Enhancing Learning Effectiveness and Satisfaction through Game-Based Learning in Higher Education

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Abstract. In modern education today, integrating advanced technologies into education is becoming increasingly common, and researching the impact of technology on learning is essential. This study will focus on exploring aspects surrounding learning motivation and the effectiveness that technology brings through understanding and analyzing the game-based learning (GBL) design framework. In higher education, teaching and learning methods that provide students with the most multifaceted opportunities for self-development require educators and institutions to focus on deeper development of flexible and unconstrained curriculum and teaching design frameworks. This allows students to feel comfortable and unpressured by their studies. With the GBL model, this is considered the basis for combining it with traditional teaching methods to create learning motivation and participation, thereby training the ability to adapt and update trends quickly and effectively. Despite growing interest, there is still limited empirical evidence on how design factors can influence learning outcomes and student satisfaction with their experience of the model throughout their studies. Insights from qualitative research have emphasized the importance of a clear alignment between game mechanics and learning objectives. The results of the study will partially clarify the factors and thus provide the correct directions for learning thru the GBL model and applying it in practice, applying existing theories and models to enhance the superiority of the GBL model, and providing information most relevant to the needs of students and educators when they need additional input to strengthen and develop the model to become increasingly appropriate.

Keywords: Game-Based Learning (GBL), Learning Effectiveness, Student Satisfaction, Motivation and Engagement, Educational Technology.

1 Introduction

21st century education, technology is indispensable, which is the driving force for the development of teaching and learning methods[1]. Previous Traditional teaching methods are valuable and practiced over the years, but are sometimes limited in maintaining student motivation and raising the level of higher-order thinking. Later, educators and researchers introduced innovative methods using technology to enhance learning motivation, and aid in improving knowledge retention[2]. One of them is the game-based learning (GBL) method, which has advanced as a breakthrough in the education industry, a tool that knows how to conceptualize many new aspects that other learning methods have not been able to do before. Leverage state-of-the-art technologies that engage students so that they feel interested in learning and achieving their goals during their studies[3], a number of studies have explored the process of introducing AI technology or game-based learning to research and evaluate how to develop how this application will be optimized and most suitable for students[4]. Research in many fields such as

learning science, mathematics and professional skills training. Studies have highlighted the effectiveness and potential of GBL in creating the appeal of game-based learning to enhance learner engagement[5], promote proactive problem-solving, and encourage interaction. However, there are still many challenges in ensuring that effective games are built to suit each student, and there is a need for an intelligent model design approach that does not let students focus solely on playing and forget about the learning task[6]. Without a clear design framework, there will be many problems in educators systematically integrating GBL into the curriculum[7]. While there has been a lot of serious gamification and gamification research in the past, little research has focused on how to develop and create comprehensive design frameworks for GBL in higher education settings. Models that are commonly applied and familiar to students, such as the ARCS model or the Catalysis framework, are an important basis for providing valuable insights into the effects on motivation and engagement, but they still lack direct application to teaching model designs. The gap for this issue underscores the need for new creativity in terms of robust and practical theoretical frameworks, in order to provide innovative ideas and the right direction for educators and instructional model designers to help develop worthwhile GBL experiences[8]. The purpose of this study is to propose a Game-Based Learning Design Framework for students, the main content of which is to explore and identify different modes of coordination based on the key principles of learning theory, motivation to participate and experiential learning[9]. The results can contribute to the wealth of information educators can take in two important directions. First, it refers to a structural framework – called the 5D-GBL Framework – which synthesizes educational theories with game design principles, providing systematic approaches to implementing GBL in the most optimal way[10]. Simultaneously, it provides suggestions based on its findings and will point out potential directions that educators can take to integrate GBL into their teaching, which will be a boost to innovation in a more diverse and effective learning environment. This study aims to answer three major questions:

(1) What are the essential elements of a high-quality GBL design?

(2) How does GBL influence learners' motivation and academic outcomes?

(3) How can a model framework be developed that can support educators in addressing all issues in different contexts?

If there's a way to address these questions, the research aims to contribute both theoretically and practically to the current field of digital technology education.

