experiment, and the strength within the theoretical framework proposed can be used to address motivational mechanisms.

As discussed in 2.3, Table 2.1 shows that points, badges, and leader boards (PBL) are dominant gamification elements with at least five nods from the eight researchers who focused on game elements and gamification in the ten years from 2011 to 2021.

The following section analyses suitable game elements for building the scenarios.

2.4.2 Game elements analysis

2.4.2.1 Most used game elements

As already mentioned, Werbach and Hunter (2012) have reported that the most used game elements are points, badges, and leader boards (PBL). Muñoz et al. (2018) also attested to this by recounting that the most used gamification element in software engineering consists of the PBL triad. Using Table 2.1, the game elements identified can be applied to software development teams. Muñoz et al. (2018) observed that combining two or more game elements produces outstanding results. Although, its success is dependent on the application environment. Furthermore, the authors reported an increase in both motivation and engagement when two or more game elements were combined. According to Jurado et al. (2015), applying PBL improved collaboration, participation, knowledge refinement, and contribution to software development. Stanculescu et al. (2016) have also identified game elements that fostered employees' learning and social behaviour. Additionally, Pereira et al. (2018) reported a laboratory pilot study that links an increase in points, leader board, and levels.

2.4.2.2 Software team reinforcement and game elements

The analysis undertaken in this section identified game elements that could be used for software team reinforcement. Muntean (2011) is of the opinion that team members' competency and understanding are essential to communicating technical requirements in a

project team. However, it is also imperative that their interaction should not interfere with their performance. On the other hand, Muñoz et al. (2017) posit that when multiple people work in a team, their soft skills are improved, enhancing cohesion through team reinforcement. Participation, contribution, communication, and improvement are known to enhance team reinforcement by improving the team's cohesion (Muñoz et al., 2017). Based on Muñoz et al. (2017) research findings, Table 2.2 lists the most used game elements in team activities (Muñoz et al., 2017). In team reinforcement, the identified game elements were all applied.

Table 2.2: Most used game elements and reinforcement team activities (RTA) (Munoz et al., 2017)

Components	Mechanics
Points	Fun
Badges	Feedback
Leader boards	Social enabled
Avatars	Competition
Levels	Cooperation
Teams/Groups	Challenges
Clear rules	Rewards
Make-believe	
Achievements	
Quests	
Items	
Goals	

There is no denying that those game elements listed in Table 2.2 affect a project team's motivation. According to Salier et al. (2017), the authors justified the game elements as being easy to activate them experimentally, their visibility to people and the ability to address motivational mechanisms. The preceding sections showed an acceptance of the different types of game elements used in a gamified experience. When applied, nearly all game elements are helpful, captivating, amusing, and motivating. According to Werbach & Hunter (2012), game elements were perceived as motivating and valuable, allowing project teams to engage better with tasks allocated and accomplish workloads.

2.5 CONNECTING GAMIFICATION TO PROJECT TEAMS MOTIVATION AND ENGAGEMENT

Some of the failures of software development projects are due to a lack of motivation Dubois and Tamburrelli (2013) and low engagement with the content (Muntean, 2011). Motivation and

engagement are closely related concepts similar to cognitive engagement and intrinsic motivation (Butler & Ahmed, 2016). Although the two pairs of concepts are used interchangeably, they should not be considered synonymous, and the existence of the other does not automatically influence the other. According to Brooks et al. (2012), motivation is related to psychological aspects that guide choice-making and behaviour. Wood and Reiners (2015) view engagement as energy related to different tasks and actions. The authors emphasised the importance of motivation and engagement in software development but highlighted their split as independent constructs (Appleton et al., 2006).

As maintained by Brook et al. (2012), the split between motivation and engagement is an ongoing discussion, where the link between the two is nuanced (Alsawaier, 2018). Brook et al. (2012) summarize that engagement has progressed to a point where it includes the internal psychological process and appearance in human behaviour, categorized into cognitive, affective, and task engagement. Willms (2003) has highlighted the link between psychological attitudes and participation in project teams when working on a task for an operational definition of engagement. Üsfekes (2017) reported that team members focused on the noticeable aspects of engagement, observing the team's behaviours, dedication, and effort in performing a task, and their levels of attendance and participation.

Engagement and motivation are often distinguished in occurrence (Ismail et al., 2020). Intrinsic motivation and prior attitudes about software development increase participation and task engagement (Üsfekes, 2017). Participation is known to work in the opposite direction, altering previous negative attitudes (Ismail et al., 2020; Üsfekes, 2017). As far as Davis and McPartland (2012) are concerned, high task engagement and strong motivation enable successful project delivery. Engagement as an evident positive behaviour is motivated by prior attitude (Ryan & Deci, 2000).

Dörnyei and Ushioda (2011:65) defined motivation as "the dynamically changing cumulative arousal in a person that initiates, coordinates, directs, amplifies and evaluates the cognitive whereby initial wishes and desires are selected, operationalized, prioritized and acted out." Motivation is categorized into intrinsic and extrinsic motivation (Lee & Hammer, 2011). However, some researchers categorize motivation according to features such as task value and prospects for success (Hsieh, 2014). Intrinsic motivation is triggered by curiosity, human needs for control, and overcoming challenges. However, extrinsic motivation is pertinent to elements not linked to the task value, such as grades, rewards, competition, and performance or assessment by others (Alsawaier, 2018). Task value is the value of a task and perception by the project teams and whether it is valuable for them or not (Hsieh, 2014). Lastly, the

expected success is how the project teams anticipate performing in the future as they engage in a task (Hsieh, 2014).

Ryan and Deci (2000) cite intrinsic motivation as something evident in every human being who desires to overcome challenges, explore, and learn. The authors argued that related circumstances could provoke or suppress intrinsic motivational elements. Therefore, successful game designs should focus on critical psychological needs (Buisman & van Eekelen, 2014). Kapp (2012) has introduced a comprehensive study of heuristics for creating educational computer games in a computer games context. Moreover, the author has cited extrinsic and intrinsic motivation elements as being essential in a virtual game environment. Although, the author emphasised that intrinsic motivational concepts make software development activities self-rewarding and are not linked to external rewards (Kapp, 2012). Ryan and Deci (2000) have examined a meta-analysis that established that extrinsic rewards undermine intrinsic motivation.

Gamification is usually applied to increase employee motivation. Ryan and Deci (2000) have stated that when individuals are motivated; they are energised and behave in a particular way when performing a task. A few key concepts are pertinent when considering gamification. As mentioned above, gamification involves using game elements in a non-game context to improve the motivation and engagement of users. The game elements to be chosen should depend on the project team's goal regarding the kind of behaviour they desire to motivate. Lee et al. (2011) pointed out three parts of motivation that a player experiences, namely: ‘the cognitive area,’ ‘the emotional area,’ and ‘the social area.’ Therefore, gamification in the software development context should focus on these three areas which are discussed in more detail as follows:

The cognitive area

This area of motivation requires a player to learn and understand how things work Buisman & van Eekelen, 2014). The game makes use of cycles which teach the player the rules of behaviour. The mechanisms used for this are storytelling and hierarchical and structural tasks or visual representations. This involves presenting facts to a project team with reasons why something is relevant in a software development context. A developer’s code lends itself to game elements. However, writing (or applying) and understanding a code is a challenge (Cohen, 2011).

The emotional area

This area of motivation refers to the theory of rewarding wanted behaviour and fining unwanted behaviour (Buisman & van Eekelen, 2014). When an emotional experience is created, it aims

to involve users in the failure or success of completing a task correctly or incorrectly. The game elements involved are badges, player penalties, trophies, levels, and reward systems (Buisman & van Eekelen, 2014). The challenge faced here is balancing the difficulty. An individual must be happy to complete a challenge; however, the challenge must not be too difficult to complete. It should not be too difficult to ensure users are motivated and are able to try again. Preferably, the difficulty of the task and the number of rewards the players receive should be modified to a player's skill level (Lee et al., 2011).

A characteristic of the game concept is that it is considered to possess a low risk of failure. Misunderstandings are part of daily life; however, understanding how a game works and how to perform better is important. Business stakeholders or end-users expect results in a software development context. In these instances, failure is not accepted as a part of learning; however, gamification plays a role (Lee et al., 2011). For example, developers develop code in a production test environment and ensure the business requirements are met before business stakeholders or users test the results. Traditionally, the developers can ensure functionality has been completed and view the final requirement in a live platform. Interactive updates can be made should the need arise at any given time; however, adding the element of trial and error is a characteristic of games. Domínguez et al. (2013) further indicate that it works for better and more engaging project teams.

The social area

This area of motivation relates to communicating and comparing one's progress with others (Buisman & van Eekelen, 2014). When playing, a player assumes specific roles in this area. The roles allow players to behave differently from their usual day-to-day behaviour (Lee et al., 2011). This can be seen as part of video games. In a non-game context, individuals take on roles that apply to the situation; academic leader and caretaker (Buisman & van Eekelen, 2014). Furthermore, Buisman and van Eekelen, (2014) explains that when people perform tasks motivated by external factors, they get more involved because they see it as part of their identity. The game elements are avatars, leader boards, customisation, and communication features (Dominguez et al., 2013, Deterding et al., 2013).

As attested by Perryer et al. (2016), an essential difference in motivation in gamification is the difference between intrinsic and extrinsic motivation. Intrinsic motivation refers to doing something that one enjoys or finds fascinating. In contrast, extrinsic motivation refers to doing something with an expected external outcome unrelated to the task, such as points, rewards or promotions (Perryer et al., 2016). Extrinsic motivators are only effective if a person is present. For example, when an individual receives a promotion, some no longer put in extra

hours. Once a raise has been earned, employee standards adjust to a new normal, and their motivation decreases (Perryer et al., 2016).

On the other hand, intrinsic motivators are believed to be more challenging. However, in most scenarios, such as job satisfaction rather than a higher salary, a person is motivated in their job when rewarded for performing well (Perryer et al., 2016). When project teams intend to gamify a development process, examining the type of motivation to be applied, and how it will affect the users is essential.

The three areas (cognitive, emotional, and social) mentioned above are the trigger and basis for a player's motivation. However, Perryer et al. (2016) recognise the challenge of separating the areas because of their close relationship and interaction, since game mechanics usually covers more than one simultaneously. For instance, the awards a player accumulates contributes to a new set of skills, increasing the complexity and difficulty of the games. Therefore, the cognitive and emotional areas are affected in the process. Similarly, the social area is continuously linked to the cognitive area. For example, reward systems impact the player's social status when a task is required to be accomplished through a player's interaction.

Dörnyei and Ushido (2011:67) defined engagement as characterizing the emotional involvement and passion for participating in and accomplishing activities. Reeves and Read (2009) pursued the development of the engagement concept throughout its history, from the time a project team or team member spends on a task to the project's outcome, the quality of the project team's effort, a project team or team members' involvement in the software process experience and lastly the effort and quality of project team's investment in the activity. Reeves and Read (2009) identified the common theme as being the visual aspect of the engagement, which is exhibited in a project team's behaviour toward the software development process experience and the time and quality invested in a software task. However, equal engagement to time on a task is unjust in portraying the complete scope. The analysis of Saeed and Zyngier (2012) suggests that engagement is not merely similar to time on task; however, the "diligence and enthusiasm" in performing the task makes the engagement a reality. Reeves and Read (2009) emphasised this linkage between the overwhelming deep involvement and engagement in a task of the project teams that are beyond time and space.

Video games are embedded in gamification, motivating, and engaging using attainable but challenging rules, clear and steady progression competition, leader boards, and gripping narratives (Hamari et al., 2016). Empirical research on the application of game elements supports their positive impact on a project team's motivation, engagement, and performance through collaboration and instant feedback (Platonova & Berzisa, 2017). The introduction of

gamification has witnessed an increase in performance, an improvement in team members' involvement in projects, and, in some instances, improved team integrity Gasca-Hurtado et al. (2016); however, the initial motivation was higher (Domínguez et al., 2013). The introduction of gamification has influenced higher results, thus indicating a positive effect associated with gamification (Vasilateanu et al., 2018). Higher results refer to how a project team feels toward the game elements used in the software process.

There are many gamification studies. Passos et al. (2011) examined 12 studies and quantified how they produced positive results that linked gamification and the project team's engagement. According to Alsawaier (2018), Seaborn and Fels (2015) examined 32 studies of pedagogic digital gamification elements. Twenty studies produced positive outcomes linking gamification to improved engagement and motivation. The remaining 12 studies did not report a positive result displaying any connection between the project team's engagement when introducing gaming elements. In the context of gamification, Nicholson (2015) divided engagement into two categories, namely cooperation, interaction, and altruism between players (a form of engagement) and engagement between players achieved through game mechanics.

Pink (2009) added that when higher levels of extrinsic motivation are used during gamification; it is not sufficient to consider its benefits. According to Nicolson (2015), the positive impact is temporary if it is not combined with competence, autonomy, and relatedness. An analysis by Üsfekes (2019) states that the role of a project team in a software development process paves the way for the birth of intrinsic motivation. The author reported that extrinsic elements such as badges and leader boards are used to evaluate the results, not focusing on intrinsic motivation in gamification design. When no positive behavioural change is transferred in the project team, the effects of gamification cannot be evaluated in the long term-term (Alsawaier, 2018).

An important step in quantitative research involves understanding the long-term effects of implementing gamification in a pedagogical context. Most research on motivation and engagement involves either mixed-methods or quantitative methods coupled with limited qualitative elements (Banfield & Wilkerson, 2014). Among the few qualitative studies undertaken, Mekler et al. (2017) identified game elements that positively impact the performance rate of project teams in the software development process. Since competition in the recruitment sector as well as the healthcare and banking industry increases, organisations attempt to retain professionals in their workforce who contribute to making a difference in their software process. Gamification appears to provide a solution to improve a project team's motivation and engagement. However, numerous organisations still see it as a potential lack

of standardization and scientific proof of its results. This study aims to identify a project team's use of game elements in a software development process in a financial institution in a South African financial institution.

2.6 SUMMARY OF CHAPTER

Chapter 2 reviewed the literature on the use of game elements in software development teams. The purpose of the literature review was to identify, analyse and evaluate research studies that have been carried out on the topic “the use of game elements in software development teams and the impact it has on the software development process” with a view to establish gaps and support the findings of the study. The literature review also covered software development, the concept of gamification, game elements, and the linking of gamification to the project team’s motivation and engagement.

The chapter surveyed the literature on game elements in software development teams and the type of game elements applied. Furthermore, the literature review established that the use of game elements promotes productivity over some time.

The evaluated studies were conducted from various parts of the world, and some researchers highlight the wide range of benefits that game elements bring to a software development process. However, concerns regarding the use of game elements in software development were identified, such that game elements are not easily implemented, and practitioners must take into account specific factors to avoid the creation of an environment that leads to pro failure (Hamari et al., 2014).

This research investigation aims to identify gaps in the literature on the study of gamification, particularly the use of game elements in software development teams and their impact on the software development process. Chapter 3 will discuss the theoretical view that underpins this study.

CHAPTER 3

THEORETICAL FOUNDATION

3.1 INTRODUCTION

Chapter 2 reviewed related and relevant literature on the use of game elements in software development. Research conducted in social sciences and information systems requires applicable theoretical frameworks or models to guide a researcher in selecting the correct conclusions while carrying out the study. Several theories have been used to explore the use of game elements. This chapter discusses the Gamification Effectiveness Theory (GET) that supports this study, followed by the conceptual model, software development teams, and gamification elements. This chapter also discusses the details of the study's key concepts and constructs and their relationship with extant literature. The literature examined focuses on using game elements in software development teams and their impact on a software development process using GET.

