THE EFFECT OF GAME-BASED LEARNING ON PERFORMANCE AND MOTIVATION OF UNIVERSITY STUDENTS: AN EXPLORATORY STUDY

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The Effect of Game-Based Learning on Performance And Motivation of University Students: An Exploratory Study

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DECLARATION

We declare that the material contained in this paper is the end result of our own work and that due acknowledgement has been given in the bibliography and references to ALL sources be they printed, electronic or personal.

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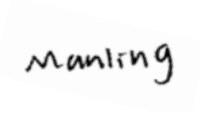
Signed: 

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APPROVAL FORM

This research paper attached hereto, entitled “Exploratory research of game-based learning in performance and motivation among university students.” prepared and submitted by Liew Vui Seong, Zou Cheng and Ting Man Ling in partial fulfillment of the requirements for the Bachelor of Social Science (Hons) Psychology is hereby accepted.

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Date: 30 November 2023

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Abstract

This study aimed to explore the impact of Game-Based Learning (GBL) on student performance and motivation in an educational setting. Our hypothesis is that GBL would lead to a significant difference in performance and positively influence motivation compared to traditional learning methods. The research employed an experimental design, utilizing a random sampling method to select participants from selected universities. Data gathering procedures involved using convenience sampling and purposive sampling methods. The sample size consisted of 36 participants, with data collected through a pre-and post-test and a motivation scale. The study targeted undergraduate students for data collection as they are potentially open to innovative learning methods. Contrary to the hypothesis on performance, there were no significant differences between the GBL and control groups. One of the reasons is that there may be a demographic reason like gender that affects the performances. Despite no significant performance differences between the GBL and control groups, the positive impact of GBL on motivation was evident, enhancing students' competence, autonomy, and relatedness. We aim to develop and implement educational curricula that promote diverse approaches for better learning experiences. The study recommends conducting longitudinal research to examine performance further and validate a new motivation scale. Similarly, it is also recommended to study individual differences to tailor the education intervention better.

Keywords: Game-based learning, academic performance, motivation, self-determination theory.

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List of Abbreviations

GBL	Game-Based Learning
SDT	Self-Determination Theory
FPS	First Person Shooting
DGBL	Digital Game-Based Learning

Chapter 1: Introduction

1.1 Background of Study

Game-based learning (GBL) combines game design principles with educational content to create an engaging and interactive learning experience. The course content is transformed into a game, providing a scenario environment where repeated self-learning, ongoing interaction, and feedback can increase students' interest and motivation. Games in education are becoming more popular because they make learning more engaging, enjoyable and help maintain focus on tasks.

In the history of GBL, the perspectives of renowned educators have significantly shaped its evolution. Maria Montessori believed that children's natural development is supported by engaging in activities and gently guided intellectual growth, rather than forceful teaching. Therefore, this approach advocates for aligning learning with children's natural curiosity, laying the foundation for modern GBL (Paula, 2011).

In the early years of a child's life, play has a significant impact on their cognitive development. This is supported by Jean Piaget's cognitive developmental theory, which highlights the transformative power of play. As children progress through developmental stages, play becomes progressively more abstract, symbolic, and socially intricate, reflecting their evolving mental faculties (Plass et al., 2015). This view supports the idea that play is a powerful tool for cognitive development, which aligns with Montessori's belief in the impact of productive engagement. These philosophies continue to have a significant influence on pedagogical paradigms. In the 20th century, Jean Piaget and Lev Vygotsky introduced game-based learning to higher education hence this added a new dimension to educational approaches and blended play and learning. (Hellerstedt & Mozelius, 2019).

The fusion of these philosophies has contributed to the rise of game-based learning, reinforcing the conviction that the interplay between work and play profoundly shapes human development. From Montessori's advocacy of purposeful engagement to Piaget's recognition of the cognitive evolution facilitated by play, these insights have collectively paved the way for integrating play into educational strategies, with game-based learning emerging as a potent embodiment of these foundational principles.

Apart from that, according to *Constructivism*, (2023), constructivism theory believes that learners construct knowledge rather than passively receiving information. Constructivism believes that learning is an active process. Learners construct new knowledge and understanding by interacting with the environment. Gamified learning enables students to become active participants in learning by providing a rich virtual environment. (Mee et al., 2020). Therefore, students actively explore, make decisions, and solve problems through tasks and challenges in games, which is consistent with the concept of constructivism in which students actively construct knowledge.

In recent years, the education sector has undergone a noteworthy transformation in the approach of both teachers and students towards learning. There are many approaches, like place-based learning, drama-based learning, and others, that educators and researchers are researching to enhance student engagement, motivation, and academic performance across the board. Game-based learning has been gaining significant attention as an innovative approach to education. The game-based learning market is projected to grow from USD 11.0 billion in 2021 to over USD 29.7 billion by the end of 2026, with a CAGR of 21.9% during 2021-2026 (Markets and Markets, n.d.). It effectively integrates gaming elements into the pedagogical process, enhancing and enriching the learning experience. This exploratory research seeks to delve into the potential impact of game-based learning on the performance

and motivation of university students, aiming to provide insight into how effective it is as an educational approach.

According to Norhidayah et al. (2021), the study provides some statistics on the usage of game-based learning in higher education. The result shows that 59.6% of participants believed that games could be effective tools for learning in higher education, and 31.3% reported playing games daily. This frequency sheds light on the consistent integration of games into the daily routines of these learners, underlining the relevance and attractiveness of game-based learning approaches in their educational experiences. According to Sager (2023), research shows that playing games in the classroom can increase overall motivation. Students become more motivated to learn, pay attention and participate in classroom activities.

On the other hand, Bouchrika (2023) reports that 74% of teachers incorporate digital game-based learning into their lessons. This method accounts for 93% of classroom time spent on tasks, and 52% of young students have played educational games. Video games are highly effective in the classroom, as 91% of school-age children are familiar with them. Additionally, 54% of US educators strongly agree that game-based learning is necessary. In November 2021, Kahoot! + Learning will launch as a new service for higher education students. It will enable them to create formative learning experiences, enhancing their knowledge throughout the school year, and preparing them for final exams (Polaris Research Market, 2021).

1.2 Problem Statement

The GBL is a teaching method that uses games to enhance the learning experience. The goal of learning with games is to make learning more interactive, engaging, and effective (Ding et al., 2017). At a Hong Kong university, small-group non-competitive GBL improved undergraduate psychology learning outcomes (Chan et al., 2021). However, effective game-

based learning requires significant resources, a theoretical framework, interdisciplinary competence, and clear goals (Greipl et al., 2020). Teachers faced challenges implementing games due to concerns about student distraction and technological difficulties. Game-based learning should supplement traditional education, not substitute it (Greipl et al., 2020).

Additionally, fewer journal articles fully support the outcomes from multiple perspectives. For instance, the meta-analytic investigation focusing on digital game-based learning (DGBL) in STEM education encompassed a relatively modest number of empirical studies—only 33 of 36 effect sizes. This relatively limited sample might not encompass the entirety of the relevant DGBL research landscape (Wang et al., 2022). The study suggests the use of a random-effects model instead of a fixed-effects model for data analysis, but this may limit examining the influence of internal and external variables on the results.

Furthermore, Ding et al. (2017) suggest that GBL is more effective than traditional learning approaches, whereas they do not specify which game elements contribute the most to this effectiveness. Much research primarily focused on short-term effects, but whether these advantages persist over an extended period is uncertain. The emphasis on short-term effects might not provide a comprehensive understanding of the sustained impact of GBL on students' performance and engagement. This raises a critical question about whether game-based learning's positive effects are retained over time, making it necessary to thoroughly examine both the practical components and long-term viability of its benefits.

Finally, despite the growing interest in GBL as a potential solution to improve university students' academic performance and motivation in the Malaysian context. As educational institutions strive to create dynamic and engaging learning environments, integrating gaming elements into the curriculum has emerged as a compelling strategy. However, there is a lack of comprehensive research on the specific outcomes and implications of GBL in the context of higher education. At the same time, it may be

problematic that the research only looked at short-term effects, as it is not clear whether the benefits of GBL last longer.

1.3 Significance of Study

Firstly, we hope to contribute to educational research. The study's exploration of game-based learning in the Malaysian context adds to the body of knowledge on effective teaching approaches. According to Tamosevicius (2022), the game's learning is flexible, adaptable, and quickly updated, making it an effective learning tool. Playing games improves memory retention and critical thinking skills, leading to better information retention. The study also shows positive results in academic performance and student interest when using a Monopoly-like board game in the elementary school geography curriculum (Vargianniti & Karpouzis, 2019). Therefore, the research can serve as a foundation for further investigations and academic discussions in the field of game-based learning and its applications.

Next, as technology continues to play an increasingly prominent role in education, understanding the effectiveness of game-based learning provides insights into how educators can harness technology better to meet the needs of today's digital-native students. According to the Ministry of Education (MoE), digital games effectively teach new skills and practices. With access to game creation tools and digital media platforms, game-based learning is crucial to any 21st-century project (Rachel, 2014). Therefore, we hope this study will influence the educator's value of this teaching method by adapting to technological advancements in the classroom.

1.4 Research Objectives

The objectives of the current study are:

1. To explore the effect of game-based learning in performance among Malaysian undergraduate students.
2. To explore the effect of game-based learning in motivation among Malaysian undergraduate students.

The research questions of the current study are:

1. Does game-based learning have significant effect on performance?
2. Does game-based learning have significant effect on motivation?

1.5 Conceptual and Operational Definition

Gamed-based learning. GBL involves using games to enhance student learning, which promotes critical thinking and problem-solving skills. Simulations can also provide students with hands-on learning experiences (Top Hat, 2019). Educators can empower students to develop their critical thinking and problem-solving skills through practical, hands-on experiences by incorporating game-based learning into the classroom.

Performance. Performance refers to the degree of accomplishment of predetermined objectives. It can be assessed by the level of effectiveness or inefficiency exhibited while carrying out a given task or activity. The process of performing a specific assignment is also considered to be a form of performance (Ghalem et al., 2016). Performance can define as GBL having a statistically significant influence on students' academic performance. (Vargianniti & Karpouzis, 2019).

Motivation. Motivation can be defined as a need, desire, want or drive within an individual. It is the process of motivating people to take action to achieve their goals. For example, in the workplace, people may be motivated by the desire for success and financial gain to satisfy their needs and wants (Management Study Guide, n.d.). It is the driving force

behind every action, initiating and maintaining behaviors necessary to achieve goals (BetterHelp, 2023).

Escape Room. The escape room is a game that requires the players to solve the riddles and puzzles to discover clues to unlock the room. Teachers are increasingly using educational escape rooms as a game-based learning tool to enhance student motivation and engagement. This approach also provides experiential learning and helps break large tasks into simpler stages within the game. It is possible to observe the student team's learning process while solving the task in an escape room environment (Järveläinen & Mäntymäki, 2019).

Big 5 Personality. The five broad personality traits described by the theory are Extraversion, Agreeableness, Openness, Conscientiousness, and Neuroticism. (Darby, n.d.). People who score high in openness have broad interests, enjoy learning new things, are curious about the world and like new experiences. Secondly, highly conscientious people are typically organized, detail-oriented, and considerate of how their actions impact others. After that, extraverted individuals are talkative, confident, and emotionally expressive. They gain energy from social situations. Furthermore, people who score high in agreeableness are more likely to cooperate, while those who score low may be more competitive and manipulative. Finally, people who score high on neuroticism may experience mood swings, anxiety, irritability, and sadness, while those who score low tend to be more stable and emotionally resilient (MSEd, 2023).

Chapter 2: Literature Review

2.1 Game-based learning and performance

Research has demonstrated that individuals who engage in GBL exhibit exceptional results in terms of conceptual knowledge compared to those who rely on traditional paper-based methods (Chan et al., 2021). This can be attributed to the heightened motivation experienced by students when using GBL, leading to more effective learning and improved performance. Furthermore, GBL has been found to enhance cognitive performance by improving working memory. It is a system that temporarily stores and manipulates information for cognitive tasks. Students often need to keep track of various game elements, such as objectives, rules, and inventory, while making real-time decisions. Therefore, this constant engagement with working memory can enhance students' ability to hold and process information, a crucial skill for academic learning and improve their performance. Another research also indicates that implementing GBL can improve an individual's working memory and working skills (Tareq et al., 2018).

Another research also supports that this learning method can help students with low visual-spatial capacity improve their performance (Chorng et al., 2013). GB L will help them sustain their attention and concentration on learning as visual-spatial memory retains visual shapes, colours, locations, and movement. Therefore, leveraging GBL can enhance motivation and learning effectiveness and improve cognitive performance. In addition, it is proven that GBL with a qualified game can help the learning process and improve memory retention (Chih & Ding, 2021). For instance, studies indicate that video game players tend to outperform others in short-term visual memory tests, highlighting the cognitive benefits of game-based approaches (Boot et al., 2008).

Finally, associative memory is another cognitive-related factor that can promote better performance through GBL, as the brain can link or associate two or more pieces of information based on their relationship or co-occurrence. GBL can promote better performance by enhancing associative memory to form connections between different elements of information, such as concepts, events, or sensory experiences. It is one of the essential types of memory that helps the student to learn knowledge effectively (Murphy et al., 2023). This learning method often involves connecting different pieces of information, such as cause-and-effect relationships, item combinations, or puzzle solutions. Therefore, building these associations in games can enhance associative memory, which is beneficial for understanding complex concepts in academic subjects. The special characteristic of GBL, like sound effects and interactive animation would optimize the associative memory to learn. In conclusion, there are a few factors that may contribute to better performance, like improved memory, knowledge retention, and sustained attention through GBL. According to Wang et al. (2022), learning with games can positively impact student performance by increasing student motivation, engagement, and knowledge retention. Additionally, research has found that gameplay and game mechanics, competition strategies, and gaming platforms can improve student academic performance (Wang et al., 2022). Therefore, GBL has many possibilities for improving students' performance with a well-designed structure. However, meta-analytic research on digital game-based learning in STEM education included only 33 empirical studies and 36 effect sizes, which may not be comprehensive enough to cover all relevant studies on DGBL. Second, data analysis used a random-effects model rather than a more precise fixed-effects model, which may limit the range of internal and external moderator variables (Wang et al., 2022).

2.2 Game-based learning and motivation

Many theories about motivation are being discussed in education to understand the effectiveness of a teaching method. It is also proven that students are more likely to be motivated when they are engaged in new learning material, like games that assist them in learning (Silva et al., 2021). According to Wang et al. (2022), researchers noted that digital games can diversify STEM learning goals and enhance students' learning motivation. GBL has significantly increased attention levels in the motivational process (Huangm, 2011). This is because GBL employs an entertaining approach to engage individuals and encourage them to delve deeper into knowledge acquisition. When games strike a balance between entertainment and learning experiences, they can effectively sustain students' attention and motivation (Jääskä et al., 2022). Research also shows that GBL can increase visual attention in tasks and text reading to help learning and play similarly (Tsai et al., 2016).

Other than that, educational settings that follow traditional methods often face challenges with unengaged students and passive learning experiences. The main difference between GBL and traditional learning methods is that it allows students to integrate their own learning interests with the content, fostering creativity (Liu et al., 2023). On the other hand, GBL has been shown to enhance students' motivation to actively engage in class, leading to a higher classroom participation rate (Valentová & Brečka, 2023). Research has also revealed a significant increase of 91% to 98% in student attendance in lecture courses when GBL is implemented (Nadolny & Halabi, 2013). GBL is a solution that creates a dynamic and engaging classroom environment. It encourages students to participate in their education, promoting motivation and interest actively (Zhang et al., 2022). Therefore, the high participation rate proves that students have high motivation to learn in a particular class.

Furthermore, GBL can increase the student’s confidence in learning (Rajan, 2022). As it provides a more engaging and interactive method of learning that encourages participation

and exploration. Similarly, it also presents several challenges and tasks to overcome in games, allowing students to experience a sense of accomplishment and mastery, which boosts their confidence. Another study also shows that both high-ability and low-ability students improved their confidence in mathematics using the GBL approach (Ku et al., 2014). This learning approach provides students with a safe and immersive environment to experiment, make mistakes, and learn without fear of judgment (Perez et al., 2022). Therefore, engaging with educational content dynamically can build a stronger belief in students' abilities, extending to academic tasks and challenges.

2.2.1 Intrinsic motivation, extrinsic motivation, and game-based learning

Other than that, extrinsic and intrinsic motivation are essential to understanding how it relates to GBL. Extrinsic motivation is the motivation that is driven the external conditions such as reward. Use game elements such as points, levels, leaderboards, challenges, and badges to increase student engagement and focus. Similarly, games can provide instant feedback, rewards, and challenges to motivate students to keep learning and enhance their learning effectiveness (Wang et al., 2022; Liu et al., 2021). It is essential that the serious game created more than just to be entertaining must include incentives and rewards to motivate the student to learn (Triantafyllou & Sapounidis, 2023). There are some situations in which the student has amotivation which is lacking the motivation to participate in the learning activities. Catalina et al. (2023) also suggested that including an appropriate penalty reward system within the GBL will create some pressure that drives the student to pay extra attention in the learning process.

