The Impact of Digital-Interactive-Book Gamification-Based Instruction on Academic Learning Outcomes of Students who Learn at Their Own Pace: Insight from Indonesia[1]

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Abstract

Gamification-based instruction learning design can enhance students' conceptual knowledge and academic achievement by reversing before-class and in-class activities. This strategy raises the issue of students having to learn independently, especially for self-directed learning (SDL), where students often struggle. To create a flipped classroom for these students who learn at their own pace, a gamified interactive e-book can be very useful. In order to gauge the strategy's potential success, a pilot study was conducted in a General English (GE) classroom. We called the class of students who used the gamified interactive e-book the General English Flipped (GEF) classroom. After taking pre- and post-tests, GEF students demonstrated significant academic growth in their learning outcomes. The interview data on students' motivation to learn also showed that the GEF students were more driven to do so. The gamification design framework specifies which gamification elements are most effective at increasing students' engagement, productivity, enjoyment, and retention of knowledge.

Resumen

El diseño de instrucción y aprendizaje basado en la ludificación puede mejorar el conocimiento conceptual y el rendimiento académico de los estudiantes al invertir las actividades previas y posteriores a la clase. Esta estrategia plantea el problema de que los estudiantes tienen que aprender de forma independiente, especialmente en el aprendizaje autodirigido (AAD), donde los estudiantes suelen tener dificultades. Para crear una clase invertida para estos estudiantes que aprenden a su propio ritmo, un libro electrónico interactivo ludificado puede ser muy útil. Para evaluar el éxito potencial de la estrategia, se realizó un estudio piloto en una clase de inglés general (GE). Llamamos a la clase de estudiantes que utilizó el libro electrónico interactivo ludificado "aula de inglés general invertida" (GEF). Después de realizar pruebas previas y posteriores, los estudiantes de GEF demostraron un crecimiento académico significativo en sus resultados de aprendizaje. Los datos de las entrevistas sobre la motivación para aprender de los estudiantes también mostraron que los estudiantes de GEF estaban más motivados para hacerlo. El marco de diseño de ludificación especifica qué elementos de ludificación son más efectivos para aumentar la participación, la productividad, el disfrute y la retención de conocimientos de los estudiantes.

Introduction

Gamification, as conceptualized by Landers (2014), has gained prominence as a transformative instructional approach that systematically integrates game mechanics into educational environments to foster student engagement, enhance motivation, and improve learning outcomes. By leveraging elements such as competition, rewards, and interactive challenges, gamification has the potential to create immersive learning experiences that transcend traditional instructional methods (Ardi & Rianita, 2022; Huang et al., 2020; Romsi et al., 2024; Sotos-Martínez et al., 2024). Empirical research has extensively examined its impact across various educational disciplines, highlighting its effectiveness in stimulating cognitive development, reinforcing knowledge retention, and promoting deeper learning through active participation (Argudo-Serrano et al., 2022; Connolly et al., 2012; Nah et al., 2014; Thomas et al., 2023). Despite the evident advantages, ongoing discourse surrounds its applicability to diverse learner populations, particularly slow learners, who often encounter difficulties with conventional instructional models due to their distinct cognitive and processing challenges. The extent to which gamification can be tailored to meet the specific learning needs of this demographic remains a critical area of inquiry, necessitating further exploration into the design, implementation, and long-term effectiveness of gamification-based pedagogies for students who learn at their own pace.