2 Literature review

2.1 Definition of GBL and distinguishing concepts

Game-Based Learning (GBL) is defined as the use of game elements and mechanics in learning environments, with its primary focus being learning and serving as a tool for students to achieve their goals. While GBL prioritizes the development of instructional designs, gamification is merely seen as a model to make lessons more engaging through elements like points, badges, or leaderboards[11]. GBL places games at the center of

the learning process[12]. Similarly, serious games are designed for purposes beyond entertainment but still need to closely follow the learning process, although they don't always align perfectly with the curriculum[13]. Therefore, GBL could be a game-changer in a new approach to differentiated instruction, requiring upfront investment and knowing how to intentionally integrate game design and instructional design[14].

2.2 Fundamental Theoretical Basis and Related Models

The application of the GBL model can be explained by various educational theories[15]. From a constructivist perspective, learners actively learn and draw meaning from the lesson through experience, which aligns with learning through games[16]. Kolb's experiential learning theory emphasizes drawing meaning and knowledge through concrete experience, which are also elements present in GBL[17]. Regarding learning motivation, Self-Determination Theory (Deci & Ryan) identifies three factors that drive intrinsic motivation: autonomy, competence, and social connection[18]. Additionally, Flow Theory (Csikszentmihalyi) explains the phenomenon of "immersion" as occurring when the learner is and has been in a state of balance between task and ability[19]. These theoretical foundations strengthen the scientific basis for GBL in both cognitive and emotional aspects of learning experiences through theories[20]. Educators have seen the potential and effectiveness of theories when applying games to learning models. Many instructional design models and motivational methods have been applied in GBL research. For example, Keller's ARCS model (Attention, Relevance, Confidence, Satisfaction) focuses on developing learning motivation[21]. However, this model focuses on the motivational aspect of learners but doesn't address the crucial need for a clear strategy to ensure the game is designed to directly align with teaching objectives and outcome assessment[22]. Therefore, they also provide useful ideas but cannot yet become the main GBL design framework, but this will be important information for comprehensively incorporating and developing the GBL model.

2.3 Experimental Information and Research Gaps

Many previous experimental studies have demonstrated the effectiveness of GBL in various fields. In language education, games help improve quick vocabulary recall and increase English communication skills. In the STEM field, GBL is integrated through simulations to solve problems and support the generation of ideas in terms of logical thinking. In specialized skills, especially for specific jobs like medicine and business, games provide scenarios for learners to practice problem-solving before applying it in real-world situations, thereby limiting risks when making decisions in practice[23]. However, studies also point out challenges such as high operating costs for the model and complex technical requirements for the machinery. The research results show that GBL offers many benefits in terms of motivation to participate and effectiveness to learn, but there is still a lack of a systematic design framework that allows instructors and educational designers to easily incorporate it into lessons so that students have the

best conditions for development through the model[24]. This gap sets the stage for the current research, which aims to propose a comprehensive Game-Based Learning Design Framework that is both theoretically sound and familiar to students' practical experiences[25].

3 Methodology

3.1 Research Design

The research design is based on a conceptual framework for Game-Based Learning (GBL). As illustrated in Figure 1, the proposed model hypothesizes the relationships between three independent variables—Motivation (MOT), Engagement (ENG), and Usability (USA)and two dependent variables, namely Learning Performance (LEA) and Satisfaction (SAT). Independent variable: Motivation (MOT) This is intrinsic motivation that encourages learners to participate regularly in GBL activities. Engagement (ENG) defines the level of involvement in terms of connection with people and awareness of learning. Usability (United States) refers to the ease of use and accessibility of the GBL platform. Intermediate variable: Learning effectiveness (LEA) is conceptualized as the improvement in knowledge and experiences discovered from GBL experiences. Dependent variable: Satisfaction (SAT) indicates the overall satisfaction of learners with the learning environment using the GBL model.
Based on the information and theoretical framework, we will formulate the following hypotheses:

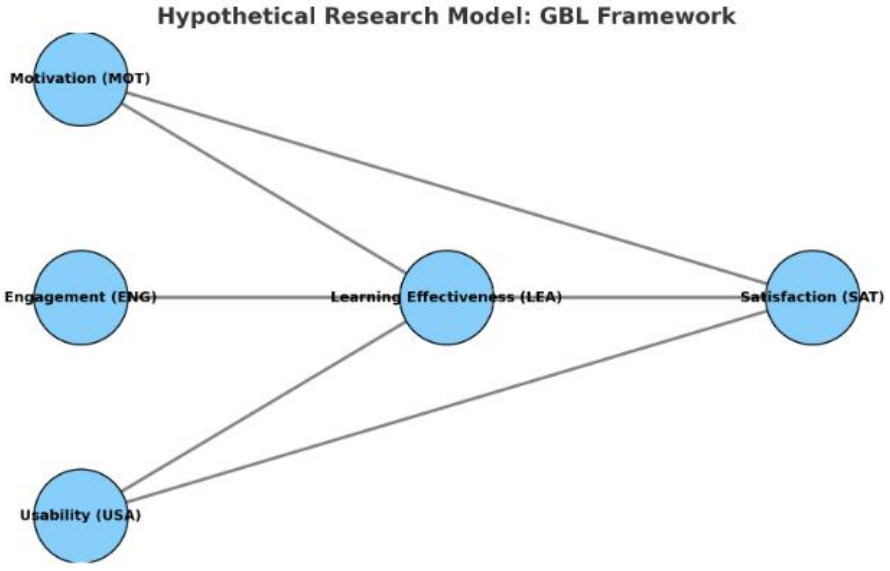

Fig. 1. Proposed Research Model for the GBL Framework

The study includes 7 hypotheses, which are: H1: Motivation positively influences Learning Effectiveness, H2: Motivation positively influences Satisfaction, H3: Engagement positively influences Learning Effectiveness, H4: Engagement positively influences Satisfaction, H5: Usability positively influences Learning Effectiveness, H6: Usability positively influences Satisfaction, H7: Learning Effectiveness positively influences Satisfaction.

Table 1. In-depth questions

Project	Code	Question
Motivation & Engagement	Q1	A recent experience when you learned through games (GBL): the situation, the tasks, the things that made you feel interested and helped increase your motivation to participate in your learning?
Game Mechanics & Usability	Q2	In your opinion, which elements of the game design (e.g., content, challenges, reward system, interface/navigation, teamwork, integration with learning content) help you understand the material best? And explain specifically with examples.
Transferability & Learning Effectiveness	Q3	Provide a specific example of when you applied GBL (or didn't) and were able to use the knowledge/skills learned from the game in an exercise or real-life situation. If you haven't been able to practice yet, what do you think the reason is?
Satisfaction	Q4	If you were given the opportunity to participate in a significant improvement process to increase the effectiveness and satisfaction of using GBL in the subject, what would you suggest?

3.2 Participants

This survey-based study focuses on university students who have or are currently using the GBL model in their learning process, have experience using AI technology, and learn through games. By examining students' perspectives and real-world experiences, educators will gain valuable feedback on how students have experienced and perceived the GBL model when applying it to their learning process, and what impact it has had. This will provide valuable insights into learning opportunities and highlight challenges that need to be addressed. An online survey on the variables in the GBL model was conducted via Google Forms and yielded 150 valid responses (n=150). The demographic information of the participants is presented in (Table 1):

Table 2. Results of frequency analysis on demographic variable

		Frequency	Percentage
Gender	Male	71	47.3%
	Female	79	52.7%
Student	Freshman	41	27.3%
	Sophomore	35	23.3%
	Junior	35	23.3%
	Senior	39	26%
Major	Information Technology	68	45.3%
	Business Administration	44	29.3%
	Communication Technology	19	12.7%
	Languages.	19	12.7%
GBL usage frequency	Daily	43	28.7%
	Weekly	68	45.3%
	Monthly	27	18%
	Never	12	8%
Game-Based Learning (GBL) acceptance	Yes	137	91.3%
	No	13	8.7%

3.3 Instrument

Two main tools have been conducted: Questionnaire scale: a questionnaire-based survey using the 5-point Likert scale that has been conducted to measure students' perceptions of motivation, participation, ease of use that impact learning outcomes, and their satisfaction with experiencing the model in the real world of the learning process. The questions were explored and identified based on previous model theory experiments when studying GBL to ensure high reliability and accuracy of the core content of the model.