Intrinsic motivation is the motivation that is driven by inner needs. When the reward and incentives have driven students to study, it is time to stimulate their autonomous motivation to learn. The study also supports that GBL can increase their intrinsic motivation and allow them to explore more knowledge effectively (Mei, 2007). GBL shows it can

promote a playful and enjoyable learning environment that gives students a more positive learning experience. At the same time, GBL also shows that it can increase multi-sensory students' intrinsic motivation by visualizing the image and providing sound effects (Xiang, 2022). However, to increase the overall intrinsic motivation, educators should know students' preferences and motivation needs, like the knowledge that is related to their future employment or the GBL is problem-centred (Kian et al., 2022). Therefore, the entertaining experience of GBL will increase the motivation to learn in the classroom when the educator carefully designs the structure of GBL.

2.3 Self-determination Theory

Deci and Ryan developed the Self-determination Theory (SDT), which exists as a recognized psychological framework that aids in understanding human motivation and the factors that drive individuals to engage in specific actions (Klein, 2019). It is essential to use this theory to understand how GBL affects students' motivation and performance by knowing the three components: autonomy, competence, and relatedness.

2.3.1 Self-determination Theory and Performance

The relationship between SDT and academic performance has been a topic of interest among researchers. Teacher intervention is another important factor that can impact students' basic psychological needs and, consequently, their autonomous motivation. A study also mentions that self-determination can enhance performance by boosting both aptitude and motivation to learn (Gyepi et al., 2022). Besides that, another study conducted by Claver et al. (2020) demonstrated that teacher intervention can strongly influence students' basic psychological needs and positively predict academic performance. At the same time, the satisfaction of autonomy and competence needs significantly outperformed general needs satisfaction in explaining academic performance, resulting in twice as much variation in the classroom (Goodman et al., 2021). This highlights the importance of creating a learning environment incorporating GBL, which nurtures students' autonomy, competence, and relatedness needs, ultimately leading to improved academic outcomes.

Besides that, one study conducted by Tóth-Király and colleagues (2022) found that goal framing, a concept aligned with SDT, leads to intrinsic motivation and better test performance. This suggests that when students are motivated by a sense of autonomy and intrinsic interest in their academic goals, they tend to perform better and persist in their educational endeavours. As Lemay et al. (2019) indicated, individuals with a high need for

autonomy may be more intrinsically motivated academically. Similarly, as suggested by Mitrea (2023), the application of SDT in traditional onsite classes can be a promising avenue for improving students' engagement and performance. Therefore, by incorporating the principles of SDT into teaching methods, instructors can create a learning environment with GBL that fosters students' intrinsic motivation and a sense of autonomy. It can improve engagement in the learning process, result in better information retention and ultimately, improve academic performance. However, striking a balance is essential, as an excessive need for autonomy may not always align with performance-oriented goals when designing GBL. Hence, the role of autonomy in GBL with academic motivation should be considered in light of individual differences and overall performance objectives.

2.3.2 Self-determination Theory and Motivation

To study the motivation further, Self-determination is being utilized in this study. First, autonomy in SDT emphasizes the individuals' desire for control and choice over their actions. The game can provide enough freedom for the student to decide the paths and goals to learn, creating a sense of ownership during the learning process. The in-game exploration of knowledge is important that motivates the student to learn. It is found that when a game has a high level of autonomy, the student will be more likely to enjoy and be motivated to learn through games (Grasse et al., 2022). Students can make meaningful choices to control their learning experience through GBL. Serious games like sandbox and open-world games are excellent examples that are being utilized in education. A noteworthy example is a research project that developed a Virtual Reality (VR) game centred around lunar exploration, where the findings revealed a greater motivation to learn compared to non-VR methods (Cao et al., 2019). Similarly, another example, Assassin’s Creed: Origins, is famously used to teach history and archaeology as it has realistic reconstructed historical events (Arbuckle, 2021;

Bondioli et al., 2019). These examples allow the students to have the autonomy to explore their knowledge through GBL.

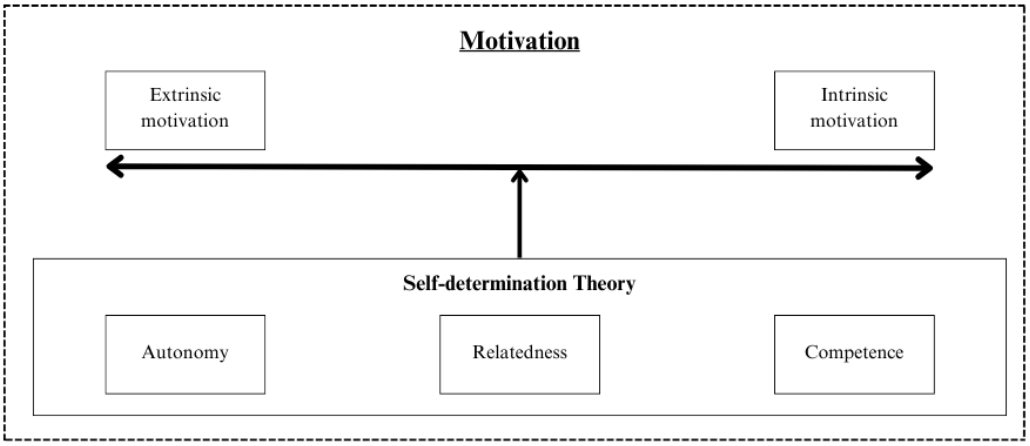


Figure 1The Theoretical Framework of Self-determination Theory.

The second component of SDT is relatedness which emphasizes the importance of social connections and the desire to feel connected to others. In GBL, students may engage in multiplayer or collaborative games, providing opportunities to interact and cooperate with peers. The social aspect of GBL can create a sense of community and foster positive relationships among learners. Building connections with peers and instructors can profoundly impact a student's motivation and enjoyment of learning. It encourages students to interact socially with others with the same goals (Matthew & Benjamin, 2021). Furthermore, GBL also presents opportunities to elevate students' complex socio-emotional skills associated with teamwork, collaboration, and communication (Plass et al., 2015). According to research, students reported a significant increase in their feelings of teamwork engagement, teamwork-building experience, and teamwork competence after attending GBL (Martín et al., 2021).

The third component is competence, which highlights the need for students to feel competent in their actions. GBL provides learners with challenges, tasks, and problems to solve, allowing them to develop and showcase their skills. According to research, games can create a sense of autonomy and competence, thereby increasing students' intrinsic motivation

to learn (Greipl et al., 2020). The game can create multiple tasks according to students' abilities, allowing them to solve them. It will allow students to experience a sense of competence and accomplishment through several levels to help less confident students (Rani et al., 2019). Understanding students' learning needs before creating teaching material is essential hence the knowledge that needs to be transferred from the game needs to be gradually increased.

In conclusion, it is vital to use SDT as a guideline to design the structure of GBL to maximize students' motivation to learn. All components play different roles in motivating students to learn. Therefore, the game must have clear goals, the feeling of autonomy, competence, and relatedness to successfully foster the motivation to learn through GBL (Proulx et al., 2018).

2.4 Conceptual Framework

2.4.1 Application of Self-determination Theory to improve motivation

The Self-Determination Theory serves as the foundational lens through which motivation is examined in this study. The theory's emphasis on autonomy, competence, and relatedness aligns accordingly with the objective of using GBL to increase students' motivation to learn. As autonomy is addressed through the freedom and choice provided by GB; competence is fostered through the learning opportunities embedded in the game; and relatedness is supported through potential social interactions within the learning environment. Therefore, the adoption of SDT in this study provides a theoretical framework for understanding motivation and guides the investigation into how GBL, as an educational approach, influences the key components of autonomy, competence, and relatedness in students' learning experiences.

2.4.2 Enhancing performance by utilizing GBL

The framework also shows that GBL can enhance students' performance. GBL's design is interactive and engaging, and it motivates students to actively participate by presenting them with dynamic and challenging tasks that stimulate their cognitive abilities. Through the intervention, students are encouraged to engage in problem-solving, critical thinking, and decision-making, all of which help to enhance their cognitive capacities. Similarly, the entertaining nature of GBL is a crucial element contributing to sustained attention and engagement. The immersive and enjoyable aspects of GBL create a positive and motivating learning environment, potentially fostering a heightened focus on the learning content. As the result, through GBL, it is assumed that it will help the student to perform better than other learning method.

2.4.3 Interrelation between Motivation and Performance

The framework suggests a two-way relationship between motivation and performance. From the perspective of SDT, the study expects that high motivation generated by GBL engagement will lead students to actively pursue learning opportunities and seek to satisfy their intrinsic curiosity or extrinsic temptation to learn. This heightened motivation, driven by autonomy, competence, and relatedness, is anticipated to translate into improved performance outcomes. Motivated students are more likely to engage with learning tasks, leading to enhanced performance, while positive performance outcomes can also contribute to sustained motivation.

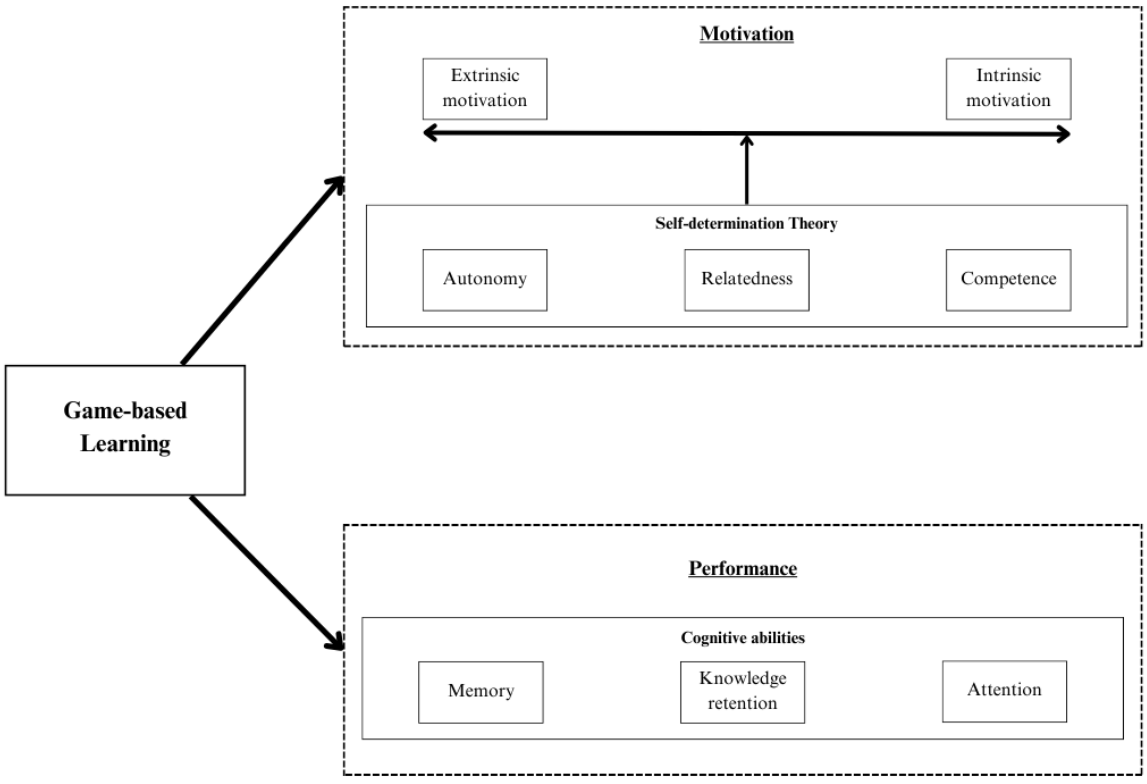


Figure 2The conceptual framework of theory

2.4.4 Hypothesis

Based on the framework, hypotheses can be formulated as below:

H1: Increased engagement with GBL can lead to improved student performance significantly.

H2: Increased engagement with GBL can enhance student motivation significantly.

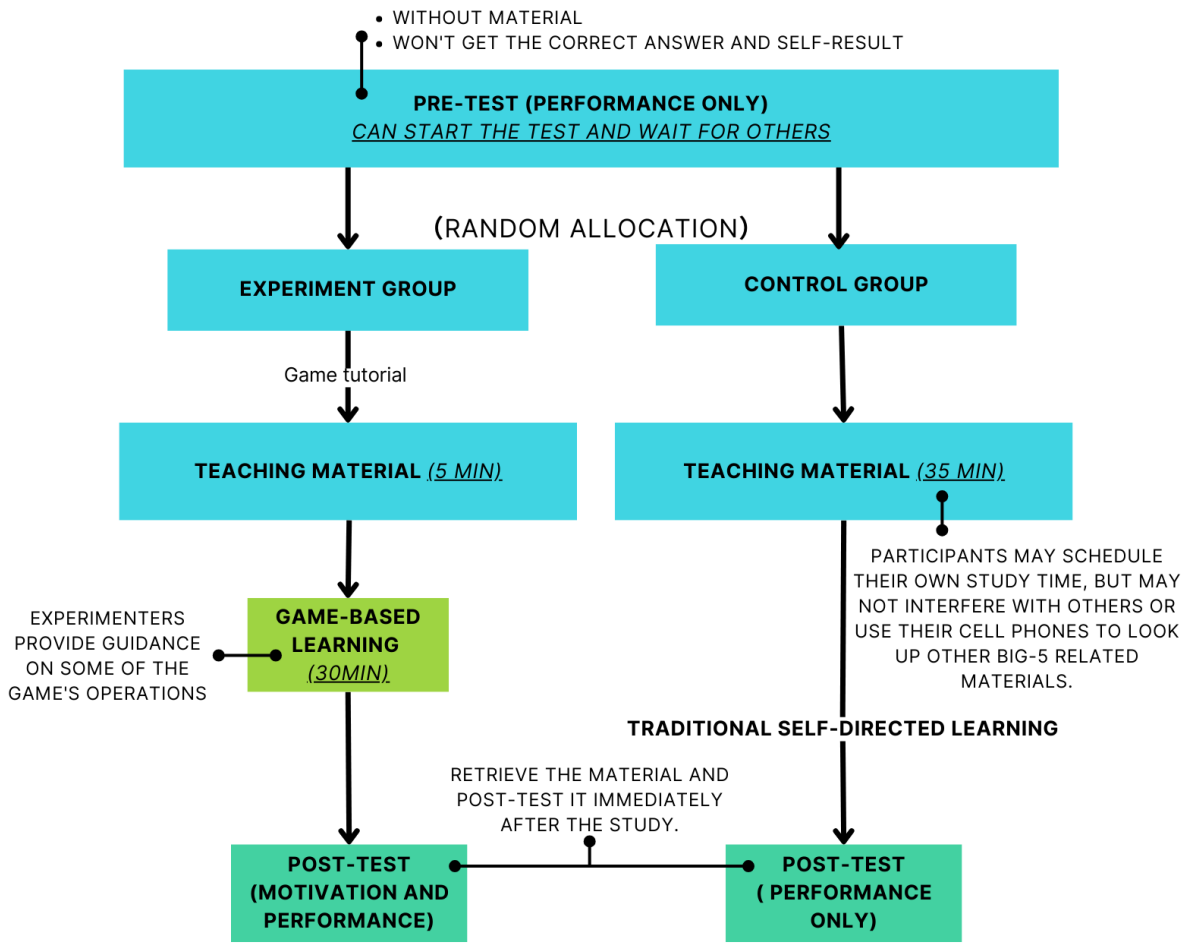
Chapter 3: Method

In this chapter, we will explore five key areas. Firstly, we will provide a detailed overview of our research design and framework. Secondly, we will outline our sampling procedure, including the sampling method, experimental site, and ethical approval. Moving on, we will delve into our sample calculations and actual response rates. The fourth section will focus on the data collection procedure, providing a thorough explanation of our approach. Lastly, we will provide an overview of the tools and questionnaires utilized in our experiment.

3.1 Research design

This study used a controlled experiment to compare GBL with traditional learning methods. The effects of these two learning approaches on students' academic performance in the experimental and control groups are finally obtained. Similarly, the effects of GBL on students' motivation in the experimental group are also determined. The operation of our experimental process is as follows.

Figure 3: Research process



Before the start of the experiment, all participants were pre-tested on Big 5 and were randomly assigned to the experimental and control groups. Both groups studied with the same big-5 related learning materials (as appendix A2 shows) that we prepared. However, students in the experimental and control groups differed only in their learning styles.