Students who learn at their own pace encounter significant obstacles in conventional classroom settings, primarily due to their slower cognitive processing, challenges in information retention, and difficulties in

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recalling learned concepts. Research underscores the effectiveness of distributed practice, an instructional approach that segments learning into shorter, more frequent sessions to optimize retention, comprehension, and cognitive reinforcement (Dunlosky et al., 2013; Heidt et al., 2016; Mejeh & Rehm, 2024; Rohrer, 2015). Moreover, advancements in educational technology have opened new avenues for supporting these learners, with gamification-based learning strategies emerging as a promising pedagogical tool. These approaches, which incorporate game mechanics such as rewards, challenges, and interactive feedback, have been shown to sustain student engagement, enhance motivation, and create dynamic learning experiences that align with students' cognitive needs (Hwang et al., 2015; Kuo et al., 2012; Lo & Hew, 2020; Viberg et al., 2021). By structuring learning environments around gamified principles, educators can offer slow learners a more engaging, adaptive, and self-paced approach to instruction, potentially improving their academic outcomes (Baxter et al., 2014; Ge, 2018; Hew et al., 2016). However, despite its growing application, the empirical evidence regarding the effectiveness of gamification-based instruction specifically designed for slow learners remains limited. Critical gaps persist in understanding how these instructional models can be optimally structured to meet their unique learning requirements, emphasizing the need for further research to validate and refine gamification strategies tailored to these learners' cognitive profiles.

A critical challenge in implementing gamification within educational settings is the careful selection and integration of game components that effectively align with defined learning objectives while catering to diverse learner profiles. Although general gamification frameworks have been explored in various studies, there is a noticeable gap in research regarding models specifically designed to support slow learners, who require structured, adaptive, and cognitively accommodating instructional strategies (García-Márquez & Bauer, 2021; Jo et al., 2018). Additionally, while Learning Management System (LMS) based gamification has been increasingly recognized as a viable approach for enhancing student engagement and motivation, its efficacy as an instructional model tailored to the needs of students who learn at their own pace remains underexplored in empirical research (Romsi et al., 2024; Slamet & Basthomi, 2024). Given that students who learn at their own pace benefit from scaffolded instruction, individualized pacing, and sustained cognitive reinforcement (Slamet et al., 2025), it is essential to investigate how LMS-integrated gamification can be systematically designed to accommodate their unique learning trajectories. Addressing this gap requires empirical validation of game-based instructional frameworks within LMS platforms, ensuring that the adaptive mechanisms, feedback loops, and interactive elements are optimized to enhance learning outcomes for slow learners.

Another critical aspect often overlooked in previous research is the role of self-directed learning (SDL) within gamification-based instruction. SDL emphasizes learners' autonomy in managing their learning process, including self-assessment, goal-setting, and selecting learning activities (Beckers et al., 2019; Bolhuis, 2003; Slamet et al., 2024a). While studies indicate that competency-based education can enhance student motivation and SDL skills, they also highlight the necessity for intensive teacher guidance to ensure effective implementation (Corbalan et al., 2009; Kicken et al., 2008; Slamet et al., 2024b). However, there is a gap in understanding how gamification can support slow learners develop SDL competencies while maintaining the necessary instructional support. (García-Márquez & Bauer, 2021; Romsi et al., 2024; Wiggins, 2016).

Therefore, previous studies on gamification have primarily focused on general student populations, its use for slow learners. Given these gaps, there is an urgent need to explore the impact of digital interactive book gamification-based instruction on slow learners' academic learning outcomes. This study aims to address this pressing need by investigating the instructional potential of gamification tailored to slow learners and evaluating its effectiveness in fostering engagement, motivation, and learning achievement.

Conceptual Framework

Gamification, in this study, is the use of interactive game aspects in academic education. Integrating game design aspects into LMS education via digital-interactive-book aims to engage students in deeper learning processes and experiences, leading to greater learning results. The development of current ICTs has made this a reality in many educational settings. Even if the concepts, such as "intrinsic motivation", could be different depending on the environment, research in the field of education has demonstrated evidence of the significant connections between the attitudes and behaviours of students and the learning results of those students (Slamet & Basthomi, 2024). Theoretically, students who put in more mental effort, spend more time really working on the task at hand, and maintain a good attitude toward the content they are studying will have better learning outcomes (Romsi et al., 2024). We use Landers' (2014) theory of gamified learning to frame the study problem, account for significant educational variables, and operationalize gamification in theory and practice.