The theory of a study is a set of concepts, definitions, and propositions that present a systematic view of phenomena by specifying relations among variables (Kerlinger & Lee, 2000). The purpose of a theory is to explain and predict the phenomena (Kerlinger & Lee, 2000).

3.2 THEORETICAL CONNECTION TO GAMIFICATION

Linking gamification to theoretical principles is not straightforward due to its thin knowledge base. Empirical research founded on theoretical principles on gamification is scarce. This is attributed to the recency of studies on the subject of gamification, particularly in software development. A study undertaken by Seaborn and Fels (2015) identified 32 studies on gamification, where only ten were founded on theories – five of which were by the same author, and the remaining 27 studies had no connection to theoretical foundations. Furthermore, the authors mentioned that several theoretical principles projected to investigate gamification were unexamined, and practical gamified methods were not founded on theories. Seaborn and Fels (2015) further argued that the research on gamification lacks reference to theories and theoretical principles through empirical observation. Therefore, there was a need to investigate which theories and theoretical principles of gamification impact a software development process. Understanding the theories and theoretical principles of gamification

that impact a software development process will bring to the fore the limited area of study and will address the gap in empirical research. ~~This study also emphasizes the need for empirical participants-based research and thus augments the necessity of gamification research with solid theoretical links that bridge the gap between practice and theory (Alsawaier, 2018).~~ GET will be discussed to understand the relationship between gamification effectiveness, motivation, and engagement in understanding the connection between game elements and software development teams.

3.3 GAMIFICATION EFFECTIVE THEORY

The literature identifies relevant constructs that demonstrate the theoretical background from which to view this study. This study aims to establish whether game elements enhance a software development process. In this study, the research is guided by a theory to understand the effectiveness of gamification. GET is one of the approaches developed to evaluate the impact of game elements within organisations. The theory clearly defines the effectiveness of gamification and the extent to which a gamified system is used and contributes to part of the specific goals of the system and its users' goals (Amir & Ralph, 2014). The effectiveness is displayed in three dimensions of formative constructs and is influenced by antecedents, which are factors that cause effectiveness, as shown in Figure 3.1.

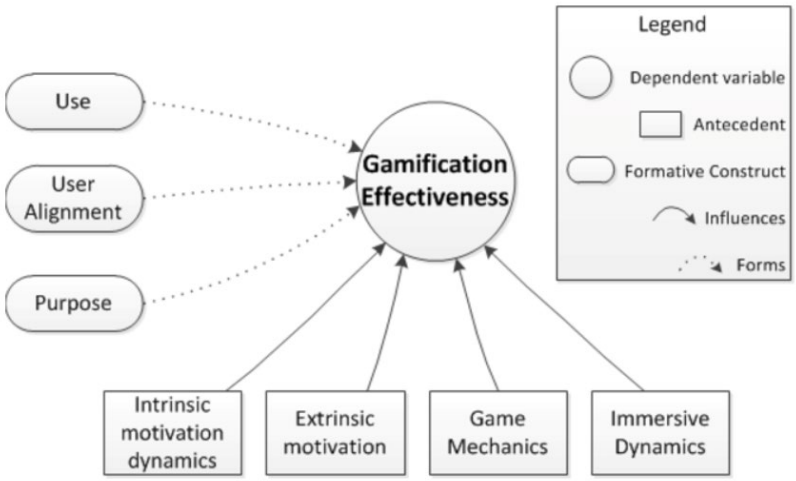

Figure 3.1: Gamification Effectiveness Theory (Amir & Ralph, 2014)

A software development process is considered a challenging task, conducted by individuals in a project team and is not easily and successfully mastered. Social variables significantly affect how users interact in a project team (Dubois & Tamburrelli, 2013). In addition, the rate

of project failure is very high. Social variables influence how individuals in a project team conduct themselves when performing a task.

Limited theories have been used to explore various dimensions of gamification. In addition, much of the theoretical foundations of gamification have not yet been well-defined. Deterding et al. (2011) link the Self-Determination Theory (SDT) to the theoretical foundation for gamification as a whole (Ryan et al., 2006). SDT is a macro theory of human motivation that is used to understand an individual's behaviour. According to SDT, it helps to understand how and why human behaviour is initiated and regulated by discussing environmental and social conditions that could affect engagement in activities (Dawud & Nikolic, 2020). However, SDT proposes a different approach to motivation, it makes a distinction between the two types of motivation: intrinsic and extrinsic, and their disadvantages. In gamification research, gamification leans more toward intrinsic motivation than extrinsic motivation because intrinsic is more about the user having a motive, whereas extrinsic is imposed by rewards.

Along the same lines, according to Csikszentmihalyi and Nakamura (2002), the Flow theory emphasises the internal state of full participation in an activity, it is also known as the flow experience and explains why people perform certain activities. The concept of flow is also called an internal experience (Csikszentmihalyi & Nakamura, 2002). This means that people do something for their own sake. People experience a flow when the activity matches their skills (Csikszentmihalyi & Nakamura, 2002). This theory was not suitable for this study due to the fact that it focuses more on internal experience than a project team's goal, unlike GET which was found fitting for this research. Based on the focus of the study on game elements within a development team, the GET developed by Amir and Ralph (2014) was used to structure the study's objective. As shown in Figure 3.1, the GET consists of the following key drivers of effectiveness: extrinsic motivation, intrinsic motivation, game mechanics, and immersive dynamics (Amir and Ralph, 2014).

Although limited empirical studies found GET to explain gamification in software development teams, GET is becoming a well-established theory for predicting motivation, engagement, and performance in project teams (Fulton, 2019). GET is the most relevant theory for this research because the main aim of this study is to establish how the use of game elements in software development teams impacts the software development process. GET comprehensively covers all the game elements unlike the other theories reviewed in this section.

3.3.1 The GET dimensions

As already mentioned, the effectiveness of the GET dimensions is influenced by Formative and Antecedents. These are discussed briefly in more detail in the subsections that follow.

3.3.1.1 Formative constructs

Gamification is demonstrated as a multidimensional structure, and formative constructs refer to its dimensions.

Use

Delone and McLean (1992) defne Use as the utilisation of a system output, which translates into user participation in the gamified system; development teams should obtain and process responses, such as requirements specified to a business analyst or user after specific inputs (Amir and Ralph, 2014). Delone and McLean (1992) have also mentioned that poor response could decrease user involvement and thus increase the possibility of the gamification platform failing.

User alignment

User alignment relates to how the goals of the user are aligned with the gamified system (Amir & Ralph, 2014). Merry et al. (2012) has given prominence to SPARX as a digital game example developed for treating clinical depression. After an analysis of SPARX, Merry et al. (2012) concluded that SPARX is effective against conventional therapy for treating depression. Furthermore, the authors drew attention to the fact that SPARX displays user alignment – the users prefer a decrease in depression symptoms that it provides.

The factors which influence the system's effectiveness are explained below.

3.3.1.2 Antecedents

Antecedents in the context of the framework are factors that cause the effectiveness of gamification (Amir& Ralph, 2014) and can be organised in different ways. The framework consists of four key antecedents of effective gamification, namely: extrinsic and intrinsic motivation, game mechanics, and immersive dynamics.

These antecedents of GET are defined briefly as follows:

Intrinsic and Extrinsic motivation

According to Amir and Ralph (2014), the gamification effectiveness theory explains how an organisation can apply gamification. Deci (1975) reasons that gamification improves motivation in a task and encourages optimal performance. In gamification, it is essential to provide fundamental human needs; competence, autonomy, and relatedness (Ryan et al., 2006).

Motivation is divided into intrinsic and extrinsic motivation. Intrinsic motivation (autonomous) is an aspect of desire that motivates an individual to engage in an activity or do something for enjoyment (Sun et al., 2017). Another explanation of intrinsic motivation relates to doing something for pleasure (Ryan et al., 2006). Extrinsic motivation is imposed on an individual to motivate the completion of an activity (Pink, 2009). Trophies, paycheques, and other external incentives are extrinsic motivators that serve as a mechanism to reward and make something worthwhile. Extrinsic motivation matches their values (Sun et al., 2017). Intrinsic motivation is the critical motivation pursued in gamification as it increases perceived autonomy and has a longer-lasting effect. Perryer et al. (2016) maintains that the contrast between extrinsic and intrinsic motivation is similar to the difference between work and play. A situation where an individual finds pleasure in an activity is not common; however, it is not challenging to envisage the opposite situation when people play games for the pleasure it brings. When analysing the difference between the two motivations, Vallerand (1997) intimated that they differ theologically since extrinsic motivation is an advantage that an individual can obtain in participating in an activity, while intrinsic motivation has a purpose in the activity itself.

Immersive dynamics

Amir and Ralph (2014) described immersive dynamics as aspects that influence the user or player's engagement in an activity or gamified system, highlighting aesthetics as an example and describing it as an emotion triggered in a player or user by a system. Another example was cited by Procaccino et al. (2005) a story relates to a narration of the user or player's process.

Game mechanics

Game mechanics are the game's rules (Dicheva et al., 2015). Every game has a purpose for the process. For instance, in a game of 30 seconds, there are agreed-upon rules; reading the card when landing on blue or yellow and rolling the dice to determine how many spaces you move (Salen & Zimmerman, 2003). The game's dynamics give a player the constraints within which they play. The game rules guide playing the game and completing a task to receive something (Kapp, 2012). Gamification takes the elements and applies them to a software process. Platonova and Berzisa (2017) indicated that gamification aims to incentivize the software development process by adding game elements, not creating a game. The authors stated that the intention of gamification is to "harness these mechanics to engage and reward behaviours that support the software development process and foster productive social interactions." Frequently when gamification is discussed, technology is a dominant component. However, it is essential to remember that gamification is not producing a new

software version but implementing similar dynamics and mechanics of gaming (Dicheva et al., 2015).

The dynamics of games are what move the game along (Fulton, 2019). In software development, game dynamics can impact a software process. Project team members are given recognition for demonstrating how to improve a software process. There are many game dynamics; points, quests, badges, leader boards, and medals (Werbach & Hunter, 2012). These game dynamics give constant feedback on progress, clear objectives, and opportunities to succeed after failure (Dicheva et al., 2015). The core of gamification is using the game elements, the crux of what keeps the attention of gamers, and applying it to a software development team. Gamifying a software process is attempting to mimic a game's dynamics in a software development process to motivate and engage (Alsawaier, 2018). The principle of gamification is not the game but the created environment which engages project teams (Fulton, 2019).

3.4 CONCEPTUAL MODEL

Based on the GET adopted for the study, a new model will be developed for enhancing the software development process. The proposed model contains the four main elements of GET: (a) user alignment, (b) game mechanics, (c) dynamics, and (d) motivation. In addition, five new elements are included: (i) Project Manager, (ii) Business Analyst, (iii) Test Analyst, (iv) System Analyst, and (vi) Developers representing “Software development Teams” and engagement, motivation, and performance, which will enhance the software development process.

These new elements in the new model are imperative to contribute to the efficient and effective enhancement of the software development process and may prove to be key in decreasing project failure and managing activities involved in a software process. These elements are interdependent, even though they exist independently of each other. Along with that, the new elements interact with each other to ensure continuous improvement in the software process.

In this section, the researcher aims to investigate how game elements mediated by engagement, motivation, and performance can enhance a software development process. Moreover, while software development teams and gamification elements are chosen to reflect the tested game elements, general information, and demographic groups such as age will be recorded. Below, the researcher explains how the decision was taken on the dependent variables and the proposed model to study the relationship between the variables and the independent variables.

Specific attention will be paid to two major features to make it suitable for the study, that is gamification elements and software development. These main independent variables will be applied by analysing the relationship between game elements and enhancing a software development process through engagement, motivation, and performance.

3.5 SOFTWARE DEVELOPMENT TEAMS

3.5.1 Game elements in software development teams

Rigby and Ryan (2011) noted that the primary goal of a team/teammates is a shared goal and engagement that aligns with gamification. Sailer et al. (2017) added that a shared goal can be transferred within a meaningful story and supports experiences of social relatedness. Effective teamwork coordination becomes a critical organisational problem when teams are the key to achieving organisational work. Steffens et al. (2015) point out that in contrast to traditional teams, gamifying a process involves close collaboration as it improves the time team members spend on a project task. Hence, it can be said that positive interactions increase and create a critical aspect and purpose of gamification (Dawud & Nikolic, 2020). In game design, Huotari and Hamari (2012) elaborates teams and developers have active parts to create a project task. A team includes project managers (PM), system and business analysts, testers, and developers with each performing its functions. Therefore, the role of a team member is the usage of the project task end goal and the interaction between them (Dawud & Nikolic, 2020). On account of this, the team members' participation in engaging with the project task's end goal serves as a basis for the project task's effectiveness. Therefore, the project task should be designed to provide an engaging, motivating, dynamic performance and exciting experience for the team member. Faraj and Sproull (2000) insinuates that project task development teams are the project task's value makers; therefore, the project task creator should ensure the project task aspects provide details that improve participation. Therefore, collaboration with a gamified software process is essential to a software development process.

Commensurate with the views of Faraj and Sproull (2000), the challenges of managing team-based knowledge work rely on the importance of software development teams. The authors further stated that organisations spent $152 billion in the United States on software in the early 90s, of which 70% of the software was built by teams. However, most larger software projects do not function as intended because projects are not completed on time or within budget.

For new projects, software development teams are formed depending on the business requirements and team members' availability. In most cases, it is unlikely for an entire project team to work on the same project again. Consequently, project teams never develop a working history over several projects. Research conducted on software development teams

established that a team's performance relates to the effectiveness of teamwork coordination, motivation, and engagement (Wholey, 1996; Ribeiro et al., 2014). A study by Walz et al. (1993) stated that the breakdown of team management and the challenges encountered in knowledge sharing hamper project outcomes in a software team. Pavlova (2019) further added that an organisation's employee who lacks motivation is less engaged, thus contributing to the failure of a project's outcome. The input of game elements within a software process will meet the study's objectives.

The proposed model in Figure 3.2 displays the study's dependent variable. The researcher refers to the model as the gamification conceptual model for enhancing the software development process via engagement, motivation, performance, and gamification elements. Although the model was GET inspired, it placed more significant meanings on the primary key drivers when using game elements in a software process such as software eLearnings. By merging the theoretical foundations of GET and additional literature involving theories of gamification for participation, the study aims to investigate gamification as a game element for software development. Therefore, testing the relationship amongst game elements in a software development process using engagement, motivation, and performance as mediating variables, satisfies the effect of gamification on improving a software development process.