3.1.1 Research process of experiment group

Firstly, since most of the participants in the experimental group were using the game for the first time so we had the students in the experimental group study the game tutorial in order to familiarize them with how the game works and how to play it. Before the start of the game, students in the experimental group were given 5 minutes to browse the material. In our

experiment, participants in the experimental group used the knowledge gained from the materials as complete clues to navigate the escape scenario of the escape room. During this process, their goal was to apply their theoretical knowledge to a real-world situation and escape the room by continuously cross-referencing and evaluating the material. Students repeatedly compare and analyze their knowledge from the textbook with the situation presented in the escape room. Immediately after a successful escape, the material was retrieved, and they were given a post-test. Upon completion, the motivation scale was provided to collect data on motivation. To ensure treatment fidelity, all participants in the experimental group received consistent exposure to the GBL intervention. The game's content, duration, and interactive elements were standardized to maintain uniformity across participants.

After the experiment, a few participants in the experimental group reported experiencing minor side effects related to the nature of the GBL intervention, which involved a First-Person Shooter (FPS) game. Specifically, some participants reported feelings of dizziness. It's important to note that these side effects were considered minor and were promptly addressed. To ensure the well-being of participants, a comfortable area was designated for rest, allowing individuals to recuperate until they felt comfortable to continue or complete the session. These measures were taken in accordance with ethical guidelines to guarantee the safety and comfort of all participants throughout the experiment.

3.1.2 Research process of control group

On the other hand, participants in the control group learned the material through independent learning. To ensure that both experimental groups had the same amount of time to learn, we calculated the average time the experimental group spent escaping the chamber as the time the control group spent learning independently. As a result, the time was 35

minutes hence students in the control group were free to organize and utilize the time without affecting others. After 35 minutes, we retrieved their material and immediately administered the post-test. During the experiment, we observed that students had difficulty concentrating fully on the 35 minutes. Some even frequently asked about the remaining time of the experiment. This did not happen in the experimental group with the same learning content and time.

3.2 Sampling procedures

The sampling methods used in this study are convenience sampling and purposive sampling. Convenience sampling is a non-probability sampling method in which selected units are included in the sample because they are the easiest to access by the researcher (Nikolopoulou, 2022). The use of convenience sampling facilitates the acquisition of the sample by using UTAR students as an existing group. We obtained participants by asking and inviting students on campus if they would like to participate in our experimental study. We used purposive sampling after participants were enrolled and pretested. This is because our experimental study is targeted at Malaysian university students. Therefore, participants who showed international students in the enrolment form will not be selected as participants. Besides that, recruitment was conducted over a week together with precise dates documented to maintain transparency by using Google Form. Participants were recruited through a systematic process, and data collection procedures were meticulously carried out to ensure accuracy and reliability.

In term for our location of study, in order to make it easier for our participants to reach the lab site and conduct the experiment. We applied for the Counseling Center on campus as a lab site. We applied to the university to conduct the experiment on November 8, 9, 14, and 15 from 12:00 noon to 3:00 pm. The Counseling Center provided us with two

rooms and a warmer room as a waiting room for participant testing and another room is a laboratory to conduct experiment. This room could accommodate six participants at a time for the experiment. The lab provided a comfortable learning environment and power source for participants to use computers for gaming experiments.

Finally, ethical approval for the research project was sought from the University in accordance with the Ethical Approval Procedure. The reference number of the approval letter is 578227-M as shown in the appendix A5 shows.

3.3 Sample size, power, and precision

We used G*Power (a widely recognized statistical efficacy analysis software tool) to determine the appropriate sample size for my study. With a calculated effect size of 1.591, we determined that the required level of significance (alpha) was 0.05 and the target efficacy level was 0.95. As shown in Appendix Al, the effect size demonstrates the expected impact of a game-based learning intervention on performance (1.232) and motivation (1.95). Again, the distribution ratio between the control and experimental groups was set at 1:1, indicating an equal distribution of participants. Thus, our total sample size of 24 participants will be divided equally into two groups, so each group should consist of 12 participants. The use of G*Power was important to ensure that our study had sufficient statistical efficacy to detect significant effects within my specific parameters. G*Power's robust methodology gives us confidence in the completeness of our sample size determination and enhances the validity and reliability of my upcoming research results.

After excluding international students from the experiment, we collected 18 local Malaysian university students for each of the experimental and control groups. They are all from different majors in UTAR but all of them are Chinese. However, the actual effective sample size for the control group was 16. The two invalid samples were used because the

participants' prediction scores were higher than 60% (score of 18 out of 30). This cutoff was set to ensure that participants in the study had little prior knowledge or exposure to the concepts being investigated. This was done to reduce the influence of pre-existing knowledge bias on their responses, which could affect the study's internal validity. By focusing on individuals who are less likely to have pre-existing knowledge, the study aims to enhance the intended impact of the intervention.

We compared the number of participants in the same type of experiment. In a prior study on higher education courses, the experimental group comprised 54 participants, while the control group consisted of 53 participants which has the total of 107 participants in the study (Eltahir et al., 2021). In another study with different GBL, there were 69 participants, 58 of whom participated in the questionnaire. This study is a case study of development using GBL employees (Sugahara, 2018). Therefore, compared to these two studies, our sample size is much lower than them. The limited size and lack of diversity within our sample population may restrict the generalizability of our findings to broader populations. Consequently, we cannot assert that our results are universally applicable to all university students in Malaysia.

3.4 Data collection procedures

3.4.1 Target participants

The data collection process involved targeting undergraduate students who were enrolled in various academic programs at UTAR. The study focused on these participants due to their active academic coursework engagement and potential openness to innovative learning methods (Machov et al., 2021). Generation Z currently have grown up in an era marked by rapid technological advancements (Bartusevičienė et al., 2023; Jovanka et al., 2023). This is because their daily lives are interacted with various forms of technology. Simultaneously, research also shows that they also prefer learning through web-based

tutorials, computer applications that facilitate practical learning, and hands-on laboratory exercises (Budiman & Franky, 2021). Therefore, this familiarity and comfort with targeted undergraduate student so educational methodologies that leverage technology.

The sampling frame included individuals from diverse academic backgrounds, including Art and Social Science, Business, Engineering, Foundation, and Science domains. This intentional selection aimed to ensure a heterogeneous sample that captured a range of academic backgrounds and learning preferences as they are less likely learn about Big 5. To be eligible for the study, participants had to be willing to participate voluntarily. This diverse population aimed to enhance the generalizability of the study's findings by offering insights into how students from different fields respond to the experimental conditions. The targeted participants played a crucial role in comprehensively understanding the study outcomes.

3.4.2 Experiment time and duration

We recruited students by asking them about their willingness to participate in a campus experiment. In the registration form, we provided 10 dates in 5 different time slots for participants to choose their preferred experiment time. in order to schedule the experiment. Finally, based on their choices, we scheduled the experiment on November 8, 9, 14, and 15 from 12:00 to 3:00 p.m. and the participants were randomly assigned. Due to our limited equipment, the experimental group was conducted in groups of two whereas the control group consisted of six people and each experiment lasted 35 minutes.

3.4.3 Data inclusion and exclusion

Regarding the selection of the target group. As our experimental study is based on the existing traditional education model in Malaysia so, our participants were selected from Malaysian university students. This is the first and most basic requirement for our inclusion. We also required them to sign an informed consent form (as shown in the Appendix A6)

when they filled out the application form. After obtaining enough participants, we provided participants with a full explanation of the objectives and procedures of the experiment. Afterwards, participants selected through objective sampling were randomly assigned to either the experimental or control group. Considering the rigor of the experiment, we also had a data adoption and exclusion criterion among all available data. Data from the same subjects, including pre-test and post-test scores for each group and motivation scale data for the experimental group, were valid if complete. Data are invalid if the pretest scores are higher than 60% or if other data are incomplete. Next, the experimental group will use a customized escape game method.

Based on our inclusion and exclusion criteria, a pretest will be administered to assess the academic performance of all study participants on the Big Five personality traits (as shown in Appendix A7). The purpose of this study is to effectively assess the impact of our teaching methods on participants' performance and motivation levels within the context of the Big Five personality traits. Correct answers and grades on the tests were not available to all participants until all experiments were completed. At the end of the experiment, we administered the post-test again using the same topics. Only then will the participants know their grades and the correct answers to the test. We will vertically compare the data from the two tests of the same subjects. The assessment evaluated the academic performance of the participants in each group. After that, we compared the results of the two experimental groups horizontally. To test whether different learning styles have an effect on the participants' academic performance. In addition, for the experimental group, we specifically used the Motivation Scale (as shown in Appendix A4) to measure their academic motivation. Finally, the results will be analyzed and compared to test whether game-based learning affects students' academic performance and motivation.

3.5 Instruments used

3.5.1 Big 5 Test

Our study utilizes a comprehensive and sturdy evaluation framework that comprises a set of 15 questions about the Big 5 and is purposely designed to evaluate the knowledge of the participants (As appendix A3 shows). These questions are consistent and standardized across both pre and post-tests, ensuring that all aspects are evaluated equally. Similarly, every question in the evaluation is assigned a label of A, B, C, or D for selection, and each question carries a weightage of 2 marks. This approach underscores the importance attributed to each aspect evaluated and ensures that every question is given equal significance in the overall evaluation process. The pre-test, conducted before the intervention, sets a baseline, while the post-test, conducted after the intervention, measures the extent of development. This dual application ensures a thorough and accurate understanding of the participants' educational progression and the efficacy of the interventions implemented throughout the study.

3.5.2 Motivation Scales

The motivation scale that we use to measure motivation is proposed by Jääskä and his colleagues (2022) based on Keller’s ARCS model. This model is a framework for instructional design that aims to increase and maintain learner motivation in educational environments. The model is designed based on four key components: Attention, Relevance, Confidence, and Satisfaction. The model perfectly matches the theoretical framework and conceptual framework:

- Attention: GBL provides a captivating and interactive platform that fully engages learners, resulting in an exceptional learning experience which helps to sustain attention.
- Relevance: GBL enhances learners' relevance through contextual and interactive

presentation of knowledge. Game scenarios resonate with interests and experiences, bridging theoretical concepts to real-world applications.

- Confidence: The confidence-building aspect of GBL is supported by the progression and challenges. As learners conquer in-game obstacles and reach milestones, their abilities grow, reflecting the competence component of the theoretical framework.
- Satisfaction: GBL's immersive and rewarding nature ensures learners' satisfaction. The game's interactive feedback, achievements, and sense of accomplishment contribute to learner satisfaction.

The scale will be only distributed to the experiment group to measure students' motivation about GBL. The comprehensive scale's details are provided in Appendix A4. The development of this scale draws upon previous research by Jääskä and references the studies conducted by Huang et al. (2013) and Kebritchi et al. (2010). Notably, both the scales utilized in these studies demonstrate a high degree of reliability, with a Cronbach's alpha coefficient of .89 for the scale employed by Huang et al. (2013) and .86 for the one employed by Kebritchi et al. (2010). These strong reliability coefficients indicate the consistent and accurate measurement of students' motivation within the context of GBL.

The scale will use a 5-point Likert scale: strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree. A set of 16 questions is included, with four questions allocated to each component. It provides a systematic approach to designing learning experiences that engage learners and increase their learning motivation. Therefore, using this study to measure students' motivation in GBL is appropriate.

3.6 Game-Based Learning Content: "Escape Simulator"

The experiment will incorporate GBL into the research by utilizing "Escape Simulator," an interactive first-person puzzler available on Steam. This game provides a

captivating platform for fostering engagement, critical thinking, and the application of knowledge. It is designed for solo play and online co-op, featuring a range of highly interactive escape rooms allowing players to manipulate objects, inspect their surroundings, and collaboratively solve intricate puzzles. Similarly, the incorporation of community-generated rooms using a level editor enhances the opportunity for varied and dynamic learning experiences.

We developed a BIG-5 character named Alex using ChatGPT. His Big-5 personality traits were high openness, high conscientiousness, low extraversion, high agreeableness and low neuroticism. We used different items and clues from the game to incorporate his character traits into different puzzles in the game's secret rooms to remind the room owner of the different traits of BIG-5. We showed his openness through many photos of travel and books in the room. Alex's to-do list and the fact that he writes in his diary that he wants to tidy up his room can show his tendency of consciousness. His refusal to attend large parties in his diary and greeting cards to friends shows his low extraversion. Many awards on the wall for helping others show that he is a person with high agreeableness. From the notes by his mother at the door and diaries left, we can see that he has good adaptability to the new environment. Puzzles and challenges incorporated into this information are used to help participants discover more information about the role (appendix A7).

After we prepared this information, it was used by Zou Cheng to create the game details. It also contains puzzles and challenges to discover more information about the character. For example, as shown in the appendix A7, we used to-do lists as clues for the puzzles, which also illustrates that Alex is a person with a high level of consistency. Participants need to follow a to-do list to get items organized to get a key into the room and some item mention clues. The travel photos involved in the puzzles in the appendix A7 represents his openness. After solving these puzzles, participants were given two squares

representing different personality traits (as appendix A7) A+ represents a high level and - represents a low level. After arranging the personality traits of the Big 5 in the correct order, they were presented with the final level. Finally, participants were required to deduce Alex's correct big-5 personality trait based on the known objects and textual information in the chamber. A successful escape is achieved by placing a square of the corresponding color in the correct position. Thus, due to the game's incorporation of personality psychology, participants were encouraged to use the knowledge gained and critical thinking skills to decipher the relationship between room elements and personality traits.

3.7 Data Analysis

Once the data is collected, the study will include descriptive statistics such as mean, median, standard deviation, and frequency distribution, which will be computed for variables such as academic performance and motivation scores in both the control and experimental groups. Besides that, to measure the performance of the control and experimental groups, the study will be utilizing pre-test and post-test comparisons. Firstly, we will use paired samples t-test to determine the extent of improvement in both groups and identify any significant differences between them. After that, we will conduct Independent Sample t-tests to compare the post-test performance scores of the control and experimental groups. This analysis will help us to gain a better understanding of the differences between the two groups.

On the other hand, we will directly interpret the motivation scale by focusing on the percentages associated with each item. This detailed examination allowed us to interpret the patterns and trends in participant responses and provide valuable insights into their motivation levels across various components. Furthermore, we will explore deeper into the average scores of each component of attention, confidence, satisfaction, and relevance. Through this approach, we can gain a complete perception of how individuals interact with

GBL. This will include not only the specific elements but also the larger aspects of drive and inspiration.

Chapter 4: Result

This chapter will explore the detailed examination of samples, evaluating their performance and motivation. We will explore different methods for analyzing samples, examine how to measure performance and investigate the underlying motivations behind these analyses.

4.1 Normality testing

In our study, we initially recruited a total of 36 participants. However, during the analysis phase, it was decided to exclude two participants from the control group. The criterion for exclusion was a score exceeding 18, as it was assumed that individuals with such scores might already have familiarity with the Big 5 concepts. This exclusion was made to ensure that the participants had a more consistence baseline understanding of the subject matter. It's important to note that this decision aimed to enhance the internal validity of the study by mitigating potential confounding factors. Additionally, it's worth highlighting that there were no missing values in the collected data, ensuring the completeness and reliability of the dataset for subsequent analyses. Therefore, methods for addressing missing data, such as imputation techniques, are not applicable in this context.

After that, the normality of the pretest and post-test distribution within each group was evaluated using normality tests. The Shapiro-Wilk Test was selected to assess data normality in our statistical analysis as it is suitable for small sample size. This test is widely utilized, especially when dealing with smaller data distributions (Shapiro & Wilk, 1965). By subjecting our data to the Shapiro-Wilk Test, we aim to gain valuable insights into the normality of the dataset under consideration.

Table 1: Normality test

Tests of Normality

		Shapiro-Wilk		
Group		Statistic	df	Sig.
Pretest	Experiment	0.952	18	0.452
	Control	0.900	16	0.079
Post-tests	Experiment	0.928	18	0.177
	Control	0.943	16	0.385

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

As Table 1 shows the normality assumption for pretest distribution in the Experiment and Control groups. In the group that underwent the experiment, the results of the test produced $W = 0.95$, $p = .452$. These results suggest no significant indication to reject the null hypothesis of normality as the result shows that it is greater than 0.05 (Shapiro & Wilk, 1965). Similarly, the Control group's results indicate that the test produced $W = 0.9$, $p = .079$. These p-values suggest that there is no significant deviation from the normality assumption, which shows that the data is normally distributed. According to the results, it can be assumed that the pretest in both groups follows a normal distribution as the p-value is more significant than .05. Although the Shapiro-Wilk test for the Control group is slightly close to the conventional significance level, the evidence from both tests combined provides a reasonable basis to assume normality. However, it is essential to exercise caution and consider potential impacts on the following analyses, especially for the Control group, where the Shapiro-Wilk result is near the significance level.