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Landers' theory of gamified learning can be found in Figure 1. Since gamification in education can be seen from several theoretical viewpoints, Landers reviews numerous learning theories for gamification, including classical conditioning, expectancy-based, goal setting, and self-determination. This paper is based on gamified learning using SDL approach for slow learners as a guiding conceptual framework because it provides a foundation for thinking about study links and outcomes and is open to diverse theoretical viewpoints.

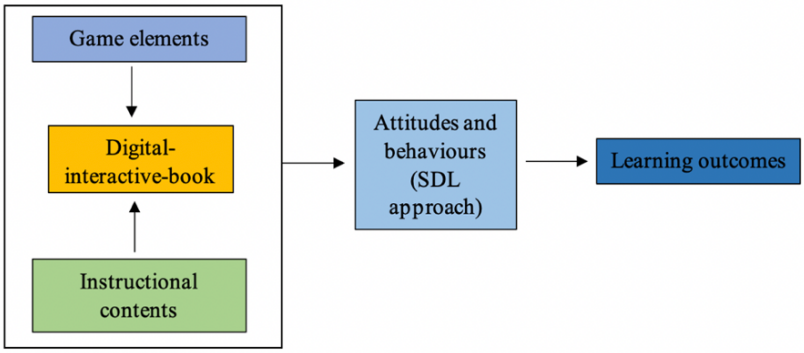

Figure 1: Adaptation of Landers' Theory of Gamified Learning (Landers, 2014)

Literature Review

The idea of game-based learning is associated with the concept of gamification, although the two are distinct from one another. Game-based learning is the process of using actual games to learn new skills or information, in contrast to gamification, which refers to the usage of components of game design in settings that are not related to gaming. For example, in a game where graduate students are required to perform medical procedures in a simulated environment, their skills are put to the test in the game corresponding to the learning task (Gee, 2013). Game-based learning is characterized by the fact that the skills that are tested in the game correspond to the learning task (Ardi & Rianita, 2022; Kapp, 2012).

In some circumstances, like the multiple-choice quiz app utilized in the previous study, the distinction between gamified and game-based learning can be blurred (Kapp, 2012). Cheong et al. (2013) argue gamification can range from serious games to routine tasks with game aspects included. A gamified multiple-choice quiz app is in the focus of development where an activity of memorizing information is converted into a game by quizzing them. The quiz structure lacks progression, rewards, and competition. To add these aspects, the program uses avatars, experience points, and badges. Accordingly, the app can be categorized as a gamified multiple-choice quiz more attractive rather than a basic instructional game used.

Recently, gamification has been used more and more in classrooms to help students learn to be effective, be engaged in their studies, be motivated to learn, and increase the scope and depth of their subject expertise (Lo & Hew, 2020). Buckley and Doyle (2016), for instance, used gamification as a teaching tool while also taking into account students' unique preferences and approaches to learning. All aspects of students' development and performance (participation, attitude, and output) were positively impacted. However, there are other studies that have looked at the drawbacks of using gaming techniques in the classroom. The gamification learning strategy was implemented by de-Marcos et al. (2014) in an undergraduate course, but the results showed that it did not seem significantly improve students' information retention or application.

While gamification and competitive techniques have been shown to increase students' interest in learning, studies have also shown that students benefit most when teachers assist them in making connections between what they have learned and their real-world experiences (Mekler et al., 2013). After introducing gamification, more learning design considerations should be made by referencing pedagogical theories in order to increase students' motivation to study. One such motivating theory is SDL, which highlights the significance of motivation in shaping one's identity and controlling one's actions (Shi & Cristea, 2016). It stresses the significance of doing something because of its inherent qualities, such as the action being intriguing and pleasant. In other words, SDL has more to do with the internal drives that guide individuals' decisions than with any kind of external influence.