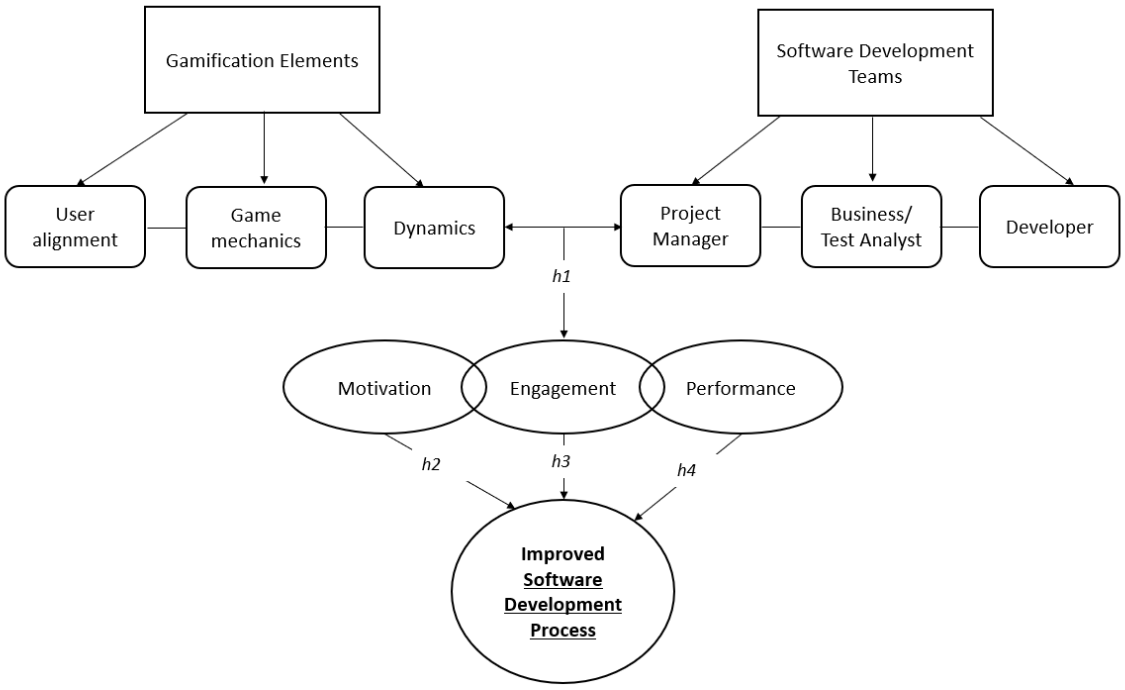

Figure 3.2: Gamification conceptual model (Conceptualized by the researcher for the current study, 2021)

Understanding the key factors behind engagement, motivation, performance, and gamification factors and the significant relationships to enhancing a software development process is

essential for development teams. By applying the GET developed by Amir and Ralph (2014), the researcher will amend the framework to assess the relationship between gamification elements, software development teams, engagement, motivation, and performance to determine an enhanced software process. Hamari and Koivisto (2015) add that game elements can benefit users in obtaining practical outcomes while invoking engagement, motivation, and performance.

3.5.1.1 Effect of game elements on software development teams

As denoted by Ryan and Deci (2000), gamification has two types of motivation; extrinsic and intrinsic, as explained above. In the theory of planned behaviour, the authors further explained that gamification elements that serve as informational feedback are challenges and rewards that establish a feeling of competence and motivation within the user. Ryan and Deci (2000) focused on elements that can guide engagement, motivation, and performance and encourage participation between team members.

Leclercq et al. (2020) reason that practitioners usually apply gaming-related principles to create an enjoyable experience that results in a positive evaluation to implement game elements. Hamari and Koivisto (2015) add that these game elements promote motivation toward several activities. The authors postulate that engagement and motivation positively impact the relationship with users, while performance is related to attitude (Ryan & Deci, 2000). Game elements have been implemented in various contexts, such as consumer behaviour and e-learning (Hamari & Koivisto, 2015).

Juul (2003) defined how games are composed; they are essentially designed from various sets of instruments and an empirical component that requires the participation of a minimum of one player. These settings may cause conflicting goals and uncertain outcomes. As a point of motivation and reward in a gamified environment, points, leaderboards, and badges can be used to lure players into engaging with a task constantly. Hamari and Koivisto (2013) opined that points, leaderboards, and badges influence users to participate in performing a task.

GET, which is fundamental to the effectiveness of the human motivation concept, adds to the explicit goals of the system and the users' goals (Amir & Ralph, 2014). Aparicio et al. (2019) describe that effectively motivated activities refer to a set of engagements that users find stimulating and are willing to participate without cohesion. Based on the above, the research formulates the following hypothesis to meet the research objectives:

Hypothesis

H_{01}: There is no relationship between engagement, motivation, and performance in a software development process.

H_1: There is a relationship between engagement, motivation, and performance in a software development process.

Sub-Hypotheses

H_{02}: There is no relationship between engagement and performance in a software development process.

H_2: There is a relationship between engagement and performance in a software development process.

H_{03}: There is no relationship between motivation and performance in a software development process.

H_3: There is a relationship between motivation and performance in a software development process.

3.6 GAMIFICATION ELEMENTS

The effectiveness of a software development process is influenced by motivation, engagement, and performance. These are discussed briefly in more detail in the subsections that follow.

3.6.1 Gamification elements in motivation

3.6.1.1 Effect of game elements on motivation

As proposed by Ryan & Deci (2000), motivation is triggered when an individual is energised to perform a task. Motivation can vary in intensity, level, or orientation (Perryer et al., 2016). The current study concerns game elements to enhance a project team's motivation in a software process. With a model that highlights gamification, the researcher hopes to determine the impact of a software process's fundamental features that motivate users to interact in the software process. Gamification provides users with a motivating environment for information exchange by allocating resources as rewards such as credits or badges (Perryer et al., 2016). The fundamental variables include motivation, engagement, and performance.

The main aim of motivation-linked rewards is to reorganise software development tasks in a model for software teams to have credits that allow them to choose tasks based on their preferences. According to the proposed conceptual model, the tasks in the conceptual model are to the team members in a reward mechanism. These tasks are based on their complexity

points and effort, like leader boards. A team member requests some tasks depending on the number of points they need. Based on these requests, the project manager distributes the tasks according to who wishes to complete the tasks such that gamification-based mapping happens between the team member and the task. Such an approach ensures that team member tasks are allocated and monitored. The task allocation uses game elements to motivate the team member by giving badges or points. Consequently, team members who complete tasks in record time are rewarded by the team lead or project manager for the achievement. The information is announced to the participant to stimulate their motivation (Üsfekes et al., 2017).

Applying this technique, team members can propose the tasks they would like to work on in the context of their points. On the testimony of Üsfekes et al. (2017), this technique has the potential to generate exciting results for knowledge diversity and productivity among team members in a software development project.

3.6.2 Gamification elements in engagement

3.6.2.1 Effect of game elements on engagement

As mentioned by Kapp (2012), engagement is a concurrent appointment and an example of an individual's ‘preferred self’ in task actions that encourage relationships to work and other personal presence (emotional, physical, and cognitive). Being emotionally, physically, or cognitively involved in a task does not inevitably distinguish engagement, considering that engagement in these participations occurs concurrently and collaboratively (Kapp, 2012). Sereno (2021) posits that an engaged team member is understood as fully present, connected, and focused on their performance. Further to this, the author stated that people use personal detachment and engagement to cope with uncertainty concerning participation in ongoing teams.

Kapp (2012) identified engagement as a part of being, something which an individual has at their disposal and makes the best of what the environment has to offer. According to the author, people chose to adopt an attitude and activities to perform well by directing their energy, regardless of physical, cognitive, or emotional work. Such self-employment is founded on what academics call intrinsic motivation and flow (Dawud and Nikolic, 2020). Contrarily, personal disengagement happens as concurrent defence and exclusion of self from the physical, cognitive, and emotional connection with the incentive (i.e., playing a passive role towards the incentive) (Sereno, 2021). To this end, the disengaged individual interprets the incentive as a lack of incentive.

Employee engagement relates to the involvement and interest of employees in their work (Sereno, 2021). Apart from personal engagement, organisations are immersed in two types of engagements, namely: employee and customer engagement. Brodie et al. (2013) described customer engagement as a context-dependent state, and the primary characteristic is the iterative mechanisms and dynamics. As argued by Kapp (2012), employee engagement aims to encourage and reinforce an employee's bond with an organisation and its functions, recognizing their involvement in tasks and fulfillment with their work.

Organisations focus entirely on customer engagement. In addition, organisations use dynamic forces to influence and support customer engagement while addressing employee engagement in the background, saving resources within this strategy (Sereno, 2021). According to Richter et al. (2015), rewards are game mechanics that encourage engagement. Rewards have the power to increase engagement when performing a task repeatedly, and Miller and Mynatt (2013) have explained that rewards stimulate a repetitive way of doing things. This encourages the enjoyment of engaging when doing a task, especially if it is done repeatedly (Richter et al., 2015). Brodie et al. (2013) proved that a state of engagement is related to continued use; the exposure of applying a game element in a project task is a start of a continuous interacting cycle. Enhancing a software process can lessen the high risk of project failure and save an organisation's revenue while increasing project team engagement initiated by rewards. Although rewards can lead to engagement, Jipa and Marin (2014) stated that witnessing other team members receive a reward for engaging in a task causes a demotivating outcome. Dawud and Nikolic (2020) added that another related use of rewards is diminishing autonomy, and team members often avoid such circumstances. Therefore, enhancing a software process will also decrease if the deficiency of autonomy reduces the engagement element that rewards bring (Dawud & Nikolic, 2020).

The behavioural intention impacts behavioural confirmation of self, the joy of the experience, and self-improvement (Dawud & Nikolic, 2020). The more a team member experiences enjoyment, the more willing they are to continue working towards enhancing a software development process without being rewarded (Lindenberg, 2001). This shows the vulnerability and impact of rewarding and how easily motivation is dominated by engagement (Hamari et al., 2014). GET suggests that a user’s motivation in a task can be placed within a selection of incorporation groups and is viewed as the user's insight into enjoying a task.

Behaviour is primarily motivated by extrinsic motivations because quantifiable rewards for engaging in a task require little effort. However, intrinsic motivations such as enjoyment are secondary influences (Hamari & Koivisto, 2015). The satisfactory results from behaviour are adequate to evoke engagement, create an understanding, and maintain the enduring will to

engage. Additionally, when an environment is understood to be enjoyable, the attitude towards the environment becomes favourable. This can be used to predict if project teams perceive rewards as an influencer for increased engagement, and if the relationship between reward motivation and improving software development will be positive.

3.6.3 Gamification elements in performance

3.6.3.1 Effect of game elements on performance

Performance is a core concept of work and organisational psychology (Sonnentag & Frese, 2005). Accordant with Campbell (1990), researchers have clarified and scrutinized the performance concept over the past decade. Organisations increasingly implement teamwork, especially software development (Ilgen, 1999; Platonova and Berzisa, 2017). Although performance is also for the individual, organisations still develop more interest in team performance than individual performance (Sonnentag & Frese, 2005). Since teams are formulated from individuals, team performance is not entirely understood without considering individual performance. From an individual performance viewpoint, three interrelated facets are important: which individual difference variables predict individual performance within a teamwork setting, which parts of the individuals' performance are relevant for team performance, and how individual performance translates into team performance.

Organisations require highly performing employees to achieve their goals, deliver on services, and achieve a competitive advantage over their competitors (Sonnentag & Frese, 2005). In addition, performance is for individuals. Completing tasks and outperforming is a source of satisfaction, feeling pride, and accomplishment. Low performance and not accomplishing goals are experienced as personal failure or dissatisfaction (van Scotter et al., 2000).

Samsonowa (2012) defines performance as an evaluated contribution to attaining organisational goals. Performance has proven to play an essential role in the gamification elements. It enables a creative approach to a task; therefore, in software development, having the opportunity to gamify an environment reveals this approach. However, game elements such as rewards are a distraction from the related activities; rewards through performance can likely negatively affect the software development process (Conradi & Fuggetta, 2002). Specifically, rewards are seen as indicators of performance that might undermine a user’s intrinsic motivation and interest in the software process tasks. However, if the emphasis is focused on incentives, then the element of performance is destroyed by losing interest in the concept of the material (Salen & Zimmerman, 2003).

GET suggests that performance in a gamified environment is self-motivation and relates more to intrinsic motivation (Amir & Ralph, 2014). Compared to engagement, gamification and performance represent a pleasant experience of playing games (Amir & Ralph, 2014). Hamari et al. (2016) have confirmed that the association between game elements and performance is weaker than engagement, although still significant. Dawud and Nikolic (2020) presume that rewards through engagement have a stronger association with enhancing a software process than performance. One reason is to enhance a software process; different tasks associated with a software process could have different game mechanics. Performance is associated with increased quality work more than competitiveness, and this leads one to believe that rewards with performance attributes are significant to an improved software process.

Furthermore, performance in an organisation may be recognized by rewarding employees financially or with other benefits. Performance is considered one of the prerequisites for success in an organisation and future career development. Gamification is a promising channel to increase employee task performance in an organisational context (Koopmans et al., 2012). Performance can be improved by rewarding employee attention to the primary task by setting goals (Latham et al., 2005).

The gamification conceptual model illustrated in Figure 3.2 aims to enhance the software development process. In this model, gamification has increased the project team's motivation, engagement, and performance.

3.7 SUMMARY OF CHAPTER

Chapter 3 outlined the theoretical model that guided the current study. Thereafter, the researcher adopted the GET model to enhance the software development process. The various constructs within the GET model which influence a software development process were also discussed. The chapter concluded by presenting and discussing the conceptual model for enhancing a software development process including the various components of the proposed model. The next chapter, chapter 4 presents the research methodology used in this study.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 INTRODUCTION

Chapter 3 reviewed the gamification effectiveness theory and model adopted for the study. This chapter outlines the research methodology used for this study followed by the design, approach, sampling plan, data collection methods as well as data analysis process is covered. The research instruments utilised in the data collection are also discussed.

4.2 RESEARCH METHODOLOGY

Research methodology is a practice that explains the techniques that are used to conduct research. Research methodology is defined by Kothari (2008) as methods and procedures applied when formulating the research design, the fundamental ideologies, and assumptions that emphasise their use.

4.2.1 Research philosophy

In line with the views of Göktürk (2005), a research philosophy is a community of researchers based on values, concepts, practices, and assumptions that develop a method of viewing reality for an organisation that shares the intellectual discipline (Göktürk, 2005).

This section discusses the philosophical assumptions that underpin this study. Research philosophy directly affects the research design (Melnikovas, 2018). For a research methodology, the first step involves choosing a philosophy that aligns with the researcher's perception of the development of this study (Melnikovas, 2018). Research philosophy guides the research, explains the study's approach, and assists in data collection. Furthermore, understanding research philosophy allows the researcher to understand better which methodologies to avoid. Several philosophies are cited in the literature, with the most attention being given to interpretivism, post-positivism, positivism, and critical theory (Orlikowski & Baroudi, 1991).

Interpretivism and positivism are the two most popular paradigms in gamification and social science research; however, the more dominant paradigm was positivism until it was short-lived in the mid-20th century, which saw the development of post-positivism (Klein and Myers, 1999; Julius, 2013; Phung, 2020). Positivism assumes that “real causes exist” (Hunt, 1991) and suggests that the conception of scientific knowledge must only be restricted to measurable

and observable characteristics, which leads to its dependence on only straight testable theories (Bhattacherjee, 2012; Saunders et al., 2019). Whereas the positivism paradigm views aspects of the world as objective and external and distinct from any social actors, interpretivism views aspects of the world as unpredictable and subjective constructs (Ormerod, 2006; Bhattacherjee, 2012).

4.2.1.1 Positivist – Philosophical approach to the study

This study is carried out using game elements in software development teams to address the research questions. The researcher identified the study as being situated in the positivist philosophy. This conclusion is based entirely on the direct theories tested (Bhattacherjee, 2012). Ormerod (2006) offers an alternative view that asserts that a researcher ought to be detached from the results and main objective of a study; this statement echoes the researcher's aim for this study. Data for this study is highly structured and was collected from various samples within development teams; a team of developers, system analysts, business analysts, project managers, and test analysts who align with the purpose of the positivist paradigm (Saunders et al., 2019). Positivism leans towards a quantitative measure, even though a qualitative measure can also be applied (Saunders et al., 2019).

4.2.2 Research Design

This section presents the research design and overall methodological plan for this study. The study is structured according to Saunders's concept of research onion layers, with motivation provided for the selected choices of the model. As shown in Figure 4.1, the research onion model consists of the following six layers: philosophy, approaches, strategies, time horizon, and techniques and procedures (Saunders et al., 2019). The six layers are discussed in greater detail.