Table 2: Descriptive statistic of pretest

Descriptives

Group		Experiment	Control
Pretest	Mean	13.3333	14.2500
	Median	14.0000	14.0000
	Variance	8.000	11.133
	Std. Deviation	2.82843	3.33667
	Minimum	8.00	8.00
	Maximum	18.00	18.00
	Range	10.00	10.00
	Skewness	-0.031	-0.323
	Kurtosis	-0.609	-1.086

As demonstrated in table 2, the experiment group's pretest results indicate a skewness of -0.31 and a kurtosis of -0.609. These values fall within the acceptable range of ±2 hence it shows that there is a distribution that is approximately symmetrical and moderately peaked (Hair, 2022). Similarly, the pretest results for the control group show a skewness of -0.323 and a kurtosis of -1.086, which also fall within the acceptable range. These results suggest that the distribution in the control group is reasonably symmetric with a slightly flatter peak, comparable to that of the experiment group. Therefore, both groups demonstrate distributions that are not significantly divergent from normality based on the criteria of skewness and kurtosis. At the same time, in the Q-Q plot (as Appendix 4), most points closely follow the reference line hence it indicates an acceptable level distribution. However, slight deviations are observed in the upper tails and lower tails. In summary, the data follows a normal

distribution approximately. This finding supports the presumption of normality for consequent analyses without outliners.

The Shapiro-Wilk test resulted in a score of $W = 0.93$, $p = 0.18$ for experiment group whereas the tests produced a $W = 0.94$, $p = 0.39$ for the control group. As the Shapiro-Wilk p-value for both group is above 0.05 hence these results suggest that there is no strong evidence against the null hypothesis of normality for the post-test in both groups.

Table 3: Descriptives statistic of post-test

Descriptives

Group		Experiment	Control
Post-tests	Mean	22.2222	23.1250
	Median	24.0000	23.0000
	Variance	30.065	10.117
	Std. Deviation	5.48319	3.18067
	Minimum	12.00	18.00
	Maximum	30.00	28.00
	Range	18.00	10.00
	Skewness	-0.477	-0.073
	Kurtosis	-0.953	-0.873

The skewness and kurtosis values for the post-test data in the experimental and control groups suggest approximately normal distributions. The experiment group exhibits a slightly negative skewness of -0.477 and a moderate level of peakedness with a kurtosis of -0.953. Similarly, the control group shows a skewness of -0.073 and a kurtosis of -0.873, indicating a nearly symmetric distribution and slightly peaked. This information suggests that

the experiment group has a distribution that differs from the control group, with a somewhat more negatively skewed distribution and a slightly higher level of peakedness. These results may be of interest to researchers or businesses studying the characteristics of these two groups. Upon analyzing the data, it can be inferred that the post-test data in both groups conform to the assumptions of normality. This inference is supported by the visual examination of Q-Q plots, which is presented in Appendix 4. Therefore, subsequent statistical analyses can be considered reliable without outliner.

Table 4: Independent T-test of pre-test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre_Test	Equal variances assumed	0.756	0.391	-0.867	32	0.392	-0.91667	1.05728	-3.07027	1.23694
	Equal variances not assumed			-0.858	29.619	0.398	-0.91667	1.06784	-3.09866	1.26533

Table 5: Mean score of pretest

Group Statistics

Group		N	Mean	Std. Deviation
Pretest	Experiment	18	13.3333	2.82843
	Control	16	14.2500	3.33667

Other than that, the independent samples t-test was also conducted to assess whether there was a significant difference in the mean scores of the pretest between the two groups. Table 4 shows that the assumption of equal variances was tested using Levene's test, yielding $p = 0.39$ as it was more significant than the significance level of .05, indicating no significant evidence to reject the null hypothesis. Consequently, the t-test results were reported under the assumption of equal variances. The t-tests for equality of means produced $t(32) = -0.867$, $p = 0.39$. In this scenario, the p-values were greater than .05 hence this result suggest that there is no significant difference in the mean pretest scores between the two groups (Experiment group: $M = 13.33$, $SD=2.83$; Control group: $M=14.25$, $SD=3.34$). Therefore, based on the results of the t-tests, there is insufficient evidence to reject the null hypothesis, and it can be interpreted that the means of the pretest are comparable across the two groups.

4.2 Descriptive statistics

Table 6: Participants distribution among experiment and control group

	Experiment Group		**Control Group**		**Total**	
	Number of participants	**Percentages**	**Number of participants**	**Percentages**	**Number of participants**	**Percentages**
Male	8	44.44%	13	81.25%	21	67.6%
Female	10	55.56%	3	18.75%	13	32.4%

Appendix B2 shows the descriptive statistics; it provides a comprehensive overview of the participant characteristics in the study. Regarding gender distribution, many participants were male, constituting 67.6% of the sample, while females comprised 32.4%. This indicates a notable gender imbalance in the study, with a higher representation of males. As the group distribution is randomly assigned hence distribution of participants across

gender in the experiment and control groups exhibits a noticeable difference. In the experiment group, there are 8 male participants and 10 females which reflecting a relatively balanced gender representation. On the other hand, the control group demonstrates a slightly unbalance distribution as there were 13 male participants and 3 females. This gender imbalance between the two groups may introduce a potential confounding factor, as it could influence how participants engage with and respond to the experimental conditions.

Table 7: Academic representation

	Arts and Social Science	**Business**	**Engineering**	**Foundation**	**Science**
Percentage	38.24%	20.59%	26.47%	8.82%	5.88%

The distribution of participants based on their area of study reveals a diverse representation across various academic disciplines. The majority of participants, 38.24% individuals, belong to the Arts and Social Science category. Following this, there are 20.59% participants from the Business field, 26.47% from Engineering, 8.82% from the Foundation program, and 5.88% from the Science domain. This varied distribution reflects a mix of academic backgrounds within the study, contributing to a more comprehensive understanding of how individuals from different disciplines may respond to the experimental conditions. The inclusion of participants from a range of academic areas enhances the study's potential for broader applicability and relevance to a diverse student population.

Table 8: Age distribution

Age	**Percentages**
18	11.8%
19	5.9%
20	20.6%
21	29.4%

22	20.6%
23	11.8%

Regarding age distribution, participants ranged from 18 to 23 years old. The most prominent age group was 21, encompassing 29.4% of the sample, followed by the 20-year-olds, representing 20.6%. The descriptive statistics highlight the diversity in participants' ages, with most falling within the early twenties. This demographic insight is crucial for understanding the composition of the study sample and its potential implications for the research findings.

Table 9: Distribution of year of study

Year of study	Percentages
Year 1	29.41%
Year 2	20.59%
Year 3	47.06%
Year 4	2.94%

The sample study reveals a diverse group of participants across different academic years. Year 1 is the second-largest group which accounting for 29.41% of the sample, adding to the variety of academic progression within the sample. Besides that, approximately 20.59% of the sample consists of Year 2 participants, showcasing a substantial representation from this academic level. Similarly, most of the sample is comprised of Year 3 students which have a total of 47.06%. This indicates a significant presence of third-year students in the study. Lastly, year 4 is the least represented, comprising only 2.94% of the total sample. By examining the distribution of participants across various stages of their academic journey, we can gain a comprehensive understanding of how students from different academic years may respond to the experimental conditions.

4.3 Hypotheses testing

4.3.1 Hypothesis 1

4.3.1.1 Within group performance analysis

During this session, we will be analyzing the progress of each group by utilizing the paired sample t-test. This statistical analysis will help us identify any improvements within each group and provide valuable insights for future decision-making.

4.3.1.1.1 Analysis of experiment group

Table 10: Paired Sample T-test within the experiment group

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pre_Test - Post_Test	-8.88889	5.27914	1.24430	-11.51414	-6.26364	-7.144	17	0.000

The results indicate a statistically significant score increase from the pre-test to the post-test condition within the experimental group using GBL. The results revealed a substantial and statistically significant increase in scores from the pre-test (M=13.33, SD=2.83) to the post-test (M=22.22, SD=5.48) condition, $t(17) = -7.144$, $p < .05$. On average, participants' scores increased by 8.89 points in the post-test compared to the pre-test, indicating a notable increase in performance following the intervention. The 95% CI [-11.51, -6.26] further supports the statistical significance of this observed increase, as the interval does not include zero. This suggests that the GBL intervention significantly impacted the measured variable, resulting in increasing scores after the intervention.

Table 11: Paired samples effect size of experiment group

Paired Samples Effect Sizes

					95% Confidence Interval	
			Standardizer[a]	Point Estimate	Lower	Upper
Pair 1	Pre_Test - Post_Test	Cohen's d	5.27914	-1.684	-2.401	-.947
		Hedges' correction	5.39927	-1.646	-2.347	-.926

[a]. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

The paired samples effect sizes for the Pre-Test to Post-Test comparison were calculated using two metrics: Cohen's d and Hedges' correction which are suitable for small sample size hence both are used in this study. Effect sizes based on Cohen's d can be classified as small (d = 0.2), medium (d = 0.5), and large (d = 0.8) based on standardized benchmarks proposed by Jacob (2013). As d = -1.68 hence this indicate that there is a substantial effect size. The 95% CI [-2.4, -0.95] for Cohen's suggests a significant impact of the intervention on the measured variable. Similarly, Hedges' correction (95% CI [-2.35, -0.93]), with a point estimate of -1.65, aligns with the findings of Cohen's d and indicate an acceptable effect size. Therefore, both effect size metrics highlight the considerable impact of the intervention on the observed changes from the pretest to the post-test.

4.3.1.1.2 Analysis of control group

Table 12: Paired Sample T-test within the control group

Paired Samples Test

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)

Pre_Test - Post_Test	-8.87500	4.12916	1.03229	-11.07528	-6.67472	-8.597	15	0.000

The paired samples t-test revealed a highly significant difference between the pre-test (M=14.24, SD=3.34) and post-test scores (M=23.13, SD=3.18, $t(15) = -8.597$, $p < .05$). Participants' scores increased by 8.88 points from the pre-test to the post-test condition. The 95% CI [-11.08, -6.67] also indicating a statistically significant and consistent increase in performance after the intervention. This suggests that the intervention significantly impacted the measured variable, resulting in higher scores for participants in the post-test condition compared to the pre-test condition.

Table 13: Paired samples effect size of control group

Paired Samples Effect Sizes

					95% Confidence Interval	
			Standardizer[a]	Point Estimate	Lower	Upper
Pair 1	Pre_Test - Post_Test	Cohen's d	4.12916	-2.149	-3.044	-1.233
		Hedges' correction	4.23611	-2.095	-2.967	-1.202

[a]. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

The paired samples effect sizes for the Pre-Test to Post-Test comparison were computed using Cohen's d and Hedges' correction. As d = -2.15 (95% CI [-3.04, -1.23]), indicating a substantial effect size. Therefore, it suggests a significant impact of the intervention on the measured variable. Similarly, Hedges' correction, with a point estimate of 2.1 (95% CI [-2.97, -1.20]), aligns with the findings of Cohen's d also indicating an exceptional effect size. Therefore, the result shows that there is a considerable impact of the intervention on the observed changes from the pretest to the post-test.

4.3.1.2 Analysis of difference between GBL and traditional learning method

Table 14: Independent T-test of post test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Post_Test	Equal variances assumed	6.693	0.014	-0.577	32	0.568	-0.90278	1.56379	-4.08812	2.28257
	Equal variances not assumed			-0.595	27.793	0.557	-0.90278	1.51743	-4.01213	2.20658

Table 15: Mean score of post-test

Group Statistics

Group		N	Mean	Std. Deviation
Post-tests	Experiment	18	22.2222	5.48319
	Control	16	23.1250	3.18067

On the other hand, an independent samples t-test was conducted to compare the post-test scores between the two groups to assess whether there was a significant difference in the mean scores of the post-test variable between the two groups. As the table 10 shows, Levene's test for equality of variances indicated a significant difference in variances between the two groups ($p = 0.014$), violating the assumption of equal variances. In this case, when not assuming equal variances, the $t(27.79) = -0.595$, $p = 0.56$. Therefore, there is no statistically significant difference between the two groups' mean post-test scores (Experiment group: $M = 22.22$, $SD=5.48$; Control group: $M=23.13$, $SD=3.18$). Both the t-values and p-values exceed

the conventional significance level of .05. Therefore, it can be concluded that GBL does not significantly affect performance compared to traditional learning methods.

Table 16: Independent sample effect size of post-test

Independent Samples Effect Sizes

			Point	95% Confidence Interval	
		Standardizer[a]	Estimate	Lower	Upper
Post-tests	Cohen's d	4.55131	-0.198	-0.872	0.478
	Hedges' correction	4.66157	-0.194	-0.851	0.467

a. The denominator used in estimating the effect sizes.

Cohen's d uses the pooled standard deviation.

Hedges' correction uses the pooled standard deviation, plus a correction factor.

Regarding the results' effect sizes, we utilized both Cohen's d and Hedges' correction to measure the magnitude of differences between the two groups. The result shows that d = -0.2 indicating a small difference between the group means. Hedges' correction, which was employed to account for small sample sizes, produced a similar point estimate of -0.19, also shows a relatively small effect size. These effect sizes emphasize the considerably small impact of the independent variable on the groups.

4.3.2 Hypothesis 2

Table 17: descriptive statistics of the student's perceptions of their GBL experience

	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD
1	I think learning from gaming was fun and exciting.	0.0%	0.0%	0.0%	**5.6%**	**94.4%**	4.94	0.24
2	I think I learned from my success and failure in the game.	0.0%	5.6%	5.6%	**33.3%**	**55.6%**	4.39	0.85
3	I prefer other learning methods over game-based methods.	11.1%	**22.2%**	**55.6%**	11.1%	0.0%	2.67	0.84
4	I understand what kind of real-life situations the game simulated.	0.0%	0.0%	0.0%	**61.1%**	**38.9%**	4.39	0.50

5	There was not enough challenge and complexity in the game.	0.0%	**38.9%**	**50.0%**	0.0%	11.1%	2.83	0.92
6	I felt like learning.	0.0%	11.1%	5.6%	**50.0%**	**33.3%**	4.06	0.94
7	It is apparent to me how to use the learnings from this gameplay.	0.0%	0.0%	5.6%	**50.0%**	**44.4%**	4.39	0.61
8	I felt gaming stressful.	**55.6%**	**22.2%**	**22.2%**	0.0%	0.0%	1.67	0.84
9	The game increased my interest in learning new knowledge.	0.0%	0.0%	0.0%	**44.4%**	**55.6%**	4.56	0.51
10	The game motivated me to progress and get better.	0.0%	0.0%	0.0%	**50.0%**	**50.0%**	4.50	0.51

11	I enjoyed participating in this game-based learning session.	0.0%	0.0%	0.0%	**33.3%**	**66.7%**	4.67	0.49
12	The narrative and game environment were disconnected from reality.	**27.8%**	22.2%	**33.3%**	5.6%	11.1%	2.50	1.29
13	I could apply the theory that was learned previously in the gameplay.	0.0%	0.0%	5.6%	**33.3%**	**61.1%**	4.56	0.62
14	I wouldn't like to be graded according to my game result.	5.6%	11.1%	**50.0%**	**27.8%**	5.6%	3.17	0.92
15	The game content and flow captured my attention.	0.0%	0.0%	5.6%	**27.8%**	**66.7%**	4.61	0.61
16	Learning the game rules and mechanics felt frustrating.	**27.8%**	**33.3%**	22.2%	11.1%	5.6%	2.33	1.19

Table 18: Descriptive statistics of motivation scale

	Mean	Std. Deviation
Satisfaction	3.7917	0.47935
Attention	4.0972	0.56969
Confidence	4.5000	0.47743
Relevance	4.0833	0.46967
All Items	4.1181	0.49904

The categorization of questionnaire items provides a structured understanding. In this context, questions Q1, Q5, Q15, and Q16 focus on attention and explore engagement levels during learning. These questions will analyze the patterns related to how effectively the learning content captures and sustains the participants' attention.

Similarly, among the questions categorized under 'confidence', questions Q2, Q9, Q10, and Q13 aim to uncover the participants' self-perceived level of competence and confidence in their ability to learn. These questions explore deeper into their perceptions and attitudes towards GBL. Therefore, by exploring responses to these questions, valuable insights can be gained regarding the impact of the learning intervention on participants' confidence levels.

The survey questions Q3, Q8, Q11, and Q14 aim to measure the satisfaction dimension of the learning experience. These questions are designed to evaluate the overall sense of contentment and fulfilment that the participants feel after completing GBL. By analyzing the responses to these satisfaction-related questions, it is possible to gain insights into the effectiveness of the instructional design and delivery of the program. This information can improve the learning experience and ensure that the participant’s needs are met.