All of the previous related studies illustrate the benefits of gamification in the classroom. The interactive gamification e-book tool is a relatively new classroom interactive carrier that combines traditional book graphics with interactive computer technology (Smeets & Bus, 2012). It can effectively promote the

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integration of multimedia elements like images, audio, and animations (Smeets & Bus, 2015), thereby improving the learning environment for gamification. Because students can access digital learning content through e-books at any time and from any location, and because e-books can provide students with the opportunity to interact with the learning content, such as by clicking on the topics provided, this technology may be useful for students who do not perform well when using traditional textbooks (Jou et al., 2016; Maynard, 2010). Therefore, the current research presented a gamification environment based on gamified interactive e-books. It was hoped that by enhancing students' interest and performance prior to class, the proposed method would lead to more active participation and better outcomes during class.

Method

The present study employed a pre-experimental research design, enabling the researchers to conduct a thorough investigation of the research question and draw meaningful conclusions that can contribute to the broader understanding of the topic. To evaluate the effectiveness of using digital-interactive-book gamification-based instruction to enhance the academic performance of the students who learn at their own pace, a pre-experimental design was employed. The study focused on the impact of this approach on General English (GE) course for these learners at STKIP PGRI Sidoarjo, Indonesia. This digital-interactive-book as a media in learning process was integrated to a Moodle-based LMS called eLSIDA (http://lms.elsida.ac.id). There was only one group of students in this experiment; this group was treated by implementing of flip classroom using eLSIDA.

Participants

One class with a total of forty students chosen with purposive sampling took part in the experiment. These students were in the third semester of the Department of History Education Study Program during the academic year 2021/2022. All the students came into the class with the same academic background and had not studied General English (GE). All participants were informed that they were free to withdraw from the study at any time they wanted, and that they could make the decision regarding whether or not to take part in this research. In this experiment, this was only group who used the digital-interactive-book gamification-based instruction in the General English Flipped[5] (GEF) classroom.

This current study was conducted with careful consideration of ethical issues. Informed consent was obtained from participants, and measures were taken to ensure privacy and confidentiality. The study was designed to promote fairness and equity, and researchers strived to maximize potential benefits while minimizing potential harms. The dignity and autonomy of participants were respected throughout the research process.

Instruments

In this research project, the pre-test, the post-test, and the interview questions served as the tools of measurement. The two English lecturers were responsible for developing the pre-test and post-test. The purpose of this test was to determine whether the different groups of students had comparable prior understanding of the topics that were covered in their GE course. There were 40 items, all of which were multiple-choice questions (MCQs), and the maximum possible score was 100. The MCQs post-test also had a total of forty questions, and the maximum score was 100. Cronbach's alpha values were 0.88 (pre-test), and 0.90 (post-test), indicating an adequate level of internal consistency.

The researchers prepared a four-question interview to evaluate students' perspectives. The measurement generated as a basis for the interview was comprised of those four questions which were prepared in advance. The questions were designed to evaluate the students' perspectives on the digital-interactive-book gamification-based instruction learning (They are: "What is the difference between this gamified interactive digital-interactive-book gamification-based instruction learning and other classes that you have attended in the past? Is it helpful to your study to use this method? Are you able to explain the reasons? In general, what are some of the benefits of using this approach to learning? What type of assistance did you obtain with the implementation of this method?") To acquire a comprehensive understanding of how the e-book as an intervention affected students, four students were invited to participate in the interview to demonstrate

[5] Flipped learning is an instructional approach where students explore core content independently before class, typically through videos or digital materials. Classroom sessions then focus on guided practice and interactive activities. In this study, flipped learning was implemented using a gamified digital-interactive book to enhance engagement and support self-paced learning in the General English Flipped (GEF) classroom.

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their thoughts and feelings in the appropriate learning environment. The purpose of this was to gain a better understanding of how the intervention affected students' academic learning outcomes.