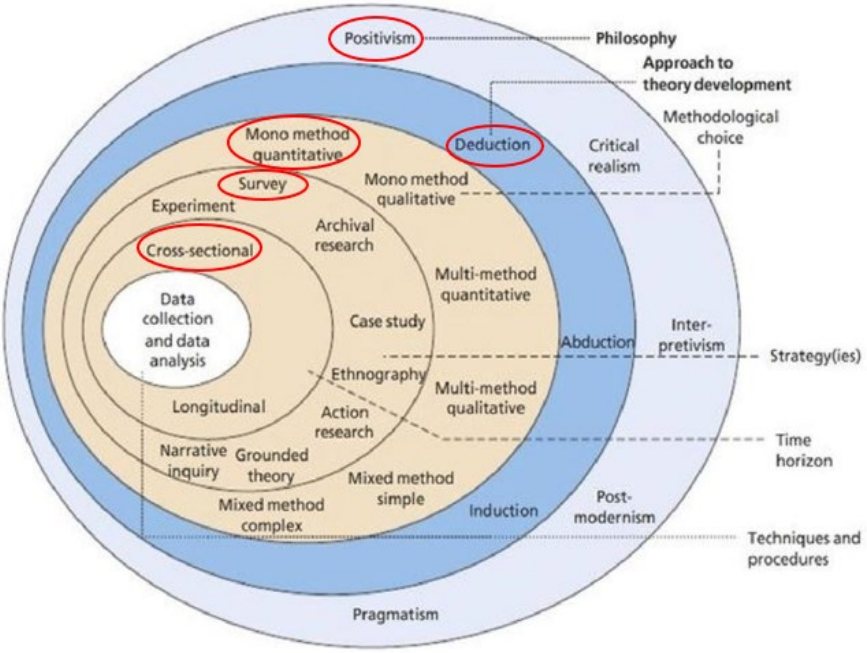

Figure 4.1: Research Onion (Saunders et al., 2019)

4.2.3 Research Approach

Creswell (2014:17) describes a research approach as a scheme and method for research that spreads from broad assumptions to detailed data collection, interpretations, and analysis methods. The author further states that research designs, philosophies, and methods influence the research approach in a study. Saunders et al. (2019) go on to identify two approaches: inductive, where the reasoning is argument cantered and the conclusion of the evidence is based on the results of observations: and logical, where the cognitive originates from the logically derived theory that seeks to align the conclusion with the evidence of testing of hypothesis.

To explore the application of gamification in a software development process and answer the research questions, the researcher used the deductive approach for being the most suitable research approach for this study. The purpose of the deductive approach is to examine concepts and patterns obtained from theory using new empirical data (Ormerod, 2006). A deductive approach assists in testing and improving or refining a theory, and this can be done by conducting surveys (Melnikovas, 2018). In addition, the deductive approach tests the GET on the software development process, by conducting a questionnaire. The selection of deduction as a research approach is meant to simplify the research findings. Therefore, the deductive approach will assist in addressing the research questions that were developed based on the GET.

4.2.3.1 Quantitative Research

Quantitative research approaches arise from philosophical thinking and are characterized by traditional, experimental, and positivist paradigms (Creswell, 2009). Research has identified the quantitative approach as the most dominant approach in research history across multiple disciplines (Orlikowski & Baroudi, 1991; Guba & Lincoln, 1994; Chen & Hirschheim, 2004). Florczak (2014) claims the quantitative approach is considered a "hard science and the crème de la crème of conducting research". The quantitative approach places emphasis on measuring and analysing casual relationships between isolated variables through statistical analysis (Olgun et al., 2017). It involves determining correlations between variables and reliable outcomes, which can be confirmed as valid and replicated by an independent researcher (Choy, 2014).

Unlike qualitative research, the hypothesis and theoretical framework of the quantitative approach are well structured. There is reduced accessibility of the researcher to the research problem being studied and lesser flexibility and explanatory analysis (Queiros et al., 2017). The research activity in a quantitative study involves deciding on samples and the variables, the type of techniques to be used, and which experiment to be conducted (Choy, 2014). Despite being viewed as all mathematical, the quantitative approach is an informed process stemming from the topic, literature review, and hypotheses selection (Choy, 2014).

Some characteristics of quantitative research identified in the literature are: i) highly reliable outcomes that are also reusable; ii) data is collected using structured research tools, and iii) studies are often used to generalize concepts more widely, examine causal relationships, and forecast future results (Brians et al., 2011; Queiros et al., 2017) which verifies why quantitative research was recommended for this research.

This approach uses a variety of data collection and analysis techniques that collect data directly from participants using tools such as checklists, surveys, and other instruments to produce numerical data, including stratified sampling (Christofides, 2005; Choy, 2014).
The process of collecting, analysing, and understanding data in quantitative research can incline toward existing theory and building new theory (Choy, 2014). In quantitative research, the researcher is theoretically non-existent; the study's participants are usually independent as if the researcher were not there (Fink, 2000).

There are several advantages of quantitative research, and some are presented in Table 4.1. One that captures the crux of the approach is that it presents an opportunity to capture the richness of organisational behaviour and ask penetrating questions (Choy, 2014).

Table 4.1 offers a comparative analysis of the various quantitative methods.

Table 4.1: Comparison of quantitative methods (Queiros et al., 2017)

Method	Advantages	Disadvantages
Field experiments	• Works in a natural setting • Larger-scale research • The observations of the experiments do not influence the subjects	• Difficult to control variables • Difficult to replicate the same conditions of the study • Ethical problems can arise
Simulation	• Used to study complex systems • Compress a time frame, which allows for studying the behaviour of the system more quickly • "What-if" questions can be tested and answered	• Model building requires deep knowledge of the field • It is time-consuming and expensive • May require specialized hardware and software tools
Surveys	• Low development time • Cost-effective • Easy data collection and analysis using statistical methods • Can reach high audiences • High representativeness • Not affected by the subjectivity of the researcher	• Reliability of data is very dependent on the quality of answers and the survey' structure • Rigidity of the structure • Don't capture emotions, behaviour, and changes of emotions
Correlational study	• A lot of information and different domains can be explored • The degree of association between two variables can be easily calculated • No manipulation of behaviour is required	• No direct cause and effect can be inferred • May lack internal/external validity • Doesn't provide a conclusive reason for the existence of a correlation between two variables
Multivariate analysis	• Several statistical tests and techniques can be used • A lot of information and different domains can be explored • Technical rigor of the process	• Complex the employed techniques • Requires the use of specialized statistical software

Table 4.1 captures the diversity and richness of quantitative research methods without disregarding the notable challenges of conducting this type of research. The identified advantage of quantitative research is that it can be measured and administered quickly; numerical data, acquired through this approach, enables comparison and determination of the extent of agreement and disagreement between respondents. The major disadvantage of quantitative is its ostensible detachment from human perception and beliefs (Choy, 2014).

This study employed a quantitative method to analyse the primary data collected via an online survey. The descriptive focus established a relationship between the variables, both independent and dependent. In addition, a reliability test was conducted to drive the correctness of the factors and the model fit.

4.3 SAMPLING PLAN

According to Anyan (2013), sampling represents a subsection of an entire population. This subset forms an overview made by any interpretation from this study. Creswell (2014) defines sampling as selecting several individuals for research and representing a bigger group from the selected group. Sampling is selecting units (e.g., organisations, people) from a defined study population of interest. A study is put into proper perspective through sampling regarding selected individuals (Babbie, 2014).

Saunders et al. (2019) point out two sampling methods: probabilistic and non-probabilistic. In non-probabilistic sampling, there is no knowledge of the sample representing the overall population (Saunders et al., 2019). Probabilistic sampling arises from a random selection, the researcher knows the probability of representing the population well, and confidence intervals for the statistical analysis are easily estimated. The respondents in this technique are randomly selected, so everyone is equally likely to be selected in that population (Bell and Bryman, 2007). Therefore, probability sampling was considered relevant for this study based on the above interpretation.

The study adopted a stratified sampling technique for the survey. As believed by Imbens and Lancaster (1996), a researcher in the stratified sampling technique, utilises a fixed number of participants from the chosen population, divides them into different strata, and randomly chooses the final subjects proportionally from the different strata. The respondents were selected based on the criteria for this study. Of the total population, 95 participants were selected through a stratified sampling technique. The different participants from the various teams were based in the Pretoria and Johannesburg region, albeit from various departments

within the financial institutions. This approach provides an equal chance for every participant to contribute to the study (Christofides, 2005).

4.3.1 Target Population and sample size

Marczyk et al. (2005) refer to the population as things, events, or a set of people that a researcher is interested in by creating samples of statistics-based interpretations. The population for this study was 95 individuals with various roles in different project teams in the four financial institutions in South Africa. An online survey was sent to the selected participants for them to complete online and at their convenience. The participants included Project Managers, Test Analysts, Developers, and Business/System Analysts from the four major banks selected and other financial institutions.

4.3.1.1 Selection of the financial institutions for the study

The researcher selected for the study project teams from three commercial banks and one regulator bank in South Africa. These four financial institutions were purposively selected based on the following criteria:

(a) The financial institution has adopted and implemented some form of game elements within the organisation;
(b) The financial institution has projects which consist of various roles; and
(c) The financial institution must exist for more than 20 years and above.

Within the selected financial institutions, it was found that the project teams in most of these organisations consist of the five standard project roles placed categorized as follows:

(i) Project Managers (PM) in the selected financial institutions are individuals liable for planning, managing, and overseeing the completion of projects on time, on budget, and within scope.

(ii) Test Analysts (TA) in the selected financial institution ensure the functional readiness of computer software and hardware products are tested and evaluated before a general release.

(iii) Developers in the selected financial institution are responsible for designing and implementing the software.

(iv) System Analysts (SA) in the selected financial institution are responsible for implementing new solution designs, enhancing existing systems, and integrating new features to improve business efficiency.

(v) Business Analysts (BA) in the selected financial institution are responsible for eliciting business requirements and bridging the gap between IT and business. Furthermore, using data analytics tools to assess processes, determine business requirements, and deliver data-driven recommendations.

The study was based on the complete count of all various roles within the categories outlined in the four selected financial institutions covered in the study. This count approach ensured that a comprehensive analysis could accomplish the study's goal. The total project roles of the four financial institutions were 95 in the study.

4.4 DATA COLLECTION

The study was carried out using a primary data collection technique. Primary data collection techniques refer to data collected from the direct field using data methods such as observation, questionnaires, and interviews (Marczyk et al., 2005). Although different approaches are used in research for data collection, the two most popular considerations for quantitative research are interviews and questionnaires. Flick (2015) claims adds that a researcher should consider the research questions when deciding on a data collection method. More than one strategy could be appropriate for data collection for a specific research question.

4.4.1 Survey

4.4.1.1 Purpose and design of the survey

Survey studies are the most common method of conducting quantitative studies in social and psychological research (Melnikovas, 2018; Reddy, 2019). Marczyk et al. (2005) defined a survey as a collection of data obtained from a sample of various individuals through their feedback to questions. A survey is a research strategy focused on describing and exploring human behaviour; hence it is preferred in social and psychological research.

Therefore, as a research strategy, the survey was identified for this study based on addressing the identified research questions and collecting quantitative data across the various software development teams. The survey involves any measurement technique that asks questions to obtain responses from the research study participants. It provides a quantitative population by

studying a population sample (Creswell, 2014). Sekaran and Bougie (2013:245) add that survey research involves observation, interviews, and individuals completing a questionnaire.

In this study, participants were surveyed through an online self-administered questionnaire that was designed using SmartSurvey. The questionnaire was administered to collect quantitative data from various financial institutions' software development teams. The questionnaire in the questions were formulated based on the project team's daily experiences and operations in software development projects and were distributed via email. A self-administered survey requires the respondents to complete the questionnaire without the assistance of the researcher (Rodrigues et al., 2018).

The questionnaire consisted of twenty-one close-ended questions and two open-ended questions. The closed-ended questions were derived from previous studies on gamification (Alsawaier, 2018; Sereno, 2021) adapted to align with this study's proposed conceptual model illustrated in Figure 3.1 in Chapter 3. The questionnaire was accompanied by an introductory note in which the researcher introduced herself and explained the purpose of the research topic and survey. The questionnaire was divided into two sections. The first section of the questionnaire focused on general information and was aimed at establishing the directorate in which the participants were employed as well as the participant's job title. The second section focused on using game elements, whereby the respondents were asked to indicate their engagement, motivation, and performance level.

The participants were presented with pre-formulated questions and well-defined alternatives, allowing respondents to select their answers. The aim of the preformat and selection options was to guarantee the quantifiability of the data thereby removing bias from the respondents (Imbens and Lancaster, 1996).

The instrument was tested through descriptive statistics and a gameplay scale (Olgun et al., 2017). For this study, the gameplay scale 5-point Likert consisting of questions that have five choices ranging from "strongly disagree" to "strongly agree" was used as a game scale (Toprac, 2011).

Table 4.2: Research matrix - the relationship between research objectives, research questions, and possible sources of data

Research Objective	Research Question	Data Collection/Source of Information
To assess the perceptions of software development team members on engagement, motivation, and performance in a software development process.	What are the perceptions of software development team members on engagement, motivation, and performance in a software development process?	• Survey • Literature
To measure the relationship between engagement, motivation, and performance in a software development process.	What is the relationship between engagement, motivation, and performance in a software development process?	• Survey
To determine the impact of engagement and motivation on performance in a software development process.	What is the impact of engagement and motivation on performance in a software development process?	• Survey

4.4.1.2 Reliability of the constructs

Cronbach's alpha is for measuring internal consistency between variables or inter-items measuring the same underlying construct. This approach is mainly applied to Likert scale-type questions in surveys where the researcher wants to determine if the scale is reliable.

Therefore, the study applied Cronbach's alpha coefficient for each construct and group of items to illustrate the internal consistency of the survey.

Table 4.3 presents the results from reliability tests for each of the Likert scales considered in the study.

Table 4.3: Cronbach's alpha for constructs

Table 4.3: Cronbach's Alpha per Instrument

Constructs	Cronbach's Alpha	N of Items
Engagement	.828	5
Motivation	.921	5

Performance	.871	5

The following results were yielded for the sub-sections of the items:

i. Engagement scale – reliability results

The Cronbach's alpha coefficient value of 0.828 for engagement is above the recommended threshold for exploratory analysis of 0.6 and is therefore deemed acceptable.

ii. Motivation scale – reliability results

The Cronbach's alpha coefficient value of 0.921 for motivation is above the recommended threshold for exploratory analysis of 0.6 and is therefore regarded as being acceptable.

iii. Performance scale – reliability results

The Cronbach's alpha coefficient value of 0.871 for performance is above the recommended threshold for exploratory analysis of 0.6 and is thus considered acceptable.

4.5 APPROACH TO DATA ANALYSIS

This section details the approach undertaken by the researcher with respect to the methods and techniques used for data analysis.

The data collection process guides data analysis to make sense of the study and a specific finding (Naidoo, 2019). The data collected from various instruments must be cleaned before hypothesis testing (Sekeran & Bougie, 2013). This ensures any blank data fields are removed and detects and corrects any inconsistent or prohibited errors from the participants' responses. The data is then broken down into themes to understand the data better during data analysis. The data is summarized and translated to answer the research questions that presented the study and meet the research objectives (Sekeran & Bougie, 2013).

Since data was derived through a questionnaire survey, it was analysed using the quantitative method as indicated in the research approach discussion. Quantitative data that is analysed is deemed raw. Therefore, raw data is meaningless and should be administered as practical, understandable information.

For data to be considered valuable, it must be analysed and interpreted using quantitative analysis techniques and presented using percentages, pie charts, graphs, and tables that focus on the frequencies of variables and the difference between variables to enable comparison. This process enables the researcher to demonstrate statistical relationships between variables (Saunders et al., 2009).