Finally, relevance, as an important aspect of the learning experience, is encapsulated in items Q4, Q6, Q7, and Q12. Participants' perceptions of the material's practicality and

applicability to real-world scenarios are vital indicators to explore within this category. Therefore, examining responses to these questions helps assess the learning content's perceived relevance.

On the other hand, during the data analysis process, we utilized reverse scoring for a select set of questions which are Q3, Q5, Q8, Q12, Q14, and Q16. This method involves reversing the original scores assigned to these questions to ensure that they are consistently and meaningfully interpreted when calculating the mean for each corresponding category. Reverse scoring is frequently utilized when survey items are phrased in a way that higher scores indicate lower levels of the measured construct. By reversing the scores for these particular questions, we can harmonize them with the scoring direction of the other items in their respective categories, facilitating precise and organized analyses.

4.2.2.1 Analysis of Attention

The overwhelming response of 97.4% (Q1) of students indicating that learning from gaming is perceived as fun and interesting suggests a highly positive reception of GBL among participants. The excellent level of excitement among learners highlights the massive potential of GBL in generating an interactive and pleasurable learning environment. This aligns with the widely accepted assumption that integrating gaming components into education can significantly boost student engagement, interest and motivation.

Next, the response to the statement "There was not enough challenge and complexity in the game" (Q5) within the attention category indicates a somewhat divided opinion among participants. As the table shows, there is a significant percentage of 38.9% held a different view and didn't agree with the statement that the game lacked both complexity and challenge. However, 50% of the participants were neutral, which indicates that they neither agreed nor disagreed with the statement. Individual differences may influence this variability in

perceptions in prior gaming experience, learning preferences, or other factors that impact how participants engage with and perceive the challenges presented in the game.

Other than that, the results suggest that GBL can capture students' attention for learning, with 66.7% of participants strongly agreeing (Q15). This high agreement rate emphasizes GBL can engage with students actively and make the learning process more interactive. Therefore, the positive impact on attention capture aligns with the assumption that GBL can enhance focus and participation in educational activities.

Additionally, the statement "Learning the game rules and mechanics felt frustrating" received relatively low disagreement rates, with 27.8% strongly disagreeing and 33.3% disagreeing (Q16). This outcome indicates that a substantial portion of participants did not find the learning process within the game to be frustrating. The lower levels of disagreement suggest that participants had a relatively positive experience navigating and understanding the game's rules and mechanics.

In summary, the survey results highlight the overwhelmingly positive perception of learning from gaming, emphasizing the fun and exciting nature of GBL for participants. The findings also underscore the success of GBL in simulating real-life situations, capturing students' attention, and reducing frustration during the learning process. These positive responses suggest that GBL can provide an engaging educational approach.

4.3.2.2 Analysis of Confidence

The analysis of the GBL impact on participants reveals promising findings, particularly in terms of enhancing confidence and motivation. Table 6 shows that the highest mean score (4.5 points) suggests that participants experienced an exceptional boost in confidence through GBL. This result supports the potential of GBL to influence participants' self-assurance in their learning journey positively. Moreover, a consistent agreement from all

students (50% agree, 50% strongly agree) with the statement, "The game motivated me to progress and get better (Q10)," highlights a significant motivational aspect of GBL. Therefore, this indicates the intervention's effectiveness in motivating the players to enhance their skills and knowledge.

Next, the statement with the highest mean value, "The game increased my interest in learning new knowledge" (Q9: mean=4.56), further supports the positive impact of GBL on participants' engagement and interest in acquiring new knowledge. Most of the participants (agree: 44.4% and strongly agree: 55.6%) expressed a high level of interest which emphasizes GBL's effectiveness in making the learning experience more engaging.

Additionally, a considerable proportion of participants (agree: 33.3%, strongly agree: 61.1%) feel they could apply previously learned theories in the gameplay (Q13). This outcome supports the potential of GBL to teach theoretical knowledge and provide a platform for practical application. Therefore, it can enhance the participants' ability to transfer learned concepts to real-world scenarios.

Furthermore, participants acknowledge the valuable learning experience gained from both success and failure within the game (Q2). A significant portion (Agree: 33.3%, strongly agree: 55.6%,) indicates that they are having a meaningful learning experience through the challenges presented by the game. As a result, it highlights the effectiveness of GBL in fostering a constructive learning environment.

In summary, the results suggest that GBL positively influences confidence and motivation and significantly enhances participants' interest in learning. It encourages applying theoretical knowledge and facilitates meaningful learning experiences through both success and failure within the game. These findings indicate the multifaceted benefits of GBL in fostering an engaging and effective learning environment.

4.3.2.3 Analysis of Relevance

In the relevance category, participants' responses provide valuable insights into the perceived connection between GBL and their learning experience. Notably, a significant number of participants, 50%, agreed, and an additional 33.3% indicated a strongly agreed response towards the statement "I felt like learning (Q6)." Therefore, the findings show the use of GBL has been shown to have a significant positive impact on learning outcomes and indicates its effectiveness as an instructional approach.

The statement "I understand what kind of real-life situations the game simulated (Q4)" received exceptional agreement, with 61.1% agreeing and 38.9% strongly agreeing. Participants perceive the GBL content as highly relevant and applicable in practical scenarios due to its strong alignment with real-life situations. This feedback suggests that GBL can create effective and relevant learning experiences for learners.

Furthermore, participants expressed a considerable understanding of how to apply the learnings from the gameplay, with 50% agreeing and 44.4% strongly agreeing (Q7). This positive response indicates that participants feel confident in translating the knowledge gained through GBL into practical applications.

Addressing the potential concern of narrative and game environment disconnection from reality (Q12), the findings show that a large portion of participants, including 27.8%, strongly disagree, and 33.3% express neutrality; hence, it does not show a significant disconnect. This response suggests that most participants did not find the narrative and game environment to be detached from reality and indicates a relatively strong alignment between the GBL content and real-world contexts.

In conclusion, these findings underscore the positive perception of relevance associated with the GBL experience. This highlights its potential to offer meaningful and applicable learning opportunities.

4.3.2.4 Analysis of Satisfaction

The analysis of the motivation scale provides valuable insights into participants' perceptions of GBL. The results show that the average satisfaction score is 3.79 out of 5, which indicates that respondents' satisfaction level is relatively low. Since the game is near four points, it is possible to enhance the students' enjoyment of the game through certain improvements.

Interestingly, over half of the students (55.6%) expressed neutrality toward preferring alternative learning methods over games-based approaches (Q3). This finding could indicate a lack of clear preferences, necessitating a deeper exploration of individual learning style preferences.

On the other hand, the response to the statement "I enjoyed participating in this game-based learning session (Q11)" within the category reveals a positive opinion among participants. The findings show that there is a high percentage, 66.7%, strongly together with 33.3% agreeing with the statement, resulting in a positive learning experience. This overwhelmingly positive feedback suggests that the participants well-received the GBL session by fostering a sense of enjoyment and engagement. The high percentage of strong agreement indicates that a large portion of the participants found the session not only enjoyable but potentially engaging and rewarding.

At the same time, 50% of participants strongly disagreed with finding gaming stressful (Q8). This strong disagreement suggests a prevalent positive response among participants regarding the stress levels associated with the gaming aspect of the learning

experience. Therefore, it shows that engagement with the GBL did not induce stress and reflected a favourable part of the learning environment.

Furthermore, the neutrality observed in participants' attitudes toward being graded based on game results highlights an area of potential consideration for educators (Q14). Some participants may not strongly object to this assessment method, while others may hold an uncertain attitude.

Based on the outcomes of the motivation scale, it shows that attitudes towards GBL are varied and complex. Although the scores for satisfaction indicate a moderate level of enjoyment, the responses to statements related to stress, preferences, and perceived real-life applicability show that a more detailed exploration of individual preferences and experiences with GBL is needed.

Chapter 5: Discussion

The results of our study have provided insights into the impact of GBL on both performance and motivation, with varying levels of support for the hypothesized improvements. While our findings did not show a significant enhancement in performance whereas they did support the hypothesis that GBL can positively influence motivation. The following discussion will explore the potential reasons behind these outcomes for both variables.

5.1 GBL and Performance

The study's results suggest that there are no significant differences between GBL and other learning methods in terms of student performance. As a result, the current data does not support the initial hypothesis (H1) that more engagement with GBL can enhance student performance. The absence of a significant disparity in performance may indicate various factors relating to autonomy, competence, and relatedness that require further investigation. However, it’s important to approach these findings with caution since the absence of statistical significance doesn't necessarily mean that GBL cannot contribute to significant performance improvement which mentioned in previous research (Chan et al., 2021; Wang et al., 2022; Goodman et al., 2021; Tóth-Király et al., 2022). Similarly, our findings also show that GBL is still able to improve academic performance but not significantly compared with other methods. This could be because GBL could be affected by other factors that could improve performance significantly.

One of the reasons that the performance is not significant is that it needs a long-term educational intervention. In order to gain a comprehensive understanding of the complex connection between education and academic achievement, particularly in regard to the impact of GBL hence a longitudinal methodology is essential (Farrington, 1991). Similarly, the

study's participants, representative of Generation Z, who are familiar with technology and exhibit comfort in its usage, require extended exposure to GBL to fully uncover its potential benefits. This is because simply observing short-term variations in academic performance may not be enough to fully uncover GBL's potential. Undertaking intervention studies of extended duration is key to developing a deeper comprehension of how GBL influences academic success over time. These studies help researchers understand how GBL's influence on learning outcomes changes over time. Therefore, researchers can better understand its role in shaping students' academic achievements by tracking the sustained influence of GBL.

Besides that, insufficient time to process the knowledge is another possible reason that will affect the performance. When the student is given sufficient time for GBL intervention, they may be able to effectively memorize the knowledge. As our study was limited by time constraints, and we were unable to establish whether GBL can effectively enhance memory and academic performance. Previous research has shown that GBL has the potential to improve various types of memory, such as long-term memory and working memory (Tareq et al., 2018; Murphy et al., 2023). GBL interventions may have a gradual impact on memory, and prolonged exposure could enhance academic performance (Nadel et al., 2012). Thus, it is important for longitudinal research to explore deeper into the impact of memory on academic performance to gain a more comprehensive understanding. Therefore, this will make it a promising area that deserves further investigation in longitudinal research. As it allows for a more comprehensive exploration of how GBL affects memory processes which could result in improved academic performance.

Other than that, even though most of the participants are familiar with technologies but some of the participants may not be suitable for the GBL learning experience. This is another critical factor that influencing the effectiveness of GBL as the participants' proficiency in game operations and their ability to navigate the learning environment

independently (Kaneko et al., 2018). Some students may require additional support and scaffolding to learn the mechanics of the game fully and obtain the educational benefits from the experience (Che & Law, 2016). Even though we provided a game tutorial before they went through GBL, it seems that the limited time of this experiment can greatly affect GBL's effectiveness for these individuals (Gabriel, 2019). Therefore, it is important to highlight that participants' prior gaming experience and technical competence should be considered when implementing GBL interventions.

Furthermore, the gender distribution in our study suggests that perceived competence in GBL may be influenced by gender and may not significantly affect academic performance. With a notable gender imbalance, where 55.56% of participants are female, it becomes apparent that gender-related factors may contribute to variations in performance outcomes. Previous research suggests that females tend to exhibit lower competence in video games (Veltri et al., 2014). This may be because females often perceived video games as less socially diverse than social media, which they found to be more interactive and engaging (Leonhardt & Overå, 2021). This gender disproportion could potentially impact the overall competence levels within the GBL setting. When interpreting performance outcomes, it is important to consider gender related. This requires recognizing individual differences that may extend beyond the educational interventions themselves and acknowledging their potential influence.

Next, the design and content of a game are also other factors influencing GBL’s educational effectiveness. To achieve optimal educational outcomes, it is essential that the game's design aligns with academic objectives (Alaswad, 2022). Since we have limited experience in designing such games, hence the overall quality of the game is conducive to learning (Frossard et al., 2015). When students are not provided with clear and concise information from the game, it can be difficult for them to understand how to use what they

have learned in practical settings. For example, when an individual processes unclear content, they will require more mental effort and divert attention away from the intended learning objectives. This increased cognitive load not only hinders the efficiency of information processing but also diminishes the overall effectiveness of the learning experience (Sepp et al., 2019). As a result, it is important to ensure that information in the game is presented in a way that is easy to comprehend and apply in real-life scenarios. Therefore, the success of GBL largely depends on game design that fosters engagement, delivers relevant educational content, and aligns with academic objectives.

Finally, learning style is also another reason that contributes to insignificant in performance. There are many other learning methods like project-based learning, problem-based learning and others that could assist students to achieves higher academic performance. The reason for this is that every student has a unique way of learning, and their preferences and responses to different teaching methods depend on their individual learning styles (Shorey et al., 2021). As research shows that first year university students have a significant relationship between learning methods and performance (Hanawi et al., 2022). Even though our study has the second largest sample size of Year 1 students, but it is not evenly distributed with other. The differing levels of representation across academic years may introduce a confounding element that should be taken into account when interpreting the study's findings. Similarly, another research also found that most undergraduate students belonging to the Gen Z demographic prefer a learning approach that incorporates multiple modes of instruction (Nathasha et al., 2022). Therefore, the use of GBL alone may not lead to significant performance improvement in students.

In conclusion, our study investigates the impact of GBL on student performance, revealing no significant differences compared to other learning methods. However, these results should be interpreted cautiously as the absence of statistical significance doesn't

reduce GBL's potential to enhance academic performance, as indicated by previous research significantly. Despite not achieving statistical significance, GBL demonstrates the capacity to influence performance positively. The need for extended educational interventions becomes apparent, with a longitudinal approach essential to fully comprehend GBL's impact on academic achievement over time. Furthermore, the study highlights GBL's potential to enhance memory and academic performance, calling for further exploration of specific cognitive abilities influenced by GBL. Additionally, participant suitability emerges as a crucial factor, emphasizing the importance of considering prior gaming experience and technical competence when implementing GBL interventions. Lastly, the success of GBL is intricately tied to thoughtful game design that aligns with academic objectives, fostering engagement and delivering relevant educational content.

5.2 GBL and Motivation

The results of our study provide significant evidence supporting the hypothesis (H2) that increased engagement with GBL can enhance student motivation. Our findings align with prior research that also shows GBL's positive impact on student motivation (Mei, 2007; Cao et al., 2019). In our study, we observed a significant increase in students' motivation and reinforced that GBL is an effective educational approach to stimulate and enhance students' engagement and enthusiasm for learning. The consistency of our results with previous studies strengthens the reliability of the findings and indicates the potential of GBL to influence student motivation positively across diverse educational settings.

5.2.1 GBL effect on competence

The impact of GBL on competence is evident in the study, aligning with the principles of SDT. Success and learning from failure within the game contribute significantly to a sense of competence among participants. This enhanced sense of competence is closely linked to intrinsic motivation, as individuals who perceive themselves as competent in a task are more likely to be intrinsically motivated to engage in that task (Santucci et al., 2012). This study also highlights that feeling like an individual is learning can be a crucial aspect of intrinsic motivation as an indicator of perceived competence. Therefore, this aligns with existing research, which supports the idea that activities promoting perceived competence can boost intrinsic motivation (Rani et al., 2019).

On the other hand, the results of our study showed that participants who prefer traditional learning methods may perceive GBL approaches as a sign of competence, thus it will lead to a diverse set of responses. The preference for different learning methods could be influenced by individual differences among students. For instance, previous research has indicated that females tend to have lower levels of video game competence than males (Kelly

et al., 2023), which is an important factor to consider since our study had a higher proportion of female participants in the experimental group. This could potentially affect their perception of competence within the GBL context. The interplay between individual preferences, diverse learning methods, and gender-related factors adds complexity to our study's interpretation of competence outcomes.

At the same time, it is possible that participants who held a neutral stance may not inherently oppose GBL, but rather, they may not strongly endorse it as their preferred learning method. This neutrality can be attributed to various factors, such as individual learning styles, prior experiences, or expectations. Recognizing this diversity in perspectives and accommodating them in educational interventions is important. Thus, A mixed-method intervention which combining elements of both GBL and traditional methods, could be a potential strategy to cater to the diverse preferences and attitudes within the participant population and enhance their competence in learning (Wijoyo et al., 2023). It has been proven to be an effective teaching method for students of all genders. Research has shown that there are no significant differences in the academic performance of males and females who engage in blended learning (Kintu et al., 2017). Therefore, this approach could lead to a more inclusive and effective educational approach, ultimately benefiting all participants.