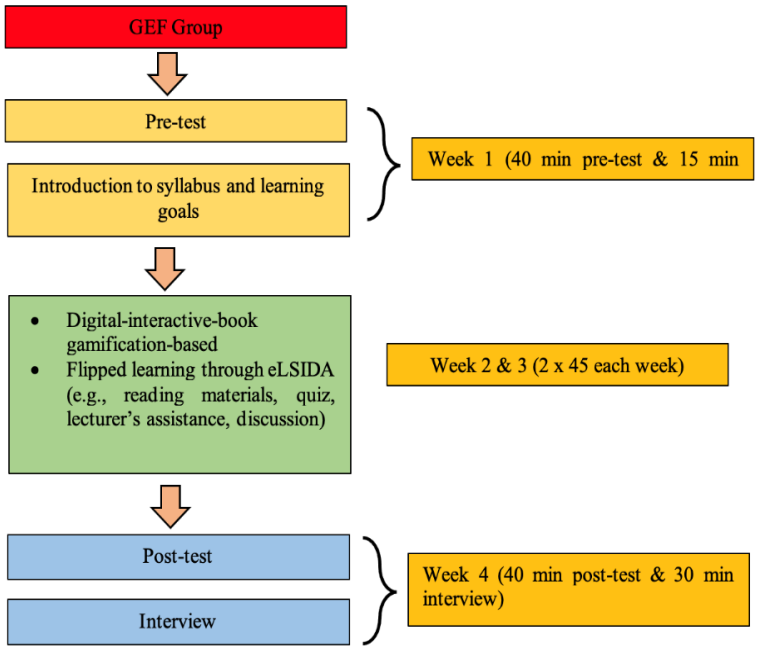

Figure 2: Research procedure

The steps involved in the experiment are represented in Figure 2. Before beginning the learning activities, each student completed the pre-test of general education course learning performance, which lasted for forty-five minutes. Following that, for the next 15 minutes, the lecturer went through the course outline and the learning goals. After that, during the second and third weeks, the students began participating in the learning activities, and various strategies for integrated learning were implemented. The gamified interactive e-book was utilized as a teaching aid in the GE flipped classroom by the GEF class. This was accomplished with the assistance of eLSIDA. The students in this group were tasked with completing the GE materials using gamification that was based on digital interactive books. It was intended that during the in-class stage of the problem-based learning process, they would solve the gamification-quizzes by studying the interactive e-book that contained the GE materials, and they would have peer discussions about the quizzes with their classmates. As can be seen in Table 1, certain aspects of gameplay were specifically chosen to be featured in this interactive e-book in order to build a gamified setting.

Game elements	Supporting game elements	Descriptions
Challenges	Quizzes	Students are provided some quizzes through digital-interactive-book.
Feedback	Immediate feedback	Students' performance is evaluated once they complete each quiz.
Communication system	Share for discussion	Students can share the results to generate discussion via chat box or forum.
Points and reward	Points and reward	Students are given rewards for completing each quiz.

Table 1: Game elements in the digital interactive book

Results and Discussion

In this section, the responses to the research question are discussed considering the findings that were collected from the implementation of the digital-interactive-book gamification-based instruction through a Moodle-based LMS namely eLSIDA. This pre-experiment design was done completely in order to answer the formulated question regarding the effectiveness of the digital-interactive-book gamification-based instruction applied to the 40 students at STKIP PGRI Sidoarjo, Indonesia. A pre-test was administered by the lecturer to each of the individuals before the beginning of the experiment. After that, eLSIDA, which is a Moodle-based learning management system, was used to instruct the treatment group (the experimental group), and the group was given the achievement test (post-test) once more at the end of the study, after which there was scoring done by the lecturer. During the data analysis, the researchers produced both descriptive and inferential statistics with the use of the SPSS Statistics 26 software. The descriptive analysis

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method was used during both the pre-test and post-test phases to calculate the values of the mean, standard deviation, minimum, and maximum scores. Information obtained from the descriptive statistical analysis that was carried out is presented in Table 2.