As mentioned above, this study used the quantitative method to analyse the data. Data obtained from the surveys was quantitatively analysed electronically through Smart Survey and tabulated in Microsoft Excel. The data were analysed by focusing on the frequencies of variables and the difference between variables presented using percentages, graphs, pie charts, and tables.

4.6 VALIDITY

Validity in research is one of the critical aspects of data collection and quantitative research. The validity of the data collection instruments was ensured through the rigorous review of the literature which adequately informed the definitions and meanings of terminologies, issues, and concepts in the study of gamification in software development (Marczyk et al., 2005). Bryman (2012) states that validity refers to measuring an item and addressing the research questions. Validation is the basis of research in social sciences because it demonstrates the quality and rigor of the research. The researcher ensured that the study participants communicated the meanings of the exact definitions of gamification and the types of game elements in the study. Lastly, the study's validity involved collecting and analysing data to evaluate the accuracy of the survey.

4.7 RELIABILITY

The data collected during research must be reliable in terms of stability and consistency (Queiros et al., 2017). Reliability is the measure that is free from error and obtains reliable results. The keyword is consistency. Reliability is concerned with issues of confirmability. Reliability in the Likert scale type of questionnaire is vital as many variables and relationships between the variables test the concept. A survey is reliable if it produces similar results when administered a few times.

Queiros et al. (2017) highlight reliability is a precondition for the validity of quantitative research and is related to measurement quality. Also, the authors recommend that if a measure produces the same results repeatedly, it is deemed reliable. A quantitative study is considered invalid should the measures be unreliable (Queiros et al., 2017).

To ensure reliability, the study pre-tested the data instruments, after which it was reviewed. Furthermore, a statistical reliability test used Cronbach’s alpha measurement (Bhattacherjee, 2012) to determine whether the variables met the criteria.

4.8 ETHICAL CONSIDERATIONS

Creswell (2009) states that collecting data without the participants' informed consent in ethical consideration is unethical. The author further states that data collection should follow the necessary guidelines and regulations when research is conducted. The researcher's responsibility is to ensure the respondents are treated with courtesy and respect and to void any misunderstanding and conflict between the respondents and the researcher.

In accordance with the University of South Africa's research ethics policy, the researcher obtained ethical clearance from the University to conduct the study at the various financial institutions identified in the research population and to collect data on software development teams.

Before the participants signed the forms, they were informed regarding the following: the purpose and objectives of the research, the participant's expectation, and given that the participation was voluntary, one could withdraw at any time with no negative repercussions.

The next section explains the ethical aspects that the researcher considered during the study.

4.8.1 Confidentiality

The study participants were notified of the confidentiality of their responses. The participants were informed that their information will be kept anonymous regardless of whether the obtained information is personal or not personal. The researcher made use of web-based forms to capture the responses of the participants. This ensured anonymity since the researcher could not establish to which the response belonged. In the case of face-to-face interviews, participants were guaranteed that their identification would be kept private (Marianna & Paraskevi, 2011).

4.8.2 Informed consent

Participation in this study was voluntary. The respondents were informed from the beginning of the purpose of the study and were notified that they had a choice to respond or not respond to any of the questions in the questionnaire survey. Furthermore, the participants were informed that they can exercise the option of withdrawing without any consequences anytime during the process of this study. These declarations were specified in the consent form, which was presented to the participant to sign before participating in the study (Marianna & Paraskevi, 2011). According to Bhattacherjee (2012), the consent form must be preserved for three years to comply with scientific research rules.

The table below summarizes the research choices.

Table 4.4: Research design summary

Application of the Research Onion to the Study	
Research Philosophy	Positivism
Research Approach	Deductive
Research Strategy	Survey
Research Choice	Quantitative
Time Horizon	Cross-sectional
Techniques and Procedures:	
Sampling	Stratified Sampling
Data collection method	Questionnaire
Data analysis method	Linear modeling

4.9 SUMMARY OF CHAPTER

This chapter presented the research methodology that guided a software development team's investigation into game elements. Furthermore, the chapter described the research philosophy, approach, and design to explain the data collection tool and survey adopted for this study. The researcher opted for the quantitative research approach. Furthermore, the chapter discussed the study population and sampling methods as well as the ethical considerations and data analysis. The following chapter presents an analysis of the findings of this study.

CHAPTER 5

DATA ANALYSIS AND RESULTS

5.1 INTRODUCTION

Chapter four was grounded on the research methodology and methods used to conduct this study. This chapter displays and interprets the data findings from the analysed data obtained from the responses to the survey. The Statistical Package for the Social Sciences (SPSS) was used to analyse the data. The findings are in accordance with the study's objectives, focusing on the use of game elements in software development teams and their impact on the software development process.

Therefore, this study investigated whether game elements enhance the software development process. The findings are presented based on the following study objectives:

- To assess the perceptions of software development team members on engagement, motivation, and performance in a software development process.
- To measure the relationship between engagement, motivation, and performance in a software development process.
- To determine the impact of engagement and motivation on performance in a software development process.

The above objectives served as a guide for formulating research questions and collecting data to answer those questions. The collection of the data for this study was informed by the quantitative approach adopted for this study.

5.2 DATA SCREENING

Table 5.0 depicts 95 completed responses from the surveys distributed within South African financial institutions, of which 52 respondents representing 54.7%, responded no, and 43 (45.3%) respondents responded in the affirmative. All the returned surveys were found to be suitable for further analysis.

Table 5.0: Data screening

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	52	54.7	54.7	54.7
	Yes	43	45.3	45.3	100.0
	Total	**95**	**100.0**	**100.0**	

Pallant (2020) has suggested a linear model that should be validated with diagnostic plots to ensure the validity of multiple regression and residual analysis assumptions. Furthermore, Pallant (2020) proposed that several assumptions should be considered to conduct a relevant statistical analysis of the data. The following are some of the assumptions:

- analysing for linear functional form;
- the identification of fixed independent elements, as well as model observations to ensure that no factors are missing;
- normality of the residuals or errors;
- screening for multicollinearity and homoscedasticity in the data;
- ensuring that outliers are identified and deleted; and
- Singularity and multicollinearity are associated with the correlation matrix.

When multivariate and bivariate correlations were examined, there were no bivariate correlations of 0.9 or higher between the independent variables. The coefficients output and residual analysis were used to assess multivariate correlation. Furthermore, all tolerance values were greater than 0.3, and the variance inflation factors were less than two.

Outliers were identified using the SPSS parameters that compared the values of residuals (error = expected – actual) and were found to be beyond the range of 4 and -4 of standardized residuals (Pallant, 2020). This was validated using a diagnostic test with a scatter plot (See Figure 5.1) and a P-P Plot of regression standardized residual (see Figure 5.2).

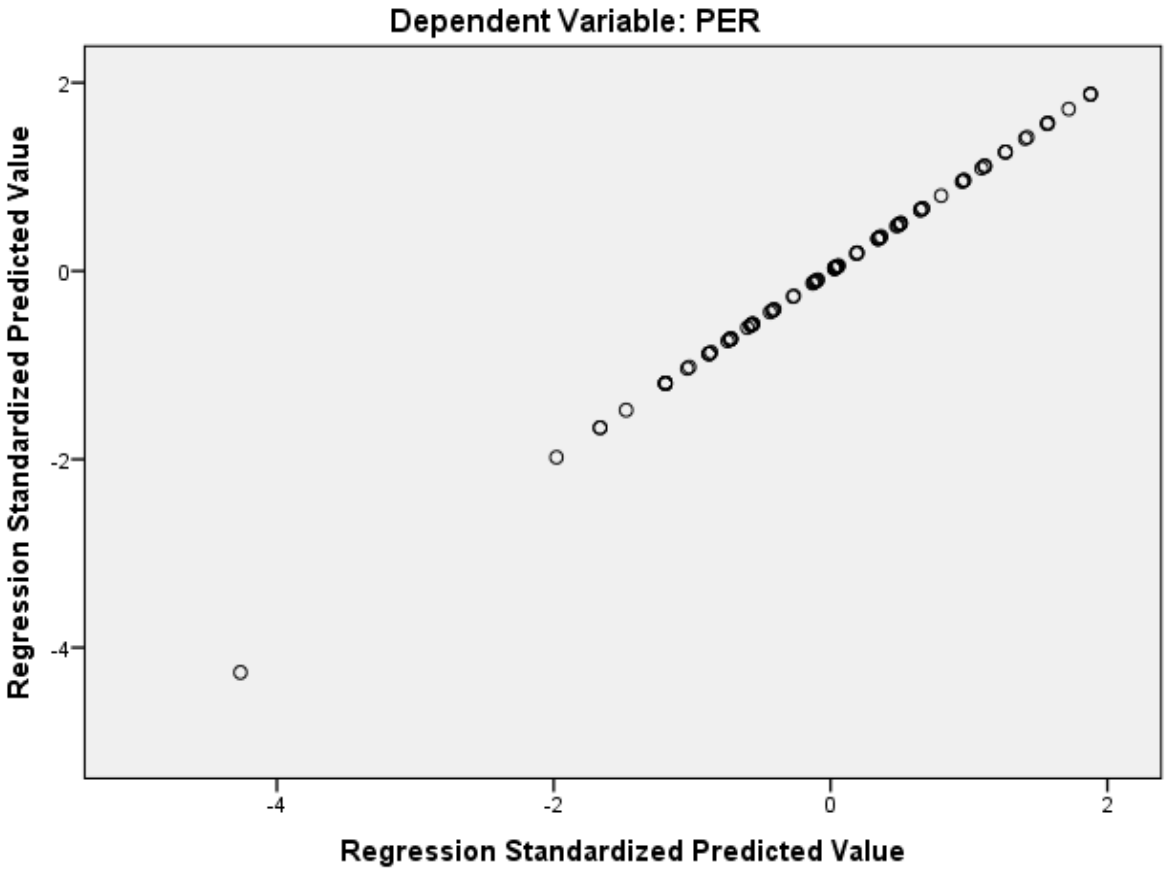

Figure 5.1: Diagnostic test with scatter plot for this study

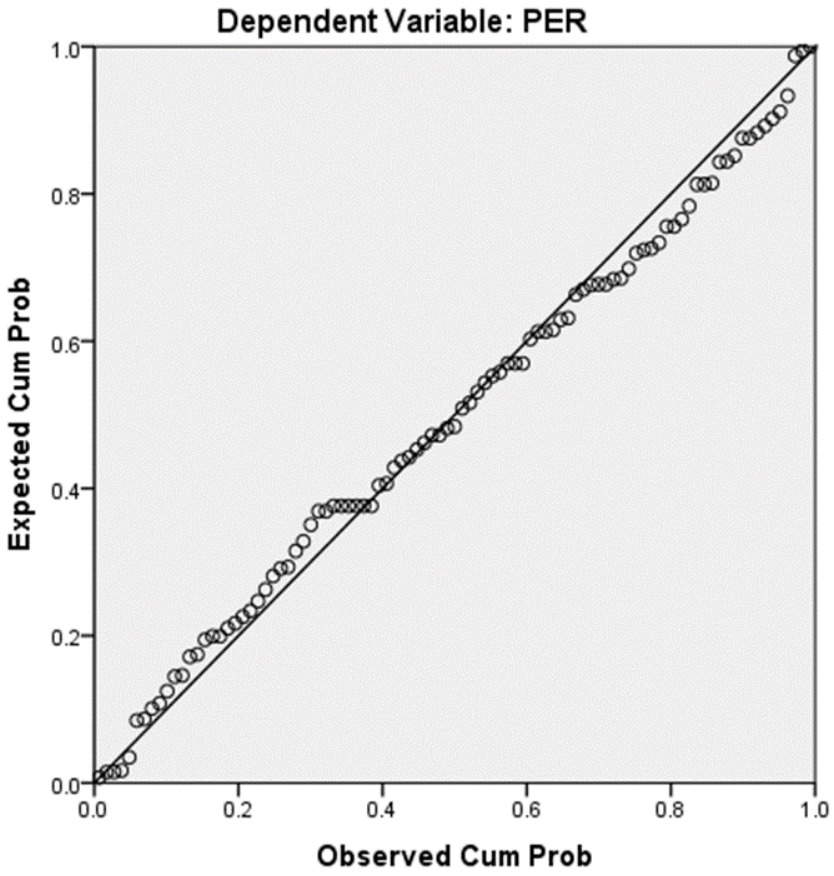

Figure 5.2: P-P of regression standardized residual for this study

5.3 DEMOGRAPHIC PROFILE OF RESPONDENTS

The study used variables such as gender, age, name of financial institution, the job role of respondents, and years of working experience in the IT profession in the survey to determine the respondents' demographic and professional profile. Creating a profile of the respondents will enable the researcher to gain a better understanding of and address the impact of game elements in the software development process in financial institutions in South Africa. The demographic information of the 95 respondents is shown in Tables 5.1 to 5.5.

5.3.1 Gender of Respondents

The gender distribution of the respondents involved in the research is presented in Table 5.1. It is quite clear from Table 5.1 that the majority of the respondents are males (56.8%), with females accounting for 43.2% of the respondents. This may suggest that males are the predominant gender in the IT space. A study by Rosenbloom et al (2008) found that despite the substantial gain that females have made in the market over the past century, the female gender remain substantially underrepresented across a range of scientific fields. Although the

female gender make up nearly 47% of the labour force, less than 27% of computer occupations are female.

Table 5.1: Gender of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	54	56.8	56.8	56.8
	Female	41	43.2	43.2	100.0
	Total	**95**	**100.0**	**100.0**	

5.3.2 Age of Respondents

Table 5.2 depicts the age distribution of the respondents. Only 1% of the respondents are below the age of 25. Nineteen (19) respondents representing 20% of the total number of respondents involved in the research were within the age group 26 to 30 years, while fifty-seven (57) respondents representing the majority of 60%, were from 31 to 45 years. Four (4) respondents representing 4% were found to be in the >45 years age group, while fourteen (14) respondents representing 15% were reported as other. With the age group of 31-45 being the majority, it was evident that financial institutions are hiring employees between the ages of 31 to 45 years old.

Table 5.2: Age of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Below 25 Years	1	1	1	20
	26-30 Years	19	20	20	21
	31-45 Years	57	60	60	81
	Above 45 Years	4	4	4	85
	Other	14	15	15	100
	Total	**95.0**	**100.0**	**100.0**	

5.3.3 Distribution of respondents according to the financial institution

Table 5.3 depicts the financial institution of the respective respondents. Among the four main financial institutions selected for the study, thirty-two (32) respondents representing 33.7% were staff members of financial institution 3, followed by twenty-two (22) respondents (23.2%) were staff at financial institution 1, fourteen (14) respondents representing 14.7% of the sample used in the study were noted to be working at financial institution 4 and Other financial

institutions. The remaining thirteen (13), representing 13.7% of the sample, were affiliated with financial institution 2.

Therefore, it can be deduced from the statistics above that the majority of the financial institution staff used in the study were from financial institution 3. This may be because financial institution 3 is regarded as one of the leading innovative banks in South Africa. It is also a fast-growing institution with the resources to recruit the required personnel.

Table 5.3: Name of Financial Institution of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Financial Institution 1	22	23.2	23.2	23.2
	Financial Institution 2	13	13.7	13.7	36.8
	Financial Institution 3	32	33.7	33.7	70.5
	Financial Institution 4	14	14.7	14.7	85.3
	Other	14	14.7	14.7	100.0
	Total	**95**	**100.0**	**100.0**	

5.3.4 Job Role of Respondents

The respondents were requested to indicate their job roles in their respective institutions. The results presented in Table 5.4 suggest that an overwhelming majority (61%) of the respondents surveyed were business analysts followed by project managers (12%), test analysts (11%), and developers (11%). Only a paltry 7% of the respondents were system analysts. The dominance of the business analyst role is expected because they interact with each job function in the software development lifecycle. Although the financial institutions surveyed seem to be dominated by business analysts, there appears, nevertheless, to be a fair representation of the various job roles in the software development industry.