Furthermore, the study's findings also show the positive influence of GBL on students' self-assurance and competence. This underscores the significance of feeling effective and proficient in engaging tasks (Gulsum et al., 2023). The demonstrated potential of GBL to increase students' self-assurance aligns with the concept of competence and positively impacts learners' self-evaluation of their skills (Lena et al., 2022). As our findings also shows that all of the participants express positive attitude towards the learning experience and learning from failure. We believe that through GBL, students perceive a sense of proficiency and contribute to their drive for personal growth, which closely aligns with the competence

element and highlights the role of GBL in fostering a supportive environment that positively influences students' self-perception of their abilities. It accentuates the importance of competence in cultivating intrinsic motivation and reinforcing the positive impact of innovative learning approaches on students' educational experiences (Luarn et al., 2023).

Through the study, we've gained valuable insights into the positive impact of GBL on the development of competence, which is in line with the principles of. The research findings suggest that success, learning from failure, and perceived competence all play key roles in promoting intrinsic motivation, highlighting the significant value of GBL in promoting a sense of competence and confidence among learners.

5.2.2 GBL effects on relatedness

When examining the impact of GBL on Relatedness, it's important to acknowledge the value of real-life illustrations in motivating learners. By integrating components that align with what students are studying, GBL enriches their comprehension and involvement (Cao et al., 2019; Arbuckle, 2021; Bondioli et al., 2019). For instance, our study's escape room activity offers participants an opportunity to explore clues and observe the room owner's personality. This simulation emulates a real-life situation where individuals gather information to predict others' personalities hence it is important to carefully design game content to establish meaningful and engaging associations.

In addition, our research aligns with previous studies that have emphasized the beneficial impact of GBL on participation rates (Zhang et al., 2022). Our own findings indicate that participants' enjoyment and positive emotions towards their involvement in the session are linked to the social aspect of relatedness. This indicates that GBL supports a sense of community and interpersonal connection within the learning environment, creating an encouraging and positive environment. Research also indicates that GBL effectively enhances

first-year university students' motivation and peer engagement during their transition to a university setting (Balakrishna et al., 2023). Our study, which included a substantial number of first-year students, connecting these findings by providing empirical evidence that GBL indeed contributes to improving motivation among this student. The transition to university life can be challenging for first-year students, and the positive impact of GBL on their motivation and social interaction underscores its potential as a supportive and engaging educational approach during this critical phase of academic development. Therefore, these social interactions can significantly shape the overall learning experience, promoting collaboration and providing students with a supportive network.

other than that, the integration of relevant learning content within GBL plays an important role in enhancing motivation. When GBL incorporates content that is perceived as meaningful and applicable to real-world contexts, it fosters a sense of relevance for the learners (Meng & Hsin, 2021). This connection between the content presented in GBL and its real-life implications. As supported by Kember et al. (2008), research indicates that delivering relevant learning material has a positive influence on motivation. It is worth mentioning that a significant number of our participants specialize in arts and social sciences. In these fields, the concepts of Big 5 theory from GBL hold great significance in their academic curriculum. This customized relevance has a positive impact on participants' motivation levels. Therefore, when GBL succeeds in delivering learning material that is perceived as relevant by students, it is likely to contribute to increased motivation as students recognize the applicability and significance of the content to their academic and real-world experiences.

In summary, the impact of GBL on Relatedness extends beyond the utilization of real-life examples to cultivate a socially engaging learning environment. The integration of real-world scenarios increases the authenticity of the learning experience, while the social

component fosters a sense of community that positively affects motivation and participation. These findings underscore the multifaceted nature of GBL, not only as a means for acquiring knowledge but also as a platform for establishing meaningful connections and nurturing a collaborative learning culture.

5.2.3 GBL effects on autonomy

The impact of GBL on autonomy is evident in the results, aligning with findings from previous research (Perez et al., 2022; Grasse et al., 2022; Greipl et al., 2020). Providing students with the freedom to explore within a game and empowering them to determine their own learning objectives and paths fosters a sense of ownership throughout the educational process. Our experiment aligns with these principles, as participants were granted the freedom to investigate an escape room for clues while simultaneously learning about the Big 5. This approach encourages exploration and affords students the ability to make mistakes within a game-based learning environment, thereby enhancing motivation.

Other than that, the study supports the idea that GBL can increase students' attention, which is one of the key elements of autonomy. One of the reasons that it can increase motivation is because it can help students perceive the relevance and meaningfulness of learning content (Keller, 1987). In GBL context, the external focus of attention, like real-life contexts and interactive engagement can increase motivation. Similarly, research also indicate that external focus is useful in maintaining attention to the task goal and mitigating distractions and improving autonomy (Lewthwaite & Wulf, 2017). Our result shows that participants overwhelmingly agreed that GBL positively influences their attention by highlighting the importance of attention to autonomy (Yu & Tsuei, 2022). Therefore, when the student is actively paying attention to learning materials or tasks, it signifies a self-driven engagement with the content, indicating autonomous motivation. This finding resonates with

previous studies which emphasize the positive impact of GBL on attention and its connection to autonomy (Huangm, 2011; Jääskä et al., 2022; Tsai et al., 2016).

Besides that, GBL can improve focus due to its engaging and entertaining elements. Our study has shown that learners experience an increase in interest when using GBL, suggesting that it provides them with motivation and choice during the learning process (Harackiewicz et al., 2016). To ensure that student engagement remains high, game design should include a moderate level of challenge, as games that are too easy can demotivate learners. This is supported by previous research which highlights the importance of captivating and entertaining GBL content in enhancing motivation through visualization and interaction (Triantafyllou & Sapounidis, 2023; Xiang, 2022). Learners who are attentive and engaged are more likely to feel a sense of autonomy and be motivated to learn, as they perceive the learning process to be interesting, enjoyable, and personally relevant.

Furthermore, the study acknowledges that expressing a preference for other methods over GBL indicates a desire for autonomy in choosing one's learning approach. This reinforces the notion that autonomy is a crucial aspect of motivation, and GBL can play a significant role in providing learners with choices and control over their learning experiences.

5.3 Implication of the study

5.3.1 Theoretical implication for future research

Theoretical implication for future research refers to the impact of research results on future theoretical development in related fields. Escape room games as learning tools are based on the theoretical framework of gamification education. This type of selection is based on the positive impact of games on improving student engagement, stimulating interest in learning, and promoting teamwork. According to Sailer and Homner (2019), this reflects the core view in gamification theory that game elements can improve learning effects. In our study, we designed an escape room and used game learning methods to allow participants to learn BIG-5 Personality from the game. For example, students are locked in a virtual escape room. In order to successfully escape, they need to understand the knowledge points of BIG-5 Personality. Therefore, future research can further explore the relationship between cognitive load and game difficulty. By analysing students' performance in GBL, we can better understand the impact of game difficulty on cognitive load and provide theoretical guidance for designing games that are more in line with students' cognitive levels.

Other than that, the findings also can contribute valuable insights for researchers aiming to explore the integration of GBL within diverse educational frameworks. The results indicate that the importance of recognizing that not all students exhibit a preference for GBL. As a result, this insight prompts future researchers to delve into the intricate dynamics of student preferences and learning styles within blended learning environments. Our study has resulted in a theoretical framework that suggests scholars investigate the relationships between GBL and different learning approaches, as it is recognized that there are different preferences from students. Therefore, future studies can contribute to the ongoing evolution

of blended learning models, fostering environments that cater to the multifaceted needs and preferences of students.

Additionally, investigating the interaction between individual differences in learning styles and the effectiveness of GBL could provide a richer understanding of the dynamics at play. Future research could explore how to better adapt to different students' learning styles and ability levels through personalized design of learning content. However, with the help of advanced technology, future research can examine the impact of personalized learning paths on students' learning effectiveness and motivation to promote a more personalized game learning experience. For example, understanding students' interaction patterns, information sharing, and team dynamics during collaborative puzzle solving will help to utilize social learning theory better and enhance the social dimension of GBL (Adipat et al., 2021).

Furthermore, this study highlights the importance of considering motivational factors in educational interventions, prompting future researchers to explore the interplay between motivation, learning environments, and academic achievement. Take the incentive mechanism of gamification theory as an example. Stimulate student interest and motivation by designing challenging tasks and providing real-time feedback. In gamified education, students are usually designed to stimulate their interest in learning through various challenges and rewards. This emphasis on motivation helps increase student engagement. Therefore, future researchers could begin to focus on the interplay between motivation, learning environment, and academic performance. According to Anderson et al. (2018), motivational factors may be affected by educational interventions and learning environments, which in turn may directly or indirectly affect students' academic performance.

5.3.2 Practical implication for programs and policies

Gamification is the introduction of game design elements and mechanics into non-game environments to stimulate participant interest, increase engagement, and achieve specific learning goals. In the GBL method for university students, educators can use gamification principles to design learning activities, tasks, and assessments.

The practical implications of this study extend to the development and implementation of educational programs and policies. Firstly, educators and curriculum developers can consider integrating GBL elements into teaching methodologies, capitalizing on its demonstrated positive impact on student performance and motivation. In our study, we design GBL where the practical application of games can inspire students' active participation and active learning. By creating a challenging and interesting game environment, students become more proactive in the puzzle-solving process and are more willing to invest time and energy in solving problems (Anunpattana et al., 2021). This is of practical help in improving students' learning performance and motivation. For example, in an escape room, participants need to solve various puzzles to find the corresponding clues and learn the BIG-5 Personality that involved. However, students are faced with a variety of puzzles and problems that require creative thinking and logical reasoning to solve the problems. Through deciphering and solving puzzles, they can exercise their ability to solve problems in complex situations.

In addition, GBL courses should be designed to provide the best balance of challenge and complexity, ensuring students are engaged without feeling overwhelmed. It requires students to solve a series of complex problems, this strengthens practical problem-solving and creative thinking skills. In the process of GBL, students need to flexibly use a variety of knowledge and skills to develop their adaptability when facing real-life problems. At the same time, it also breaks the traditional academic environment and provide students with a

relaxing learning experience (León et al., 2021). While students relieve stress in the game, they can also improve their self-confidence by successfully solving puzzles. Therefore, GBL can have a positive impact on the mental health of university students, such as reducing academic stress.

On the other hand, educational institutions may also consider integrating GBL into broader educational policies to foster a more interactive and dynamic learning environment. This integration can be viewed as a proactive step toward embracing innovative pedagogical approaches that cater to the diverse learning preferences of students. When educators conduct solely GBL, it can cause students to experience learning fatigue. GBL has the potential to initially captivate students' interest and foster engagement. However, frequent use of this approach may result in a decline in its effectiveness due to the onset of fatigue and reduced motivation among students (Maloney et al., 2023). Similarly, policymakers also play a crucial role in endorsing and supporting initiatives that advocate for the integration of GBL within educational frameworks. They may find value in supporting initiatives that promote the integration of GBL, recognizing its potential to enhance the overall educational experience.

Finally, exploring factors aligned with the intrinsic motivation of GBL in grading systems could further optimize its effectiveness. By integrating GBL elements into grading structures, educators can potentially optimize the motivational aspects of GBL. This integration may involve recognizing and rewarding achievements within GBL experiences, thereby reinforcing students' engagement and motivation. Exploring these intersections between GBL and traditional grading systems can contribute to refining the effectiveness of GBL as an educational tool. Overall, this research holds practical implications for educators, curriculum designers, and policymakers in elevating the quality and effectiveness of educational initiatives.

Through the practical application of escape room game, educators can introduce innovative elements into teaching, increase students' enthusiasm, cultivate practical application skills, and create a more interesting and in-depth learning experience. This has practical and far-reaching implications for promoting innovation in educational methods and meeting the diverse learning needs of students.

5.4 Limitation

There are some limitations that need to be acknowledged that may affect the results of the current study. First, the major limitation of this study is time constraints. Gamified learning may require more time to complete, and due to time constraints, sufficient time cannot be allocated to gamified learning. Therefore, the generalizability of the research results is also affected to a certain extent. We were unable to find other participants within a short period of time, so all participants recruited for the current study were Chinese UTAR students around us.

The second limitation of GBL is contextual factors. The context of the study may introduce a range of variables that may influence the results, including whether individuals have previous exposure to GBL and varying levels of access to technology. These background factors may lead to differences in students' performance in game learning environments and affect their learning effects. Therefore, these factors need to be carefully considered when designing and interpreting game-based learning studies to ensure the reliability and validity of the results.

Third, the limitation of the GBL approach concerns the measurement of motivation. The motivation scale used in this study may not comprehensively cover all motivation factors related to GBL. Future research could consider employing a more comprehensive set of motivational measures to provide a nuanced understanding of the different motivational aspects involved. This helps to reveal students' motivational driving forces more fully in GBL environments, thereby improving the design and implementation of game-based learning methods.

The final limitation of this research is the relatively small sample size. The sample size of our study was relatively small, consisting of only 36 participants. This may affect the

statistical power of the study, making it less capable of detecting subtle effects or associations. To ensure the broad applicability of our findings, a more extensive and diverse sample would be required. As a result, we recommend exercising caution when attempting to apply the results beyond the specific group studied. In the interest of developing a more comprehensive understanding of the subject, future research with larger and more diverse samples would be advantageous.

5.5 Recommendations for future research

The first recommendation for future research is to conduct longitudinal research. Longitudinal research methods can track the progress of students' performance and motivation over a longer period. Thus, it can provide a more comprehensive and in-depth understanding of research. Through the research, it can provide a more detailed understanding of the efficacy of this approach in enhancing students' academic performance and engagement. In conclusion, longitudinal research is a powerful method that can compensate for the disadvantages of short-term research. Similarly, it will be able to provide more comprehensive and in-depth insights and help understand the effects of game-based learning methods more comprehensively.

Second, future research can explore individual differences more. Use questionnaires to collect information about students' learning styles, interests, previous gaming experiences, and others. This can help researchers understand individual differences quantitatively and provide a basis for subsequent research. In addition, surveys can also be designed, or existing gaming experience scales can be used to understand students’ experiences, preferences, and skill levels in the gaming field. This helps predict students' adaptability and performance in GBL environments.

At the same time, exploring individual differences such as learning styles and prior gaming experiences is an effective way to address contextual factors in GBL methods. Studying how individual differences interact with the effects of GBL can provide an in-depth understanding of individual students' differences, thereby tailoring educational interventions to meet their needs better. After that, researchers can personalize GBL courses based on students' learning styles and previous gaming experiences. Additionally, understanding individual student differences can help provide educators with customized recommendations and interventions for different student groups. This enables educators to support students and improve teaching effectiveness more specifically.

Next, validation of the motivation scale is another recommendation that can be conducted. Future research could focus on validating and refining the motivation scale used in this study. Ensuring that the scale accurately captures the different dimensions of motivation associated with GBL will improve the reliability and validity of future studies using similar measures.

Finally, in order to address the limitations of a relatively small sample size, it may be beneficial for future research efforts to expand the participant pool to encompass a more diverse and representative group. By increasing the sample size, researchers can not only improve the statistical power of their study but also conduct more nuanced analyses and gain a deeper understanding of potential variations across different demographic groups (Serdar et al., 2021). Therefore, it is recommended to form collaborations with multiple educational institutions can provide access to a broader participant base, resulting in a more comprehensive representation of the target population. Such an approach would enhance the external validity of the findings and strengthen the generalizability of research outcomes.

5.6 Conclusion

In conclusion, our study has provided valuable insights into the impact of GBL on both student performance and motivation. While the results regarding performance did not reveal significant differences between GBL and other learning methods, it is important to interpret these findings with caution. The absence of statistical significance does not deny GBL's potential to enhance academic performance. Our study suggests that factors such as the need for extended educational interventions, time constraints, participant suitability, gender-related influences, and game design intricacies may contribute to the nuanced outcomes.

Next, the need for a long-term educational intervention is emphasized, highlighting the importance of a longitudinal approach to fully comprehend GBL's influence on academic achievement over time. Additionally, the study points to the significance of participant suitability, emphasizing the consideration of prior gaming experience and technical competence when implementing GBL interventions.

Furthermore, the gender distribution in the study suggests potential gender-related influences on GBL's effectiveness, as previous research indicates variations in video game competence between genders. The importance of thoughtful game design is emphasized, underlining the need for clarity and relevance in delivering educational content within the game to maximize its impact on learning outcomes.

In contrast, the study revealed significant positive effects of GBL on student motivation. The relationship with SDT principles showcases the impact of GBL on competence, relatedness, and autonomy. The study's findings emphasize the positive influence of GBL on students' sense of competence, self-assurance, and engagement with learning tasks. Additionally, the integration of real-world scenarios within GBL enhances

relatedness, fostering a sense of community and interpersonal connection among participants. At the same time, the autonomy afforded by GBL, allowing students to explore and make choices within the game, contributes to a heightened sense of ownership and motivation.