	N	Minimum	Maximum	Mean	Std. Deviation
Pre-Test	40	50	76	63.85	6.495
Post-Test	40	60	84	74.48	6.587
Valid N (listwise)	40				

Table 2: Descriptive analysis results of tests

Table 2 shows that the mean score on the post-test was higher than the mean score on the pre-test. The mean score on the pre-test was 63.85, while the mean score on the post-test was 74.48. This indicates that there was a significant improvement. According to the findings, there was a statistically significant difference between the group mean before the treatment and the group mean after the treatment was completed. Specifically, the mean score on the post-test was higher than that of the pre-test, indicating that the treatment had a positive effect on the academic learning outcomes of the students. In addition to this, the standard deviation (SD) for the post-test was 6.495, whereas the SD for the pre-test was 6.587. (Table 2). The inferential test, also known as the pair sample test, can be carried out if it has been shown that the data follow a normal distribution, as was discussed earlier. Because there was only one group included in the sample, carrying out a test to determine whether or not it was homogenous was unnecessary. The Kolmogorov-Smirnov test was also utilized in order to examine the normality of the data. The findings of the Kolmogoroz-Smirnov test are presented in Table 3.

		Pre-Test	Post-Test
N		40	40
Normal Parameters[a,b]	Mean	63.85	74.47
	Std. Deviation	6.495	6.587
Test Statistic		.148	.167
Asymp. Sig. (2-tailed)		.027[c]	.007[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

Table 3: One-sample Kolmogorov-Smirnov test

As shown in Table 3, the Sig. value for the pre-test was .027, and the Sig. value for the post-test was .007. The critical significance level (α) for hypothesis testing was set at .05. A significance level of .05 indicates a 5% chance of obtaining the observed results by chance, and it is commonly used in statistical testing to establish the level of confidence in the results. In this study, the Sig. value for the post-test was lower than the critical significance level, indicating that there was a significant difference between the pre-test and post-test scores. Additionally, the normality assumption was met for both the pre-test and post-test data, as the Sig. value was higher than .05. Therefore, a paired sample t-test was performed to compare the means of the pre-test and post-test scores. The results of the paired sample t-test showed a significant difference between the pre-test and post-test means, suggesting that the digital-interactive-book gamification had a positive effect on the academic learning outcomes of the students.

Considering the fact that the necessary condition for testing the hypothesis had been met in this particular case, inferential analysis was carried out by means of a test based on a pair of samples. To assess whether or not the digital-interactive-book gamification-based instruction strategy had a statistically significant impact on the academic achievement of the students, a procedure of t-test for testing hypotheses was carried out. The results of the experiment are presented in Table 4.

				95% Confidence Interval of the Difference	
T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
62.177	39	.000	63.850	61.77	65.93
71.511	39	.000	74.475	72.37	76.58

Table 4: One-Sample Test

According to Table 4, the level of significance (Sig. (2-tailed)) was .000, which was lower than .05. It was discovered that the alternative hypothesis (Ha), which stated that "There is significant in mean gain score of the slow learners on the implementation of the digital-interactive-book gamification-based instruction

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toward the students' academic learning outcomes", was "accepted", while the null hypothesis (Ho), which stated that "There is no significant in mean gain score of the slow learners on the implementation of the digital-interactive-book gamification-based instruction toward the students' academic learning outcomes", was "rejected". The results of this study indicate that the use of digital-interactive-book gamification-based instruction led to improved academic learning outcomes for the students. Specifically, the findings showed that the students' achievements significantly improved following the treatment, suggesting that the digital-interactive-book gamification approach was effective in enhancing the students' understanding of the whole number topics covered in the GE course.