Table 5.4: Job Role of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Developers	9	9	9	9
	Business Analyst	58	61	61	70
	Test Analyst	10	11	11	81
	System Analyst	7	7	7	88
	Project Manager	11	12	12	100

Total	**95**	**100.0**	**100.0**	

5.3.5 Working Experience of Respondents in IT

The respondents were requested to indicate the number of years they worked in the IT industry. Table 5.5 shows that in terms of IT work experience in the financial industry, most of the respondents surveyed (41%) had been the Table reveals that zero (0) out of the ninety-five respondents (95) have over 10 years of experience working for their financial institution, while 37% had between 6 and 10 years of experience and 19% had 1 to 5 years of experience. No respondents were recorded with less than one year of experience. These results indicate that financial institutions in South Africa have employees with good working experience.

Table 5.5: Working Experience of Respondents in IT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than one Year	0	0	0	0
	1-5 Years	19	20	20	20
	6-10 Years	37	39	39	59
	More than 10 Years	39	41	41	100
	Total	**95.0**	**100.0**	**100.0**	

The following section outlines the descriptive statistics of each variable, namely: Engagement, Motivation, and Performance.

5.4 DESCRIPTIVE STATISTICS OF GET VARIABLES

The statistics are displayed per construct for each instrument as depicted in Table 5.6.

Table 5.6: Statistics per Instrument

		N	Minimum	Maximum	Mean	Std. Deviation
Engagement	E1: When game elements are applied in the software development process/project, I feel full energy.		1	5	3.73	.950
	E2: Time flies on the project while making use of game elements.	95	1	5	3.58	.894
	E3: I am enthusiastic about working on projects.	95	1	5	4.37	.851
	E4: I feel optimistic when I am working within the project team.	95	1	5	4.20	.906

		N	Minimum	Maximum	Mean	Std. Deviation
	E5: I engage better in a team when game elements are applied.	95	1	5	3.45	.796
Motivation	M1: While applying game elements, I feel satisfied in achieving my work goals.	95	1	5	3.73	.791
	M2: While applying game elements, I enjoy communicating my ideas to my team.	95	1	5	3.80	.807
	M3: Applying game elements will help me improve and deliver better.	95	1	5	3.60	.868
	M4: Applying game elements will assist me to communicate and contribute more efficiently and effectively to the project team.	95	1	5	3.60	.843
	M5: While applying game elements, I feel motivated to take on new tasks.	95	1	5	3.69	.876
Performance	P1: When game elements are applied in the software development process, my performance has improved.	95	1	5	3.56	.834
	P2: When game elements are applied in the software development process, my communication has improved.	95	1	5	3.58	.894
	P3: I am enthusiastic about working on projects.	95	1	5	4.20	.807
	P4: I feel optimistic when I am working within the project team.	95	1	5	4.16	.854
	P5: While applying game elements, I feel satisfied in achieving my work goals.	95	1	5	3.61	.854
	Valid N (listwise)	**95**				

The Likert scale was used in the questionnaire survey to measure the attitudes and/or opinions of the respondents with regard to the impact of game elements in the software development process. Specifically, the respondents were asked to rank the level of agreement for a series of statements on a scale ranging from strongly agree (1) to strongly disagree (5). Means scores ranged from 3.45 to 4.37. The lowest mean score (*M* = 3.45, *SD* = .796) was obtained for E5 (I engage better in a team when game elements are applied). The highest mean score (*M* = 4.37, *SD* = .851) was obtained for E3 (I am enthusiastic about working on projects).

The highest standard deviation of .950 was obtained for E1 (When game elements are applied in the software development process/project, I feel full energy), and the lowest standard deviation of 0.791 was obtained for M1 (While applying game elements, I feel satisfied in achieving my work goals). A lower standard deviation indicates that the data was scattered tightly around the mean.

5.5 EXPLORATORY FACTOR ANALYSIS

Exploratory factor analysis (EFA) was used to determine the number of factors for the application of gamification in the software development process in South African financial institutions. The EFA was conducted to determine the underlying structure of the three factors (engagement, motivation, and performance) represented by their associated set of items. The EFA was applied to explore the existence of scientifically based factors to represent the three factors identified in the literature. Therefore, they were established using the EFA to test the constructs' validity and reliability.

The EFA used a principal component analysis as an extraction method and a component matrix as a rotation method. The following subsections will discuss the validity and reliability tests.

5.5.1 Kaiser-Meyer-Olkin Measure and Bartlett's test of sphericity

The sphericity and sampling adequacy tests are essential before performing factor analysis. These tests confirm whether it is worthwhile proceeding with factor analysis (Hinton et al., 2004). Therefore, before commencing the exploratory factor analysis, the tests used were the Kaiser-Meyer-Olkin (KMO) sample adequacy measure and Bartlett's test of sphericity.

According to Taherdoost (2016), the threshold value must be more than 0.5 to proceed with adequate factor analysis. As a measure of factorability, a KMO value of 0.5 is considered poor, 0.6 is acceptable, and a value closer to 1 is good (Taherdoost, 2016).

Bartlett's test of sphericity is conducted to confirm the relationship between the variables. If there is no relationship, it is not necessary to conduct a factor analysis. The statistical significance value for Bartlett's test of sphericity must be smaller than 0.05 to indicate that factor analysis is appropriate.

The results indicate that Bartlett's sphericity test, the KMO depicted in Table 5.7 shows that the obtained value of 0.903 is above the recommended acceptance level of KMO > 0.6. The p-value of Bartlett's sphericity test is < 0.05 and is substantial enough to undertake a factor analysis.

Table 5.7: Kaiser-Meyer-Olkin Measure and Bartlett's test of sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.903
Bartlett's Test of Sphericity	Approx. Chi-Square	1204.274
	df	105

	Sig.	.000

5.5.2 Eigenvalues

Table 5.8 summarises the eigenvalues and explains the total variance. A general rule is that factors with an eigenvalue that is more significant than one that should be considered essential for analysis purposes should be retained (Taherdoost, 2016). Table 5.8 suggests that, of the three components included in the factor analysis, only three contain eigenvalues greater than 1. Therefore, the component with the lowest eigenvalue of less than one was not retained.

Table 5.8: Eigenvalues

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.618	57.455	57.455	8.618	57.455	57.455	5.383	35.885	35.885
2	2.011	13.405	70.860	2.011	13.405	70.860	3.481	23.205	59.090
3	.784	5.224	76.084	.784	5.224	76.084	2.549	16.994	76.084
4	.607	4.043	80.128						
5	.514	3.427	83.554						
6	.479	3.191	86.745						
7	.375	2.497	89.242						
8	.304	2.027	91.270						
9	.276	1.841	93.111						
10	.248	1.652	94.763						
11	.234	1.562	96.324						
12	.199	1.327	97.651						
13	.136	.907	98.559						
14	.113	.751	99.309						
15	.104	.691	100.000						

Extraction Method: Principal Component Analysis.

5.5.3 Communalities

The communalities present how closely a specific item is related to others (Taherdoost, 2016). A value close to one indicates that an item is strongly associated with the others. Items with low communalities below 0.3 should be retained from the equation. The communalities for all 15 items were reasonable when a method of extraction called the Principal Component Analysis was used (see Table 5.9).

Table 5.9: Communalities

	Initial	Extraction
E1: When game elements are applied in the software development process/project, I feel full energy.	1.000	.546
E2: Time flies on the project while making use of game elements.	1.000	.522
E3: I am enthusiastic about working on projects.	1.000	.795
E4: I feel optimistic when I am working within the project team.	1.000	.752
E5: I engage better in a team when game elements are applied.	1.000	.626
M1: While applying game elements, I feel satisfied in achieving my work goals.	1.000	.753
M2: While applying game elements, I enjoy communicating my ideas to my team.	1.000	.702
M3: Applying game elements will help me improve and deliver better.	1.000	.777
M4: Applying game elements will assist me to communicate and contribute more efficiently and effectively to the project team.	1.000	.728
M5: While applying game elements, I feel motivated to take on new tasks.	1.000	.740
P1: When game elements are applied in the software development process, my performance has improved.	1.000	.725
P2: When game elements are applied in the software development process, my communication has improved.	1.000	.638
P3: I am enthusiastic about working on projects.	1.000	.798
P4: I feel optimistic when I am working within the project team.	1.000	.777
P5: While applying game elements, I feel satisfied in achieving my work goals.	1.000	.749

Extraction Method: Principal Component Analysis.

5.5.4 Principal Component Analysis

This study uses the principal component analysis (PCA) technique and the Varimax method to determine the construct validity for each sub-section of the survey. The Varimax method's goal is to identify concealed constructs that were not evident through direct analysis (Taherdoost, 2016). As an initial solution, PCA was carried out on the survey's three variables (engagement, motivation, and performance) before rotating the factors to determine the factorability of the correlation matrix and the likely number of factors.

The results consist of all sub-sections with eigenvalues greater than 1.0, as depicted in Table 5.10, which are above 60% of the required threshold.

Table 5.10: Rotated Component Matrix

	Component		
	1	2	3
E1: When game elements are applied in the software development process/project, I feel full energy.		.780	
E2: Time flies on the project while making use of game elements.		.764	
E3: I am enthusiastic about working on projects.		.852	
E4: I feel optimistic when I am working within the project team.		.851	
E5: I engage better in a team when game elements are applied.	.751		
M1: While applying game elements, I feel satisfied in achieving my work goals.	.595		
M2: While applying game elements, I enjoy communicating my ideas to my team.	.663		
M3: Applying game elements will help me improve and deliver better.	.877		
M4: Applying game elements will assist me to communicate and contribute more efficiently and effectively to the project team.	.857		
M5: While applying game elements, I feel motivated to take on new tasks.	.808		
P1: When game elements are applied in the software development process, my performance has improved.			.681
P2: When game elements are applied in the software development process, my communication has improved.			.634
P3: I am enthusiastic about working on projects.			.821
P4: I feel optimistic when I am working within the project team.			.847
P5: While applying game elements, I feel satisfied in achieving my work goals.			.777

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

5.6 CORRELATION ANALYSIS

The Pearson correlation was used for the study to determine if there was a relation between GET variables and the impact of game elements on software development teams. The Pearson correlation was used to establish whether any of the theory's constructs significantly impact software development teams in financial institutions. This section discusses the

relationship between the variables Engagement, Motivation, and Performance. The relationship between these constructs was expressed using Pearson Correlations, as illustrated in Table 5.11.

Table 5.11: Pearson Correlations

		Engagement	Motivation	Performance
Engagement	Pearson Correlation	1	.714**	.796**
	Sig. (2-tailed)		.000	.000
	N	95	95	95
Motivation	Pearson Correlation	.714**	1	.800**
	Sig. (2-tailed)	.000		.000
	N	95	95	95
Performance	Pearson Correlation	.796**	.800**	1
	Sig. (2-tailed)	.000	.000	
	N	95	95	95

**. Correlation is significant at the 0.01 level (2-tailed).

The following sub-section will discuss the hypotheses' relationships and how regression analysis was tested using correlation. The purpose of correlation in regression analysis is to test for collinearity. While a correlation greater than or equal to 0.5 indicates a huge correlation between the variables, a correlation greater than or equal to 0.30 indicates that a medium correlation exists. Lastly, a correlation, greater than or equal to 0.10 demonstrates that the correlation is small. A weak relationship is indicated by a correlation that is less than 0.10 (Lane, 2013).

This study considers the Pearson product-moment correlation of continuous variables (Pallant, 2020). The r-values range from 0.714 to 0.796, which indicates a good relationship between the constructs. The r-value can range from -1 to 1: if the value of r is close to 1 there is a stronger relationship between the constructs. The p-value is smaller than 0.05, indicating a significant correlation between the constructs. There is a significant correlation between engagement and motivation ($r=0.714$; $p<0.05$). Similarly, there is a significant correlation between engagement and performance ($r=0.796$; $p<0.05$) and between motivation and performance ($r=0.800$; $p<0.05$).

5.7 THE RELATIONSHIP BETWEEN THE PREDICTOR AND PREDICTED VARIABLE

This subsection presents the regression analysis results where the relationship regarding multiple linear regression is discussed. Regression analysis was used to test the relationships and it was predicted that one variable would do based on the score of the other (Lane, 2013).

The predicted variable in this study was Performance, and the predictor variables were Motivation and Engagement.

5.7.1 Performance as Dependent variable

The relationship between variables was examined using regression analysis. The coefficient of regression (R^2) for Performance was found to be 0.743, which indicates that independent variables of engagement and motivation explained the variance.

The overall multiple regression model is significant at a 95% confidence level with a p-value that is less than 0.05. This is a statistically significant contribution, as indicated by the Sig. F change value of (0.000) which is effectively less than 0.05. The ANOVA table (i.e., Table 5.13) indicates that the whole model (which includes both blocks of variables) is significant (F (2,94) = 132.959, p<0.05). The coefficients show the extent to which the variables contribute to the model or equation (see Table 5.14). From the significance column, only three variables make a statistically significant contribution; their p-values are less than 0.05. The standard Beta values for engagement and motivation are 0.460 and 0.471, respectively, which was significant for the dependent variable performance. Collinearity Statistics were acceptable because the variance inflation factor (vif) is within the acceptable range of 2 to 3 (Pallant, 2020). Also, Durbin-Watson is approximately 2, which is in the acceptable range (Pallant, 2020).

Table 5.12: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.862[a]	.743	.737	.35363	.743	132.959	2	92	.000	1.834

a. Predictors: (Constant), Motivation, Engagement

b. Dependent Variable: Performance

Table 5.13: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	33.253	2	16.627	132.959	.000[b]
	Residual	11.505	92	.125		
	Total	44.758	94			

a. Dependent Variable: Performance

b. Predictors: (Constant), Motivation, Engagement

Table 5.14: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	.372	.217		1.714	.090	-.059	.803		
	ENG	.468	.077	.460	6.092	.000	.315	.620	.490	2.040
	MOV	.445	.071	.471	6.242	.000	.304	.587	.490	2.040

a. Dependent Variable: Performance

5.7.2 Assessment of hypothesis

This section discusses the hypothesized relationships between constructs that were tested. Both the supported and unsupported hypotheses will be discussed.

Table 5.15: Hypothesis Assessment

Hypotheses	Paths	Beta	Sig	Decision
H_1: There is a relationship between engagement, motivation, and performance in a software development process.	Performance ← engagement Performance ← motivation	.460 .471	P<0.05	Supported
H_2: There is a relationship between engagement and performance in a software development process.	Performance ← engagement	.460	P<0.05	Supported
H_3: There is a relationship between motivation and performance in a software development process.	Performance ← motivation	.471	P<0.05	Supported
H_{01}: There is no relationship between engagement, motivation, and performance in a software development process	Performance ← engagement Performance ← motivation	N/A	N/A	Not Supported
H_{02}: There is no relationship between motivation and performance in a software development process.	Performance ← engagement	N/A	N/A	Not Supported
H_{03}: There is no relationship between engagement and	Performance ← motivation	N/A	N/A	Not Supported

Hypotheses	Paths	Beta	Sig	Decision
motivation in a software development process.				