Finally, our study recognizes the multifaceted nature of GBL, not only as a tool for acquiring knowledge but also as a platform for establishing meaningful connections and nurturing a collaborative learning culture. The findings provide practical implications for educators, curriculum designers, and policymakers, emphasizing the need for tailored interventions with multiple other learning approaches. Other than that, it also important to consider individual differences, prior experiences, and preferences to enhance both academic performance and motivation when designing the intervention.

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Appendix A1

G Power Calculation

Correlation among construct scores

	Mean	SD	ES	SS	SE	LM	LP
ES	2.00	0.95	**0.846**				
SS	3.85	0.94	-0.070	**0.824**			
SE	3.04	0.99	-0.223	0.164	**0.757**		
LM	3.42	1.02	-0.413	0.198	0.458	**0.813**	
LP	3.17	0.99	-0.242	0.185	0.736	0.606	**0.743**

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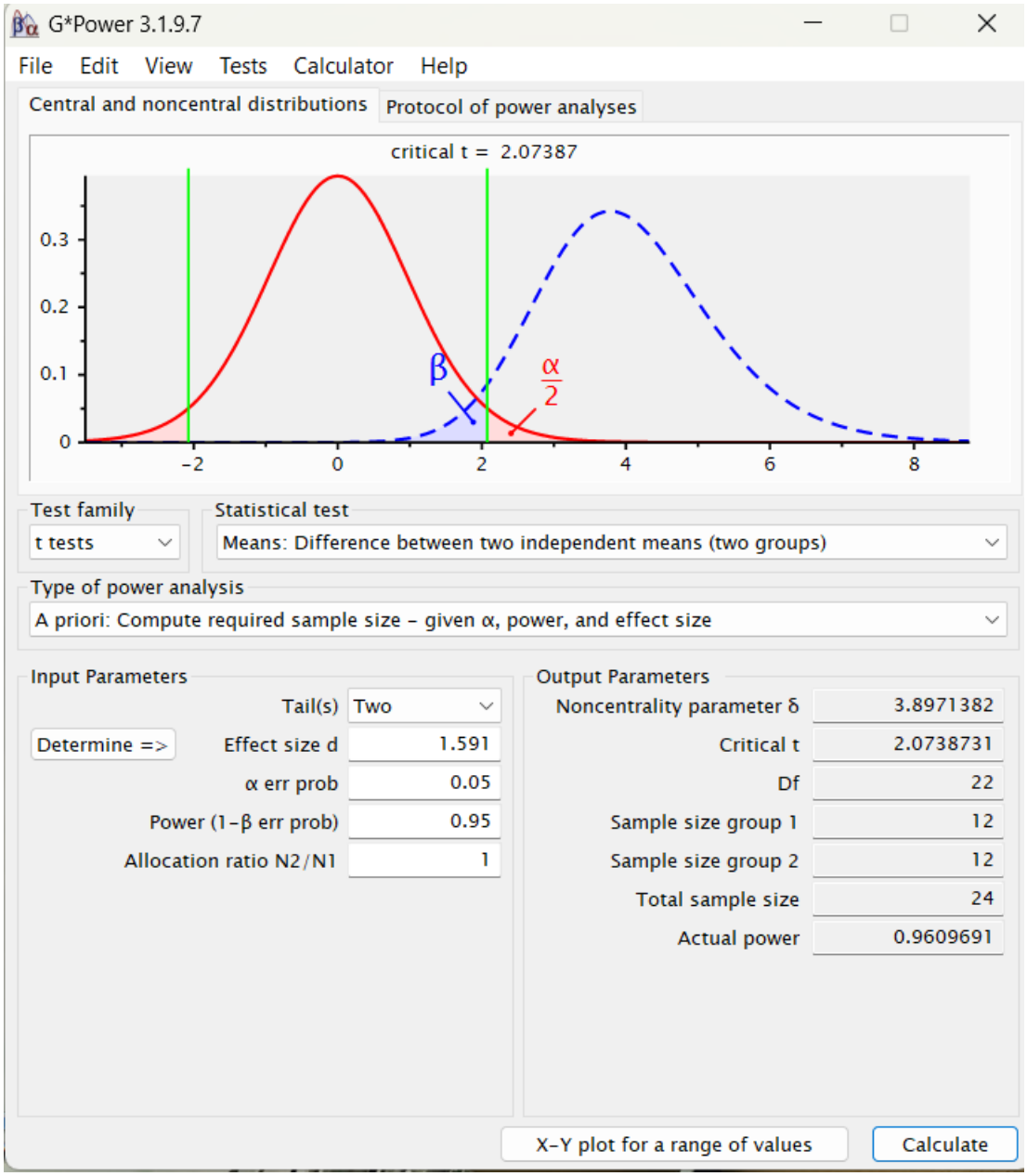
$$f^2(motivation) = \frac{(0.813)^2}{1-(0.813)^2} = 1.95$$

$$f^2(performance) = \frac{(0.743)^2}{1-(0.743)^2} = 1.232$$

$$f^2 = \frac{1.95 + 1.232}{2} = 1.591$$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Central and noncentral distributions
Protocol of power analyses
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Test family
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Statistical test
Means: Difference between two independent means (two groups)
Type of power analysis
A priori: Compute required sample size – given α, power, and effect size
Input Parameters
Tail(s) Two
Determine =>
Effect size d 1.591
α err prob 0.05
Power (1−β err prob) 0.95
Allocation ratio N2/N1 1
Output Parameters
Noncentrality parameter δ 3.8971382
Critical t 2.0738731
Df 22
Sample size group 1 12
Sample size group 2 12
Total sample size 24
Actual power 0.9609691
X-Y plot for a range of values
Calculate

Appendix A2

Learning material

Big-5 Materials

The Big-5 theory began with the research of D. W. Fiske (1949) and was later expanded by others. The Big 5 personality traits are extraversion, agreeableness, openness, conscientiousness, and neuroticism.

Extraversion is sociability, agreeableness is kindness, openness is creativity and intrigue, conscientiousness is thoughtfulness, and neuroticism often involves sadness or emotional instability. They can be memorized using the acronym **OCEAN**.

It is important to note that each of the five primary personality traits represents a range between two extremes.

Neuroticism

- Places people according to their emotional stability and personal adjustment
- High - People with high scores are more vulnerable to anxiety and depression
- Low - Individuals with low scores tend to be calm and well adjusted

Extraversion

- Places extreme extraverts at one end and extreme introverts at the other
- High - Extraverts are very sociable people
- Low - Introverts are reserved and independent people

Openness

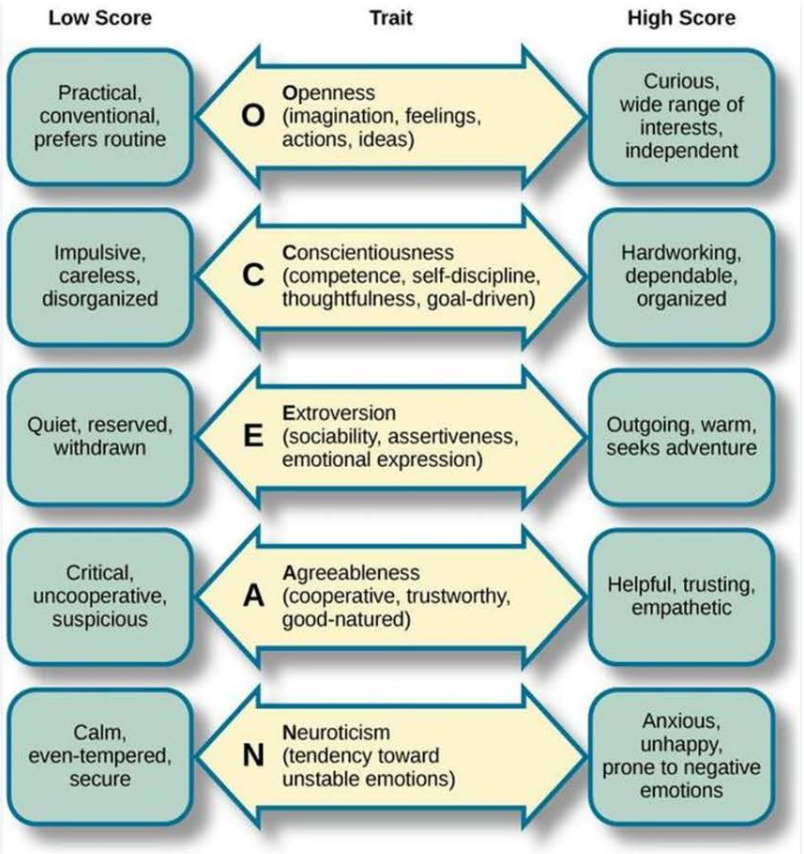
- Involves active imagination, divergent thinking, and intellectual curiosity
- High - People on the high end are unconventional and independent thinkers
- Low - Individuals on the low end prefer the familiar rather than the imaginative

Agreeableness

- Reflects the degree of harmony with others and society.
- High - People with high scores are helpful, trusting, and sympathetic
- Low - Individuals with low scores tend to be antagonistic and skeptical

Conscientiousness

- High - People on the high end are organized, plan oriented, and determined
- Low - Individuals on the low end are careless, easily distracted from tasks, and undependable
- Referred as will to achieve or simply work



Appendix A3

Proposed Pre & Post-Test Questions

1. Individuals who are organized, responsible, and goal-oriented tend to score high on which trait?
    a) Extraversion
    b) Neuroticism
    c) Openness
    d) <u>Conscientiousness</u>
2. Which trait is associated with being sympathetic, compassionate, and cooperative?
    a) Extroversion
    b) Conscientiousness
    c) <u>Agreeableness</u>
    d) Openness to Experience
3. Which trait represents a tendency to be independent, self-reliant, and self-confident?
    a) Agreeableness
    b) Openness to Experience
    c) <u>Extroversion</u>
    d) Neuroticism
4. People who are warm, friendly, and cooperative tend to score high on which trait?
    a) Conscientiousness
    b) Neuroticism
    c) <u>Agreeableness</u>
    d) Extroversion
5. Which trait reflects a preference for routine, structure, and organization?
    a) Extroversion
    b) Neuroticism
    c) <u>Conscientiousness</u>
    d) Openness to Experience

6. Which of the following personality traits reflects emotional stability and personal adjustment?
    a) Extraversion
    b) Agreeableness
    c) Openness
    d) <u>Neuroticism</u>
7. People with high scores in neuroticism are more susceptible to:
    a) Creativity and intrigue
    b) <u>Anxiety and depression</u>
    c) Being organized and determined
    d) Antagonism and skepticism
8. Individuals with low scores in agreeableness are more likely to be:
    a) Helpful, trusting, and sympathetic
    b) <u>Careless, easily distracted, and undependable</u>
    c) Unconventional and independent thinkers
    d) Calm and well-adjusted
9. Individuals with high scores in extraversion are characterized by being:
    a) Careless and undependable
    b) Reserved and independent
    c) Organized and plan-oriented.
    d) <u>Sociable and outgoing</u>
10. People with high scores in openness are more likely to:
    a) Be reserved and independent.
    b) Prefer the familiar rather than the imaginative
    c) Be organized, plan-oriented, and determined.

d) Exhibit active imagination and intellectual curiosity

11. Which personality trait reflects the degree of harmony with others and society?

a) Neuroticism

b) Extraversion

c) Agreeableness

d) Conscientiousness

12. People with low scores in conscientiousness are more likely to be:

a) Anxious and depressed

b) Careful and detail-oriented

c) Helpful, trusting, and sympathetic

d) Careless and easily distracted from tasks.

13. Individuals with high scores in agreeableness are more likely to be:

a) Reserved and independent

b) Unconventional and independent thinkers

c) Helpful, trusting, and sympathetic

d) Calm and well-adjusted

14. People with low scores in openness prefer:

a) Familiarity over imagination

b) Being sociable and outgoing

c) Being organized and plan-oriented

d) Being creative and intrinsically motivated

15. The Big Five personality traits were first researched by:

a) D. W. Fiske

b) Sigmund Freud

c) Carl Jung

d) Abraham Maslow

Appendix A4

Motivation Scale

The motivation scale that we use to measure motivation is proposed by Jääskä and his colleagues (2022) based on Keller's ARCS model.

	Survey statement **Construct**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1	I think learning from gaming was fun and exciting.					
2	I think I learned from my success and failure in the game.					
3	I prefer other learning methods over game-based methods. **(R)**					
4	I understand what kind of real-life situations the game simulated.					
5	There was not enough challenge and complexity in the game. **(R)**					
6	I felt like learning.					

7	It is apparent to me how to use the learnings from this gameplay.					
8	I felt gaming stressful. **(R)**					
9	The game increased my interest in learning new knowledge.					
10	The game motivated me to progress and get better.					
11	I enjoyed participating in this game-based learning session.					
12	The narrative and game environment were disconnected from reality. **(R)**					
13	I could apply the theory that was learnt previously in the gameplay.					
14	I wouldn't like to be graded according to my game result. **(R)**					
15	The game content and flow captured my attention.					

16	Learning the game rules and mechanics felt frustrating. **(R)**					

R= Reverse items

Appendix A5

Ethical clearance

UNIVERSITI TUNKU ABDUL RAHMAN DU012(A)
Wholly owned by UTAR Education Foundation Co. No. 578227-M

Re: U/SERC/258/2023

9 October 2023

Dr Pung Pit Wan
Head, Department of Psychology and Counselling
Faculty of Arts and Social Science
Universiti Tunku Abdul Rahman
Jalan Universiti, Bandar Baru Barat
31900 Kampar, Perak.

Dear Dr Pung,

Ethical Approval For Research Project/Protocol

We refer to the application for ethical approval for your students' research project from Bachelor of Social Science (Honours) Psychology programme enrolled in course UAPZ3013/UAPZ3023. We are pleased to inform you that the application has been approved under Expedited Review.

The details of the research projects are as follows:

No	Research Title	Student's Name	Supervisor's Name	Approval Validity
1.	Academic Socialization in Tertiary Learning: Exploring the Experiences of UTAR University Students and Coping Strategies	1. Chew Chun Xian 2. Lyu Te 3. Quennie Bong Hui Wen	Dr Chie Qiu Ting	9 October 2023 – 8 October 2024
2.	The Effect of Game-Based Learning on Performance and Motivation of University Students: An Exploratory Study	1. Liew Vui Seong 2. Zou Cheng 3. Ting Man Ling	Ms Sanggari a/p Krishnan	

The conduct of this research is subject to the following:

(1) The participants' informed consent be obtained prior to the commencement of the research;

(2) Confidentiality of participants' personal data must be maintained; and

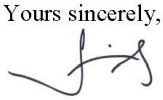
(3) Compliance with procedures set out in related policies of UTAR such as the UTAR Research Ethics and Code of Conduct, Code of Practice for Research Involving Humans and other related policies/guidelines.

(4) Written consent be obtained from the institution(s)/company(ies) in which the physical or/and online survey will be carried out, prior to the commencement of the research.

Should the students collect personal data of participants in their studies, please have the participants sign the attached Personal Data Protection Statement for records.

Thank you.

Yours sincerely,



Professor Ts Dr Faidz bin Abd Rahman
Chairman
UTAR Scientific and Ethical Review Committee

c.c Dean, Faculty of Arts and Social Science
Director, Institute of Postgraduate Studies and Research

Kampar Campus : Jalan Universiti, Bandar Barat, 31900 Kampar, Perak Darul Ridzuan, Malaysia
Tel: (605) 468 8888 Fax: (605) 466 1313
Sungai Long Campus : Jalan Sungai Long, Bandar Sungai Long, Cheras, 43000 Kajang, Selangor Darul Ehsan, Malaysia
Tel: (603) 9086 0288 Fax: (603) 9019 8868
Website: www.utar.edu.my

Appendix A6

Personal Data Protection Notice

PERSONAL DATA PROTECTION NOTICE

Please be informed that in accordance with Personal Data Protection Act 2010 ("PDPA") which came into force on 15 November 2013, Universiti Tunku Abdul Rahman ("UTAR") is hereby bound to make notice and require consent in relation to collection, recording, storage, usage and retention of personal information.

1. Personal data refers to any information which may directly or indirectly identify a person which could include sensitive personal data and expression of opinion. Among others it includes:

   a) Name
   b) Identity card
   c) Place of Birth
   d) Address
   e) Education History
   f) Employment History
   g) Medical History
   h) Blood type
   i) Race
   j) Religion
   k) Photo
   l) Personal Information and Associated Research Data

2. The purposes for which your personal data may be used are inclusive but not limited to:

   a) For assessment of any application to UTAR
   b) For processing any benefits and services
   c) For communication purposes
   d) For advertorial and news
   e) For general administration and record purposes
   f) For enhancing the value of education
   g) For educational and related purposes consequential to UTAR
   h) For replying any responds to complaints and enquiries
   i) For the purpose of our corporate governance
   j) For the purposes of conducting research/ collaboration

3. Your personal data may be transferred and/or disclosed to third party and/or UTAR collaborative partners including but not limited to the respective and appointed outsourcing agents for purpose of fulfilling our obligations to you in respect of the purposes and all such other purposes that are related to the purposes and also in providing integrated services, maintaining and storing records. Your data may be shared when required by laws and when disclosure is necessary to comply with applicable laws.