The results of interviews conducted demonstrated the positive attitudes toward the implementation of the digital-interactive-book gamification-based instruction through eLSIDA. First, S4GEF (Student 4 of the GEF class commented in reference to the enhancement of learning activities,

> *I appreciate the magic classroom of e-books via eLSIDA. I was able to solve problems that I couldn't handle by going back to the charm and learning it again. This allowed me to have a better grasp of how to tackle problems when I met them in the future.*

S2GEF remarked,

> *I've always had the impression that learning English was a challenging task. And I was too embarrassed to ask my lecturer questions if I was having trouble understanding the material being covered in class. The quizzes were challenging as well. This time, though, I viewed the video while I was at home, and eLSIDA had a digital book. Because I had the information reinforced twice, I believed that it gave me a deeper understanding.*

Following that, S1GEF shared that she found it helpful to discuss the course material with the other students in her class:

> *Because my classmates and I were free to approach my friends for clarification whenever we were stuck, I was able to absorb far more information from the course.*

After that, S3GEF said,

> *I already knew what I would learn before taking the class, so IA could finish many questions during the in-class learning.*

This allowed her to feel less anxious than she had in the past when she was in similar situations.

In conclusion, in terms of the statements that students made about their learning performance, most students believed that the digital-interactive book was useful for the learning that took place in class. The most significant change was that students could read the e-books again in class to reinforce what they had learned, and they could also search for similar learning content in the e-books to get some extra help if they needed it.

In terms of the enhancement of the desire to study, S2GEF mentioned that she believed the most significant change was that the instructor did not strictly regulate her and that the ambiance in the classroom was very laid back:

> *I had the ability to read, study, and pursue my interests all by myself. In contrast to the typical English textbooks, the e-book included some engaging stories throughout its content.*

Then, S1GEF mentioned that she desired to participate in this game for a couple more times:

> […] *even if I make a mistake, I have the opportunity to begin the process all over again and earn additional points and badges.*

According to the frequency statistics, the students in the GEF class showed a higher level of interest and a more powerful sense of drive in their educational pursuits. Regarding the level of acceptance, S4GEF commented,

> *I had never used e-books in class before, and I didn't know that math books can be so much fun. I wish I could give it another shot.*

It is assumed that in contrast to learning in conventional classes, she favoured acquiring knowledge in this manner.

Lastly, S3GEF expressed her wish that General English courses could continue to be presented in this manner in the future.

Related to the findings shown above, we can reach the following conclusion: The digital-interactive-book gamification-based instruction through eLSIDA offered students benefits for learning activities.

The findings of the General English (GE) learning performance tests revealed that students in the GEF class made great progress in the course. The current findings corroborated the findings of Hew et al. (2016) and

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Lo and Hew (2020), who reported that, in comparison to conventional teaching methods, the gamified flipped learning approach could significantly improve students' academic performance. They said that this could be accomplished by increasing students' learning engagement and giving them more chances to collaborate with their classmates. In addition, the students in the GEF group demonstrated a high level of academic achievement. It is important to note that the students in this group also had better academic performance, which indicates that the use of a digital book delivered through eLSIDA could potentially stimulate more learning than the traditional instructional approach they had received in the past. These results were consistent with those of previous studies (Jou et al., 2016; Zhao et al., 2021).

According to the findings, the gamification activities that were carried out were collaborative activities, social networking sites, classroom activities (for example, activities that are engaging and captivating, elements of competition, and actions that are performed independently), and associated with short-term activities. The activities were performed during the first implementation since they were considered essential in creating the game atmosphere. To maintain a sense of learning while also having fun during the implementation, gamification aspects had to be incorporated into the activities of the lessons, with the primary focus being on maintaining motivation and having fun. It was found that including social games in the various topics of the lessons fostered an atmosphere of collaboration (Fiş Erümit & Karakuş Yılmaz, 2022; Leonardou et al., 2022). The interactions among the students facilitated the students' learning from each other (Felszeghy et al., 2019; Vesin et al., 2018). In addition, a sense of play was created within the educational setting through the utilization of social games, platforms for social networking, and activities both within and outside of the classroom (Huang et al., 2020; Landers, 2014).