The results shown in Table 5.15 shows the Beta value, which is supported by a p-value that is less than 0.05, thus signifying the relationships under investigation exist and are significant. The H_1 hypothesis shows that engagement and motivation are related to performance, with a beta value of 0.460 and 0.471 being supported. Both beta values were less than 0.05, indicating that it was significant enough to be supported. The H_2 hypothesis indicates that engagement positively relates to performance, with a beta value of 0.460 being supported. The beta value is less than 0.05, indicating that it is significant enough to be supported. The H_3 hypothesis shows that motivation positively correlates with performance, with a beta of 0.471 being supported. The beta value was less than 0.05, indicating that it was significant enough to be supported. The H_{01} hypothesis shows that engagement and motivation have no relationship with performance. Therefore, this hypothesis was not supported. The H_{02} hypothesis shows that engagement has no relationship with performance. Therefore, this hypothesis was not supported. Similarly, the H_{03} hypothesis shows that motivation has no relationship with performance. Therefore, this hypothesis was not supported.

The detailed discussion on the results is presented in section 6.2 in the next chapter

5.8 SUMMARY OF CHAPTER

This chapter presented the results of the quantitative data responses collected from the survey. Data were collected from respective individuals from various project team members of selected financial institutions. The data obtained from the survey is based on the main constructs of the study. The variables relating to the study's objective (i.e., engagement, motivation, and performance) were examined. The chapter presented the respondents' screening and demographic profiles. This was followed by the descriptive and factor analysis, the reliability of the constructs, correlation analysis, and the relationship between the predictor and predicted variables. It has been established that performance, which is regarded as a game element in a software development process, positively impacts the project teams' engagement and motivation.

The next chapter provides a summary, conclusion, and recommendations that may contribute toward the wider application of gamification in the software development process.

CHAPTER 6

DISCUSSION, RECOMMENDATIONS, AND CONCLUSION

6.1 INTRODUCTION

This chapter presents the summary of the study's findings concerning the research questions. The links between the study's objectives are discussed. The chapter concludes by providing recommendations derived from the findings, outlining the study's limitations, and providing suggestions for future research.

Gamification has changed how project teams communicate, engage, and do business; therefore, game elements will likely be used by project teams and industries worldwide in their software development process. This research study examined several factors related to the use and application of gamification amongst project teams in financial institutions in South Africa. Considering the factors that influenced the increased use of gamification in a software development process, it was essential to understand the issues related to gamification and its application, mainly in a financial institution context.

The study aimed to understand the factors that impacted the application of gamification in a software development team in financial institutions. The literature reviewed showed that although the uptake of game elements in project teams is considerately moderate in financial institutions, the use of game elements is mostly low. The constructs determined for this study were primarily based on the Gamification Effective Theory (GET). This study explains the factors that impacted the use of game elements amongst project teams in financial institutions. Therefore, it contributes to knowledge in technology, gamification technology, and software development. Furthermore, the study emphasizes the software development context of gamification. It examines the factors that impact gamification applications that are important for improving the software development process.

Numerous existing studies are aimed at understanding the application of gamification, however, they are limited to non-existent in the South African context, especially for financial institutions. Most studies tend to focus on online marketing (Lucassen & Jansen, 2014). To this end, this study sought to exploit this research gap by investigating the application of gamification in software development teams in South Africa’s financial institution context. Furthermore, considering that no studies have been reported on the factors that impact the application of gamification in a software development process, the findings of this study could pave a way for enhancing future research in a software development context. Additionally, project teams in financial institutions have high project delays and failures, further contributing

to decreased lack of motivation, engagement, and performance. Since gamification is now very popular in the industry, it was important to establish whether project teams use gamification and to determine the impact on the software development process.

6.2 SUMMARY OF THE FINDINGS

The literature review revealed some of the reasons behind the adoption of gamification, even though these studies address mainly online marketing usage. The literature further identified that some of the factors that impact the application of gamification globally are an increase in motivation, engagement, and performance (Amir & Ralph, 2014).

This study had a total of 95 respondents participating. The research was carried out in the cities of Pretoria and Johannesburg, which are located in the Gauteng Province of South Africa. The study established that the application of gamification is high in specific institutions, namely Financial Institutions 1 and 3. Variables that were perceived to impact the application of gamification, were engagement, motivation, and performance.

To effectively conduct the research, a quantitative approach was adopted by the researcher. A survey was employed to gather data which was analysed numerically and represented using tables and graphs.

The developed survey tested the relationship between the three factors (i.e., engagement, motivation, and performance) to determine the impact of these factors on the application of gamification. The survey was used to gather information on the profile of the respondents in terms of gender, age, name of the financial institution, job role, and years of work experience in the IT industry. From the demographic information, it was established that the IT industry is male-dominated, and this also applies to the various South African financial institutions that were studied. An analysis of the age groups of the respondents indicates that employees who participated in the survey are relatively young (i.e., within the age group of 26 – 45 years).

A total of 6 hypotheses were constructed to analyse the relationships between the three constructs determined from the theories reviewed. The assumptions were demonstrated empirically and were found to be statistically significant. Therefore, the research and data analysis make theoretical and practical contributions, as detailed in section 6.4. The research intended to shed light on gamification and examine its impact on the software development process.

The study's outcome yields valuable suggestions for decision-makers in financial institutions, organisations, and service providers offering gamification services. The study's significant variables were validated, using findings from past research.

The objectives of this study are outlined below:

Objective 1: To assess the perceptions of software development team members on engagement, motivation, and performance in a software development process.

Objective 2: To measure the relationship between engagement, motivation, and performance in a software development process.

Objective 3: To determine the impact of engagement and motivation on performance in a software development process.

6.2.1 Engagement, motivation, and performance in a software development process

Objective 1: To assess the perceptions of software development team members on engagement, motivation, and performance in a software development process.

The study's first objective was to assess software development members' perceptions of engagement, motivation, and performance on gamification. Using engagement, motivation, and performance as the core concern of gamification, the study found those game elements to be positively related to team members' performance. It suggests team members exposed to any form of game elements contribute to achieving their goals in project teams and adopt gamification (Perryer et al., 2016). It created a perception that awareness and usage of gamification translated into visibility. In line with the GET theory, which suggests that the effectiveness of game elements leads to the application of gamification; this is the extent to which a gamified system is used and contributes to any specific goals of the system and its users' goals (Amir & Ralph, 2014).

The study found that the more aware project teams are about gamification and its benefits, the more likely they will make use of game elements and change their perception.

The results suggest that the engagement and motivation of project teams that do not use gamification reflect on their performance due to a lack of motivation when engaging in a project team and task. A lack of engagement and motivation also increases the risk of project failure. Brodie et al. (2013) added that a state of engagement is related to continued use; the exposure of applying a game element in a project task can be the start of a continuous interacting cycle. Therefore, the risk of project failure influences the decision to adopt gamification.

Furthermore, it is reasonable to assume that, although project teams are aware of gamification, deciding not to use it could be due to a lack of not understanding of the

gamification concept or the reluctance not to use game elements in project teams. Brown et al. (2003) established that South Africans are more risk-averse and cautiously approach new technologies.

The study's results showed that although project teams are aware of gamification, their perception translates into team members' engagement, motivation, and performance in a software development process that is positively impacted (Kumar and Krishnamurthi, 2016). This highlights the benefits of gamification on the impact of their performances in a project team. This study's results align with the GET theory of Amir and Ralph (2014) on the attribute of motivation that improves motivation in a task and encourages optimal performance and the decision to adopt gamification. Other studies have also reported that awareness of gamification will influence the adoption rate (Hamari and Koivisto, 2015; Sereno, 2021).

Objective 2: To measure the relationship between engagement, motivation, and performance in a software development process.

Another study objective was to measure the relationship between engagement, motivation, and performance in a software development process. Several studies have examined the relationship between the three variables and their impacts on the application of gamification in a software process (Deek et al., 2005). For instance, Desai and Nagaraju (2018) claim that engagement, motivation, and performance are good indicators of gamification adoption. The results of the study by Desai and Nagaraju (2018) showed that motivation as a construct was related to performance as an independent variable. In this study, when applying game elements, individuals feel satisfied when they achieve their work goals, enjoy communicating their ideas to their team, and improve and communicate better with team members (Amir & Ralph, 2014). In addition, applying game elements assisted individuals to communicate and contribute more efficiently and effectively to the project team and thus motivated them to take on new tasks (Perryer et al., 2012). In this study, performance is based on the enthusiasm displayed by individuals when working on projects, feeling optimistic when working within the project team, and being satisfied when achieving work goals, as detailed in section 5.4. In addition to that, when game elements were applied in the software development process, communication amongst the individuals lead to an overall improvement in the communication of the team.

The results of this study showed that engagement as a construct has a relationship with performance as an independent variable. In this study, motivation means individuals engage better in a team when a game element was applied to their project and feel optimistic when working within the project team. In addition, the individual was enthusiastic about working on

projects and made use of the time spent on the project while making use of game elements and feeling energetic.

Objective 3: To determine the impact of engagement and motivation on performance in a software development process.

The third objective of the study was aimed at determining the impact of engagement and motivation on performance in a software development process. The impact is understood to mean how a person using technology would improve a person's task performance. Descriptive analysis was conducted to determine the respondents' level of agreement or disagreement with statements on the impact of engagement, motivation, and performance on software development. The results show that all three variables (engagement, motivation, and performance) positively impacted project team members, as discussed in section 5.4
The results also showed that the impact is 0.743, meaning there is a 74.3% contribution toward performance. Therefore, engagement and motivation impact performance, and their contribution is significant for the study.

This study indicates that project teams will use game elements if they find them useful and observe a positive impact. When testing the impact of engagement and motivation on performance, the majority of respondents strongly agreed that they found gamification as an element that improved their engagement and motivation, which increased their performance (see section 5.8.1).

However, a few respondents agreed that they have neither the experience nor the awareness of the term gamification and could therefore not provide a view on game elements, as shown in Table 5.6. On the other hand, a few respondents disagreed that gamification does not impact them in any way and they, therefore, did not see the need to adopt gamification. The strongly agreed outcome is in line with the GET theory's immersive and dynamic impact, which indicates that users who use game elements positively influence the user or player's engagement in an activity. Supported by Dichev and Dicheva (2017), game elements harness engagements and reward behaviours that support the software development process and foster productive social interactions that encourage user adoption.

Although some project teams still find it necessary to continue with their traditional way of working, time wasted on playing games could contribute to project failure and thus prevent them from adopting gamification. Furthermore, the results showed that some respondents do not entirely agree with gamification from an understanding and awareness perspective and therefore still feel the need to continue with the traditional ways of working.

Low levels of awareness of gamification result in low levels of adoption of gamification. On the other hand, a high-level of awareness of gamification suggests that project teams understand the benefits of gamification and the results it has on a project team's performance.

In conclusion, motivation and engagement constructs as independent variables contribute slightly over 74% towards performance as a dependent variable.

6.3 DISCUSSION OF THE MAIN RESEARCH QUESTION

The gamification conceptual model was tested, and the model was assessed using a multiple linear regression model. Furthermore, the GET framework was introduced as a base for the study, which was used to investigate factors that enhance the software development process in financial institutions. The independent variables that impact the use of game elements were motivation and engagement. The following values were reported for the final model: the coefficient of regression (beta value) for Performance was 0.743, which indicated that the variance was explained by independent variables of engagement and motivation with beta values, which is supported by a p-value less than 0.05. Therefore, the model was considered significant.

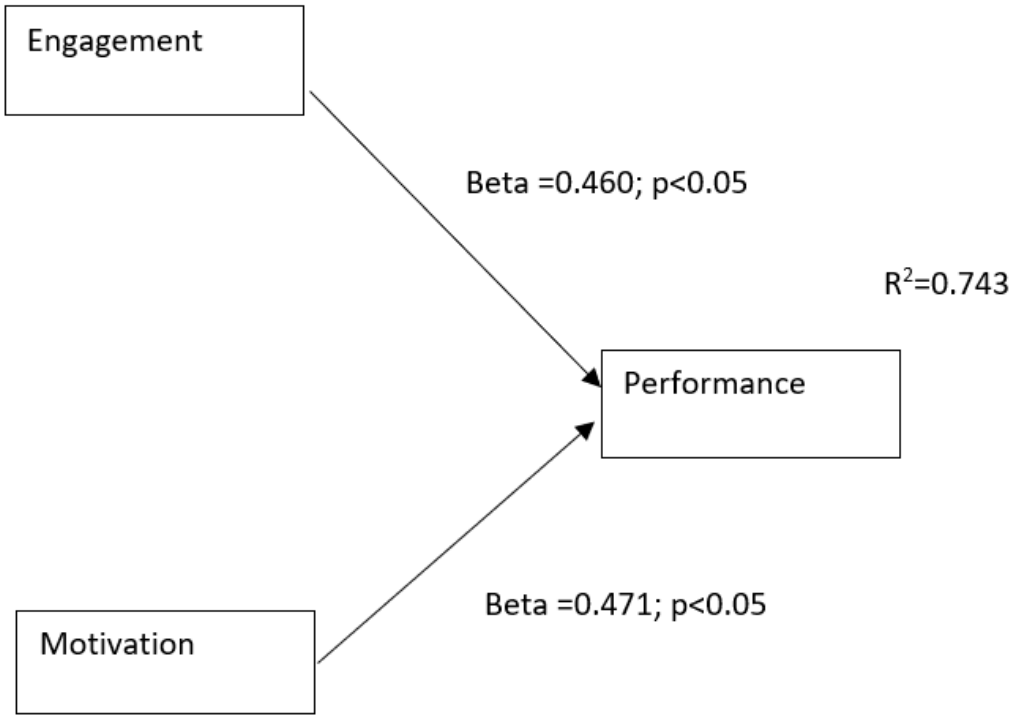

Figure 6.1: Final Research Model

To answer the main research question identified:

How does the use of game elements in software development teams impact the software development process?

The use of game elements that impact the software developments was driven by the following hypotheses that were not falsified:

H_1: There is a relationship between engagement, motivation, and performance in a software development process.
H_2: There is a relationship between engagement and performance in a software development process.
H_3: There is a relationship between motivation and performance in a software development process.

The following hypotheses was not supported:

H_{01}: There is no relationship between engagement, motivation, and performance in a software development process.
H_{02}: There is no relationship between motivation and performance in a software development process.
H_{03}: There is no relationship between engagement and motivation in a software development process.

Based on the supported hypotheses, the underlying factors that impact the software development process in South African financial institutions are engagement, motivation, and performance. Project team members' perception of gamification is influenced by increased performance. This, in turn, positively impacts the software development process.

6.4 RESEARCH CONTRIBUTIONS

6.4.1 Theoretical Contribution

Theoretically, the study's findings contribute to the knowledge in technology, gamification technology, and software development, especially in financial institutions. As a quantitative study, the study addressed the perceptions of project team members in financial institutions on gamification in a software development process.

The study has shown that the use of GET is not applicable to every circumstance and context. Although numerous studies reviewed in the literature have used the Self-Determination Theory (SDT) to understand the application of gamification, it yielded different outcomes. For

example, some studies (e.g., Deterding et al., 2011) used SDT constructs, but not all constructs, however, are relevant to all studies.

The results indicated that GET is applicable in the gamification environment to aid the understanding of gamification attributes of software development that affect adoption. Although not all the variables were congruent with the respondents' needs, neither did they can yield significant results; this leaves room for understanding adoption better contextually. For example, the constructs of motivation and engagement were highlighted as a determinant of the impact of gamification on software development. The study found that, although motivation and engagement were high, it does not necessarily translate into usage.

To academia, this research would present a source of academic reference for future studies and to policymakers and the regulatory environment, it serves as a platform for considering the development of policies that favour gamification and bring underperforming or struggling project teams into the realm of exploring gamification for their institutions. As a result, motivation and engagement constructs as independent variables contribute 74% towards performance as a dependent variable.