4. Any personal information retained by UTAR shall be destroyed and/or deleted in accordance with our retention policy applicable for us in the event such information is no longer required.

5. UTAR is committed in ensuring the confidentiality, protection, security and accuracy of your personal information made available to us and it has been our ongoing strict policy to ensure that your personal information is accurate, complete, not misleading and updated. UTAR would also ensure that your personal data shall not be used for political and commercial purposes.

Consent:

6. By submitting or providing your personal data to UTAR, you had consented and agreed for your personal data to be used in accordance to the terms and conditions in the Notice and our relevant policy.

7. If you do not consent or subsequently withdraw your consent to the processing and disclosure of your personal data, UTAR will not be able to fulfill our obligations or to contact you or to assist you in respect of the purposes and/or for any other purposes related to the purpose.

8. You may access and update your personal data by writing to us at_____.

Acknowledgment of Notice

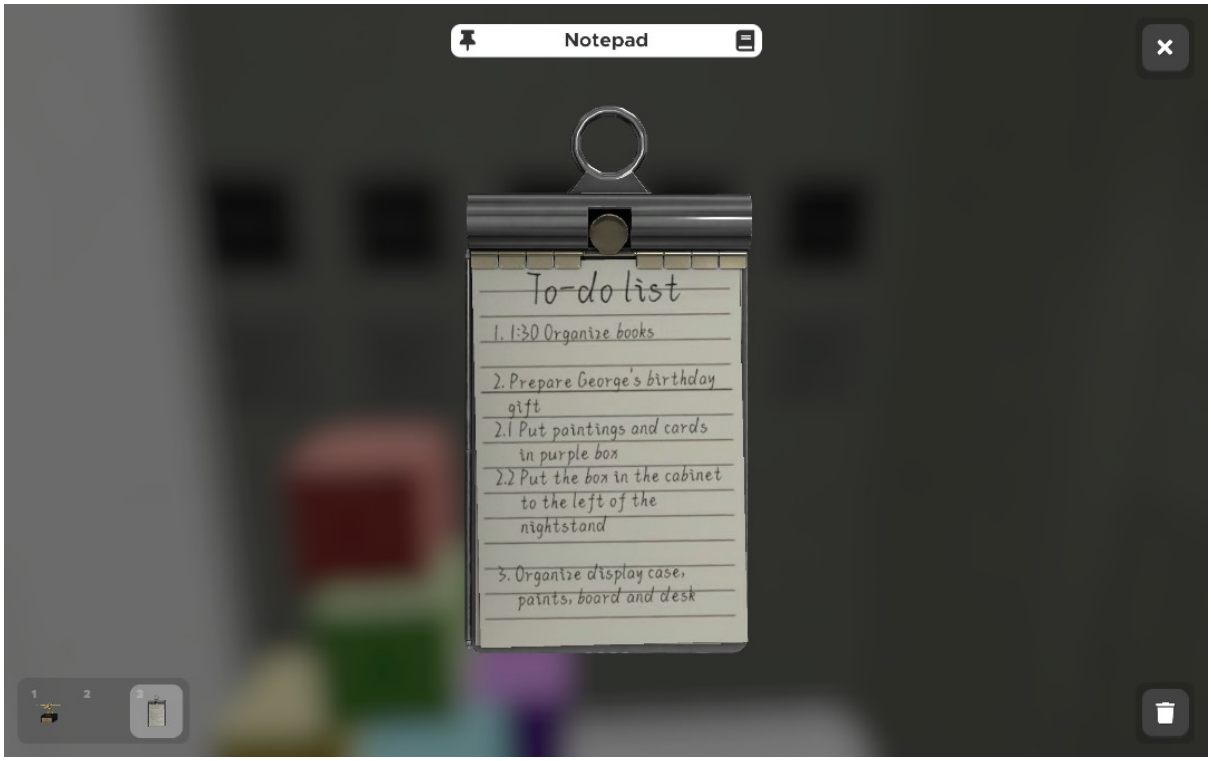
[ ] I have been notified and that I hereby understood, consented and agreed per UTAR above notice.

[ ] I disagree, my personal data will not be processed.

……
Name:
Date:

Appendix A7

In-game content

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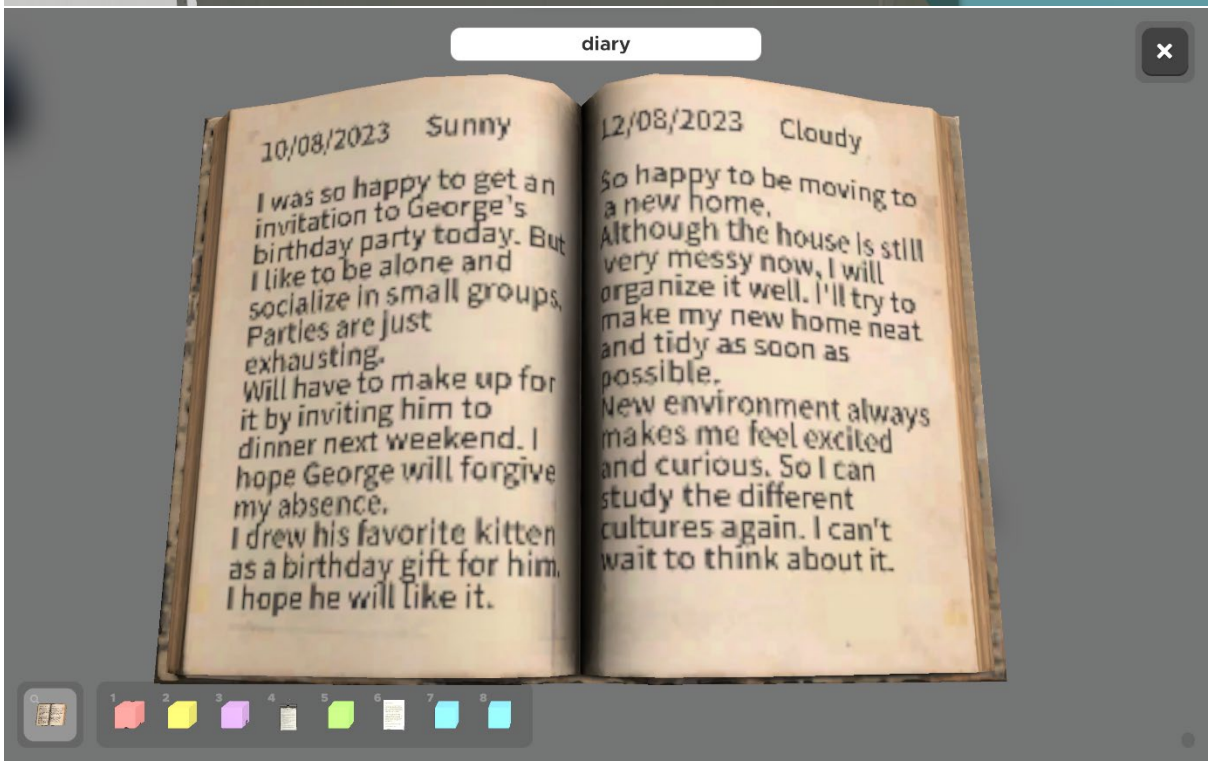

diary
10/08/2023 Sunny
I was so happy to get an invitation to George's birthday party today. But I like to be alone and socialize in small groups. Parties are just exhausting.
Will have to make up for it by inviting him to dinner next weekend. I hope George will forgive my absence.
I drew his favorite kitten as a birthday gift for him. I hope he will like it.
12/08/2023 Cloudy
So happy to be moving to a new home.
Although the house is still very messy now, I will organize it well. I'll try to make my new home neat and tidy as soon as possible.
New environment always makes me feel excited and curious. So I can study the different cultures again. I can't wait to think about it.


Helping Others Award!
This certificate is presented to
Alex
for
his selflessness in helping others
Great Job!
Date 07/July/2018
Certificate of Achievement
This certificate is proudly awarded to
Alex
SIGNATURE
SIGNATURE

Appendix A8

Participants gameplay

Link:

https://drive.google.com/file/d/1e5awcTd1IBk2s3wcVXat1KH7Sod__FN8/view?usp=sharing

Appendix A9

Consent Form

Title of Research Study: The Effect of Game Based Learning on Performance and Motivation of University Students: An Exploratory Study

1. Introduction:

Greetings. We are students from Bachelor of Social Science (HONS) Psychology, Faculty of Arts and Social Science, Universiti Tunku Abdul Rahman. You are invited to participate in a research study. Before you decide whether to participate, it is important for you to understand why the research is being done and what your participation will involve. Please take your time to read the following information carefully and feel free to ask any questions before making your decision.

2. Purpose of the Study:

The purpose of this research study is to examine the performance and motivation of game-based learning among Malaysian undergraduate students.

3. Procedures:

Participants will engage in an experimental session and will be presented with questionnaires to complete. The entire process is expected to last between 90 to 120 minutes.

4. Risks:

There are no known risks associated with participation in this study beyond those encountered in everyday life.

5. Confidentiality:

All information collected during this study will be kept strictly confidential. Your name and personal information will not be disclosed in any reports or publications resulting from this research. Data will be stored securely and will only be accessible to the research team.

6. Voluntary Participation:

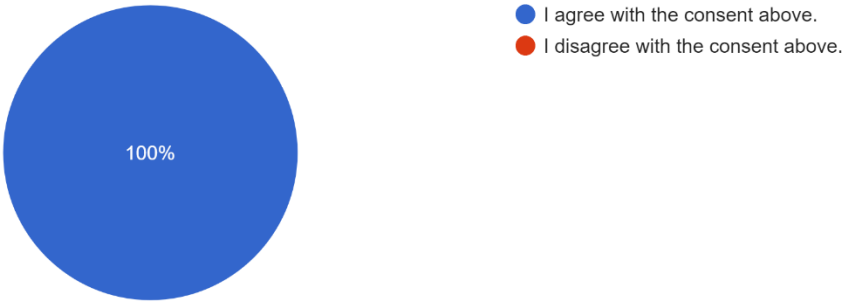
Your participation in this study is entirely voluntary. You may refuse to participate or withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled.

Appendix A10

Participant's acceptance of informed consent

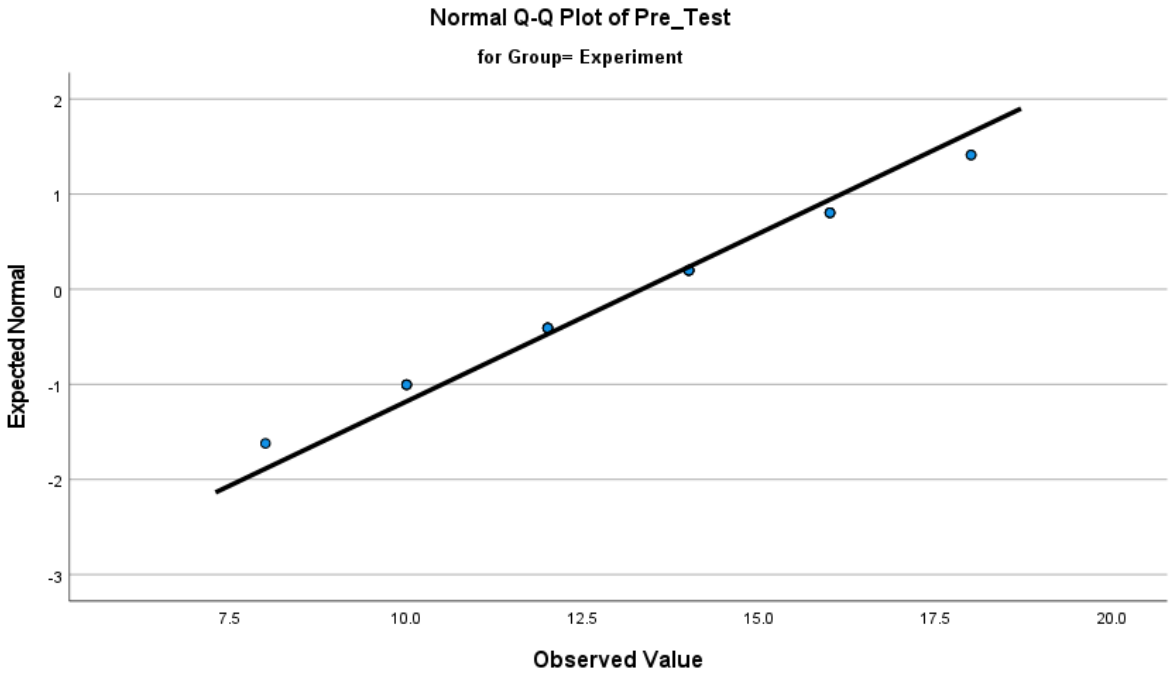
I have read the information provided above and have had the opportunity to ask questions. I voluntarily agree to participate in this research s... consent form, I acknowledge my informed consent.

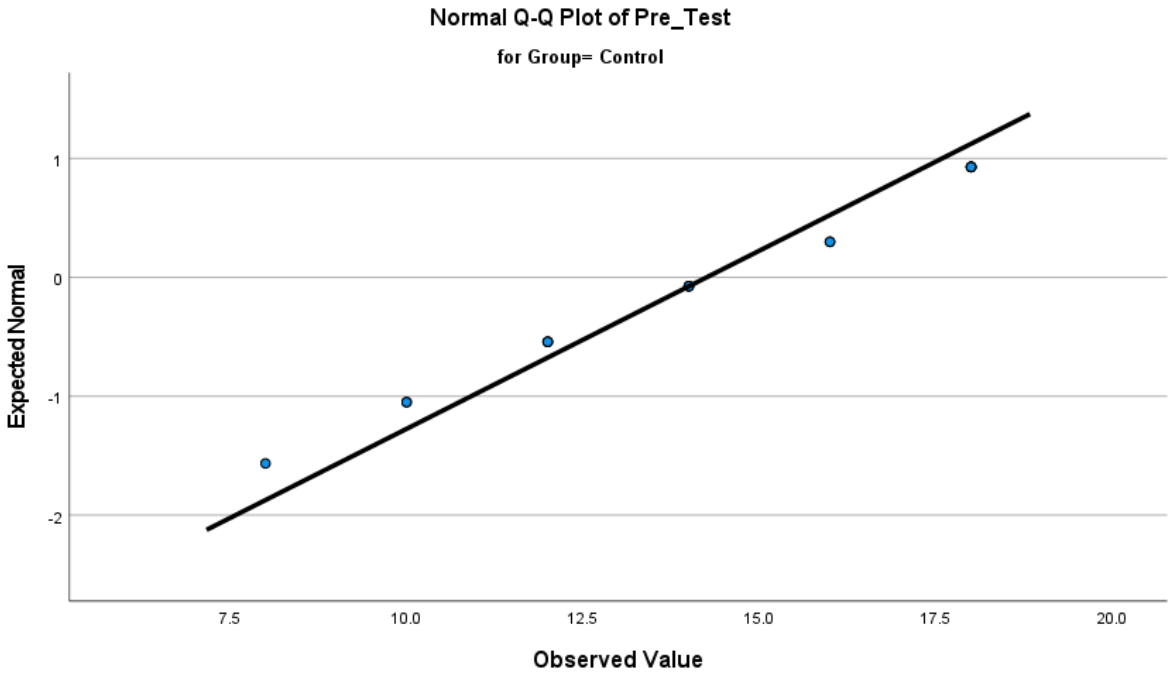
38 responses



Appendix B1

Q-Q plot of pre-test for experiment and control group





Appendix B2

Statistic description

Statistics

		Gender	Age
N	Valid	34	34
	Missing	0	0
Mean		1.3235	20.7647
Std. Deviation		.47486	1.47830

Gender

	N	%
Male	23	67.6%
Femal...	11	32.4%

Age

	N	%
18.0	4	11.8%
19.0	2	5.9%
20.0	7	20.6%
21.0	10	29.4%
22.0	7	20.6%
23.0	4	11.8%

Appendix B3

Paired sample statistics of experiment group and control group

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre_Test	13.3333	18	2.82843	.66667
	Post_Test	22.2222	18	5.48319	1.29240

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre_Test	14.2500	16	3.33667	.83417
	Post_Test	23.1250	16	3.18067	.79517