During the gamification activities, the status of the students was communicated in the digital environment and classroom. Additionally, the awards they gained, such as trophies and badges, were shared, and the game atmosphere was reinforced owing to the competitive nature of the students. A sense of play was fostered as a result of the well-balanced cycles of difficulty and reward activities which contributed to participants' feelings of motivation and flow (Karagiorgas & Niemann, 2017). Students were driven to participate enthusiastically in the activity by the social learning environment that was provided. In addition, students were encouraged to actively participate in a social learning environment when they worked on fun activities in groups while participating in the social learning environment. It is possible to draw the conclusion that learning could be supported in gamification contexts that encourage social engagement, stimulate intrinsic drive, and produce a flow state. In contrast to situations where students are merely passive recipients of knowledge, this approach emphasizes their active role in the learning process. (Lin-Siegler et al., 2016).

In this investigation, the GEF learning model allowed for greater student autonomy, which in turn piqued their interest and increased their level of participation and involvement throughout the entire process of learning by utilizing a variety of different settings, including the story background and peer discussion. This motivated students to do the educational activities out of their own free will, rather than because the instructor required them to do so (Buckley & Doyle, 2016; de-Marcos et al., 2014; Karagiorgas & Niemann, 2017). It then should be the responsibility of teachers to make sure that their pupils have access to the resources and feedback that will help them feel successful and confident in their abilities. As an alternative to norm-based evaluation, for instance, more pertinent information may be provided to students in order to assist them in comprehending how to master the learning activities (Cheong et al., 2013; Ge, 2018; Gee, 2013; Shi & Cristea, 2016). Based on the findings of the current research it is argued students could learn about GE concepts by reviewing the e-book via eLSIDA, which could make up for the inadequacies of the pre-class learning in the flipped classroom. This was because there was a great deal of knowledge pertaining to GE materials, starting from the basic understanding of part-whole. Additionally, it had the capability of assisting students if they were unable to overcome difficulties when engaging in learning challenges in the classroom.

Discussion in a GE course refers to the process in which students talk about the components, skills, or techniques they used in the game. When a player tries to teach others what they already know about the game, they open themselves up to new opportunities for learning (García-Marquez & Bauer, 2021; Landers, 2014; Zhao et al., 2021). As a result of participating in the discussion, the students should have a deeper comprehension of their points of view. They would be able to gain more confidence in their ability to solve mathematical issues if they did it this way. The current research did include a few caveats and restrictions. To begin, the researchers in this study did not investigate the behavioural patterns of students while they were engaged in the learning process. This would have been beneficial to the in-depth assessment of the efficiency of various learning methodologies. Second, it is recommended that long-term and large-scale

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experiments be carried out based on this study. These experiments should also be supplemented by additional learning strategies, such as investigating which learning strategies can enhance students' meta-cognition tendency in an environment that is gamified for learning.

Conclusion

We now have some clear information about the overall effects of gamification on the learning outcomes of students and how the technique of gamification can lead to positive outcomes for learning activities. The limitation of our conceptual framework, which emphasized that well-designed instructional content must be utilized in combination with gamification, is something that should be highlighted here because it is important. It is not possible to use gamification as a substitute for ineffective instructional designs and inadequate study materials. This research has led to the conviction that combining gamification with other field breakthroughs (such as the flipped classroom or opportunities for learning analytics) could provide fruitful combinations to improve educational results that have not yet been explored in various spheres of expertise. In addition, the findings of this research could provide evidence that the effects of different gamification design components on the results of student learning are not always equal. This study offers a critical understanding of gamification and directs scholars as well as practitioners to other potentially productive paths of investigation. We hope that the potential of gamification can continue advancing as a common aim of increasing educational results for all students.

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