6.4.2 Practical Contribution

The study’s findings can provide guidelines to financial institutions and other organisations regarding the key factors that influence the application of gamification. From a practical perspective, the research findings can provide financial institutions and project teams with information to formulate strategies to enhance software development.

Considering the study's findings, financial institutions could create a gamification department that can be used to educate people in the institution about the benefits of gamification to increase the rate of gamification adoption among project teams. A need has been identified to educate other departments and create awareness on how to apply gamification. This can be achieved by setting up demo sessions that take project teams through a project life cycle where a team displays the use of game elements to achieve project tasks within specific project timelines. Considering the application of gamification is not that high, this is an opportunity to introduce new ways of working. Organisations should leverage this opportunity to further enhance their IT and other departments.

6.5 LIMITATION OF THE STUDY

Considering that the current study is not without limitations, its results should be interpreted while factoring in its limitations.

The study's main limitation is that it is limited to commercial banks in South Africa. Other financial institutions such as insurance companies were excluded from the study. Future research would need to be carried out on insurance companies since they form part of the financial services sector in South Africa. Furthermore, the study was conducted within a specific developing country (i.e., South Africa) therefore, the study cannot be generalised to all developing countries; this is the study's second limitation.

6.6 RECOMMENDATIONS

This study could serve as a basis for a longitudinal study on the application of gamification over a considerable period as opposed to a short period.

Other variables could be considered, (e.g., demographic factors such as qualification, marital status, and others) as moderating factors for future studies.

This study's constructs were based on the GET framework, and a theoretical model was constructed. This model provides a framework for researchers and organisations to assess the factors that lead to the application of gamification. When these factors have been identified, they are used to design interventions to target additional potential gamification users.

As a quantitative study, this study addresses the use of game elements in software development teams and their impact on the software development process. Financial institutions can use the findings of this study to develop their strategies and identify factors that impact the applications of gamification rates.

6.6.1 Future research

Future studies are recommended to explore the following:

This study focused on commercial banks based in Johannesburg and Pretoria. Conducting a comprehensive study on game elements within South African financial institutions could provide a more comprehensive view of the value of gamification in enhancing a software development process. Future research can investigate how insurance financial institutions in South Africa can use gamification to enhance their software development processes. The research was a cross-sectional study, and future research should focus on conducting a longitudinal study.

6.7 CONCLUSION

This study was aimed at investigating the use of game elements in software development teams and their impact on the software development process in South African financial institutions. The study made use of the study model to answer the research question, and a framework based on GET was conceptualized. A survey was distributed among various project teams in financial institutions to identify the relationship between the GET variables. To test the six hypotheses in this study, the SPSS version 22.0 was used for data analysis.

This chapter presented the outline of the study's main findings and the conclusion. It made recommendations derived from the findings and discussions and their implications on the use of game elements in a software development process in South African institutions. Based on these findings, the relevant theory and literature were examined to establish whether they were relevant to this study and aligned with its outcomes. The main findings indicated that gamification is being used in financial institutions and it has the potential to enhance the software development process by improving team members' performance. This study indicates that different game elements are used in a software process. These game elements engage and motivate project teams to participate and communicate effectively to resolve tasks promptly. The study also showed that game elements improve how project teams engage with each other.

Scholarly perspectives in the literature review supported the discussion. The findings are based on responses from project team members, and they show that gamification is used in financial institutions, there are policies and guidelines for using game elements, and only specialist roles utilize game elements. The overall conclusion is that gamification is not used to the optimum in financial institutions.

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APPENDICES

APPENDIX 1: ETHICAL CLEARANCE CERTIFICATE

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UNISA COLLEGE OF SCIENCE, ENGINEERING AND TECHNOLOGY'S (CSET) ETHICS REVIEW COMMITTEE

2021/06/08

Dear Miss Lutendo Lesley

ERC Reference #: 2021/CSET/SOC/014
Name: Miss Lutendo Lesley
Student #: 54908337
Staff #:

Decision: Ethics Approval from 2021/06/08 for three years Humans involved.

Researcher(s): Lutendo Lesley
54908337@mylife.unisa.ac.za, 082 4990960

Supervisor (s): Prof E Mnkandla
mnkane@unisa.ac.za, 011 670 9059

Working title of research:

Exploring the Application of Gamification in the Software Development Process

Qualification: Masters degree in Computer Science

Thank you for the application for research ethics clearance by the Unisa College of Science, Engineering and Technology's (CSET) Ethics Review Committee for the above mentioned research. Ethics approval is granted for 3 years.

*The **low risk application** was expedited by the College of Science, Engineering and Technology's (CSET) Ethics Review Committee on 2021/06/08 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment. The decision will be tabled at the next Committee meeting for ratification.*

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The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa COVID-19 position statement on research ethics attached.
2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the College of Science, Engineering and Technology's (CSET) Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
8. No field work activities may continue after the expiry date *expiry date*. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.
9. *Permission to conduct research involving UNISA employees, students and data should be obtained from the Research Permissions Subcommittee (RPSC) prior to commencing field work.*
10. *Permission to conduct this research should be obtained from the [company, CE organisation, DoE, etc name] prior to commencing field work.*

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Note

The reference number 2021/CSET/SOC/014 should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.

Yours sincerely,

Dr D Bisschoff
Chair of School of Computing Ethics Review Subcommittee
College of Science, Engineering and Technology (CSET)
E-mail: dbischof@unisa.ac.za
Tel: (011) 471-2109

Prof. E Mnkandla
Director: School of Computing
College of Science Engineering and Technology (CSET)
E-mail: mnlane@unisa.ac.za
Tel: (011) 670 9104

Prof. B Mamba
Executive Dean
College of Science Engineering and Technology (CSET)
E-mail: mambabb@unisa.ac.za
Tel: (011) 670 9230

APPENDIX 2: PARTICIPANT INFORMATION SHEET

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PARTICIPANT INFORMATION SHEET

Ethics clearance reference number:

13/02/2021

Title: Exploring the Application of Gamification in the Software Development Process

Dear Prospective Participant

My name is Lutendo Lesley, and I am doing research with Ernest Mnkandla, Director School of Computing in the Department of Computing towards a Master of Science in Computing at the University of South Africa. We are inviting you to participate in a study entitled **Exploring the Application of Gamification in the Software Development Process.**

WHAT IS THE PURPOSE OF THE STUDY?

I am conducting this research to find the use of game elements in software development teams and the impact it has on the software development process.

WHY AM I BEING INVITED TO PARTICIPATE?

The participants for this study will greatly assist in identifying if gamification does improve a software development process. The total number of participants that will take part in this research is 100.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

The study involves surveys. Questions directed towards software developments are based on if gamification does improve a software development process which will be gathered from South African financial institutions will be asked in the survey. The survey will take about 15 minutes to complete.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

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Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

No monetary gifts or any other gifts will be given for taking party in this study. However, as a participant, you will learn a lot on gamification in South African financial institutions.

ARE THEIR ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

The only foreseeable risk would be the time to complete the survey due to project demands and timelines, but as stated before, the survey will only take 15 minutes to complete.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

Your name will not be recorded anywhere and your participation in this research will be kept private by the researcher. No one will be able to connect you to the answers you give. To ensure consistency of responses across all questions in the questionnaire, your answers will be linked with other questions using Cronbach's alpha measurement.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

The responses received from Smart survey website will be stored and have a password protected account by the researcher for a minimum period of five years for future research or academic purposes. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

There will be no payment or incentives offered for participant, though you will gain valuable knowledge in participating. Participation is voluntary. No costs will be incurred by you.

HAS THE STUDY RECEIVED ETHICS APPROVAL?

This study has received written approval from the Research Ethics Review Committee of the School of Computing, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

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HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Lutendo Lesley on 0824990960 or 54908337@mylife.unisa.ac.za. The findings are accessible for 1 year.

Should you require any further information or want to contact the researcher about any aspect of this study, please contact Lutendo Lesley on 0824990960 or 54908337@mylife.unisa.ac.za.

Should you have concerns about the way in which the research has been conducted, you may contact Prof Ernest Mnkandla on 011 670 9059 or mnkane@unisa.ac.za. Contact Dr Danie Bisschoff on (011 471 2109 or email dbischof@unisa.ac.za) the research ethics chairperson of the School of Computing, Unisa, if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.

Lutendo Lesley

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APPENDIX 3: CONSENT TO PARTICIPATE

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CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits, and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the questionnaire/survey.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname..... (Please print)

Participant Signature..... Date.....

Researcher's Name & Surname.....Lutendo Lesley..... (Please print)

Researcher's signature.....  .....Date.....13/02/2021...

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APPENDIX 4: PERMISSION LETTER

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Request for permission to conduct research at Financial Institutions.

"Exploring the Application of Gamification in the Software Development Process"

17/05/2021

Peter Tshiguvho
CEO office, Retail
083 384 7464 and Peter.Tshiguvho@mmltd.co.za

Dear Peter Tshiguvho, CEO, Metropolitan Retail,

I, Lutendo Lesley am doing research with Prof Ernest Mnkandla, a Director in the Department of School of Computing towards a Masters degree at the University of South Africa. We are inviting you to participate in a study entitled Exploring the Application of Gamification in the Software Development Process.

The aim of the study is to explore the use of game elements in software development teams and the impact it has on the software development process.

Your company has been selected because an investigation needs to take place within your software development teams which will require participants of the project team to fill out a questionnaire.

The study will entail a team of developers, system analysts, business analysts, project managers and test analyst which are in line with the purpose of this project.

The benefits of this study are to encourage project teams and developers to learn about new software or technologies, exceedingly encourage and raise their productivity levels and it could influence the quality of their work if applied to motivate best practices.

Potential risks for this project are not applicable.

Yours sincerely

Lutendo Lesley

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APPENDIX 5: SURVEY QUESTIONNAIRE

Survey on Exploring the Application of Gamification in the Software Development Process

This questionnaire is about gamification. Gamification is the application of game elements in a non-game context. It is aimed to explore the outcome on the use of game elements in software development teams and its impact on the software development process.

SCREENING QUESTION

In your workplace, do you make use of game elements (e.g., Points, Badges, Leader boards, Avatars etc.)?

No	0
Yes	1

IF NO, THE SURVEY ENDS

SECTION A: BIOGRAPHICAL DETAILS

1. **What is your gender?**

Male	1
Female	2

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2. **Name of the Financial Institution:**

Financial Institution 1	1
Financial Institution 2	2
Financial Institution 3	3
Financial Institution 4	4
Other	5

3. **Please indicate age:**

Below 25years	1
26-30ye	2
31-45	3
Above 45	4

4. **Please indicate your job role:**

Developer	1
Business Analyst	2
Test Analyst	3
System Analyst	4
Project Manager	5

5. **Please indicate how long you have been working in the IT workspace:**

Less than one year	1
1-5 years	2
6-10 years	3

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SECTION B: ENGAGEMENT

The following statements are based on how you feel while making use of game elements (e.g., Points, Badges, Leader boards, Avatars etc..). Please select how you feel by using a 5-point Likert scale below.

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly agree

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
E1	When game elements are applied in the software development process/project, I feel full energy.	1	2	3	4	5
E2	Time flies on the project while making use of game elements.	1	2	3	4	5
E3	I am enthusiastic about working on projects.	1	2	3	4	5
E4	I feel optimistic when I am working within the project team.	1	2	3	4	5
E5	I engage better in a team when game elements are applied.	1	2	3	4	5

SECTION C: MOTIVATION

Please indicate to what extent the following statements apply to your work experience with game elements (e.g., Points, Badges, Leader boards, Avatars etc..).

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly agree

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
M1	While applying game elements, I feel satisfied in achieving my work goals.	1	2	3	4	5
M2	While applying game elements, I enjoy communicating my ideas to my team.	1	2	3	4	5
M3	Applying game elements will help me improve and deliver better.	1	2	3	4	5
M4	Applying game elements will assist me to communicate and contribute more efficiently and effectively to the project team.	1	2	3	4	5

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M5	While applying game elements, I feel motivated to take on new tasks.	1	2	3	4	5

SECTION D: PERFORMANCE

Please indicate the level of your performance on how game elements (e.g., Points, Badges, Leader boards, Avatars etc..) have impacted you.

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly agree

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
P1	When game elements are applied in the software development process, my performance has improved.	1	2	3	4	5
P2	When game elements are applied in the software development process, my communication has improved.	1	2	3	4	5
P3	I am enthusiastic about working on projects.	1	2	3	4	5
P4	I feel optimistic when I am working within the project team.	1	2	3	4	5
P5	While applying game elements, I feel satisfied in achieving my work goals.	1	2	3	4	5

SECTION E: GAMIFICATION IN SOFTWARE DEVELOPMENT PROCESS

1. **What game elements (e.g., Points, Badges, Leader boards, Avatars etc..) are you making use of?**

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2. **How are the game elements applied in your software development/project team?**

APPENDIX B: LIST OF FINANCIAL FIRMS INSTITUTION IN SOUTH AFRICA TO BE INCLUDED IN THE STUDY

1. South African Reserve Bank
2. Nedbank
3. First National Bank
4. ABSA

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APPENDIX 6: CERTIFICATE OF EDITING

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Authors:

Lutendo Lesley

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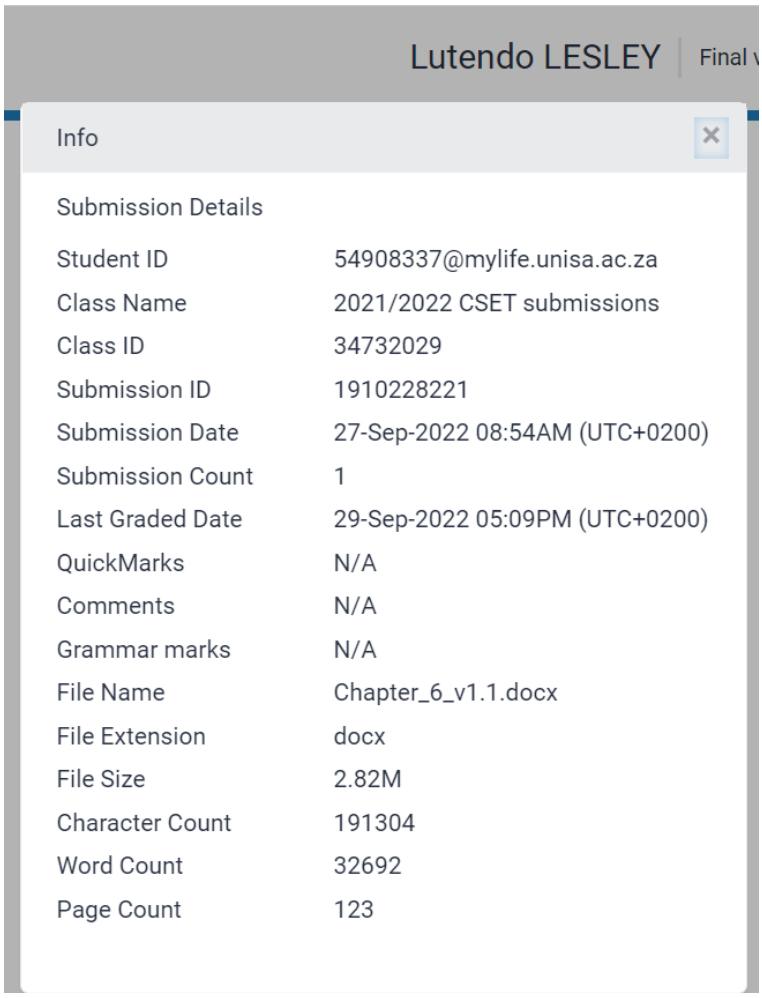

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