In-depth interviews: Conduct in-depth interviews with information technology majors and faculty to gain more specific information about the educational opportunities, challenges, and feasibility of applying this model to the implementation of the formal curriculum framework. Specifically, the interview information includes

open-ended questions related to the design creation process, and receives student feedback and support from faculty and the school.

3.4 Data Collection Procedure and Analysis

This study was conducted using a mixed methods approach, combining quantitative and qualitative research. The quantitative survey was conducted through Google Forms with 20 quantitative questions to assess the level of the variables, along with 4 in-depth survey questions aimed at understanding the variables that directly impact learners' perceptions of applying the GBL model. The learner data collection process took place in September 2025, yielding 150 student responses through quantitative survey questions and variables. We proceeded to the data analysis stage, including Cronbach's alpha reliability analysis, t-tests, mean statistics, frequency statistics, one-way ANOVA, and regression. The range of values for the analysis variables is determined and evaluated using these statistical analysis methods, which is a way to describe and present results from the data in an accessible and comprehensive manner. The descriptive statistical indicators used have been explained in accordance with the research objectives. The average scores of the variables under consideration are based on the Likert scale, a common measurement method in research used to assess abstract variables related to behavior and attitudes, to draw conclusions.

4 Results and discussion

4.1 Survey results

Table 3. Cronbach's Alpha, Mean, and Standard Deviation

Criteria	N	Cronbach's alpha	Mean	SD
Motivation (MOT)	150	0.796	4.3000	.65053
Engagement (ENG)	150	0.795	4.2689	.64932
Usability of GBL Design (USA)	150	0.852	4.2689	.72937

Table 3 shows the results of the variable analysis with Cronbach's alpha reliability co-efficient, the mean and standard deviation values of the three observed variables. The Cronbach's alpha values for all variables on the scale are above the threshold of 0.70, indicating good internal consistency among the variables and achieving an accurate result of (MOT =. 796; ENG =. 795; USA =. 852). Among the analysis variables, the usability of the USA design of the GBL design showed the highest reliability (α = 0.852). The average scores for all variables are relatively high, ranging from 4.27 to

4.30 on a 5-point observation scale. This indicates that students generally have a positive view of the factors influencing motivation, engagement, and usability in game-based learning. The standard deviation ranged from 0.65 to 0.73, reflecting a moderate variation with no significant difference between the responses. The analysis results show that the variables measuring motivation, engagement, and usability for the model are reliable and suitable for this study. A special feature is that when the usability reaches the highest level of reliability and consistency, this serves as the basis for evaluating its robustness and suitability in assessing students' perspectives on GBL design. The average value across all factors is relatively high, indicating that students have a positive perception of the GBL model in promoting motivation and engagement, while also highlighting its user-friendliness. These results are consistent with previous studies, not only emphasizing that usability is a highly influential factor in learner satisfaction and effectiveness in the learning environment but also demonstrating adaptability and agreement when technology is supported. Motivation and engagement were positively evaluated, with high reliability and average values for the core variables, indicating their potential role in shaping learners' overall experience with GBL.

Table 4. Independent Samples T-Test and One-way ANOVA

Criteria	N	Sig. (Independent sample T-test)	Sig. (2-tailed) Equal variances assumed	Sig. (Test of Homogeneity of Variances)	Sig. (ANOVA)
Motivation (MOT)	150	.837	.732	.522	.733
Engagement (ENG)	150	.461	.820	.348	.830
Usability of GBL Design (USA)	150	.317	.343	.733	.768

Independent t-tests were analyzed to obtain results on motivation, engagement, and usability of the GBL design to examine if there were significant differences between male and female students. The results show no significant statistical differences in outcomes based on the two-variable survey samples across the three observed variables (Motivation: p =. 837; participation: p =. 461; Usability: p = .317), indicating that both gender

variables have relatively similar perceptions of GBL. The test for homogeneity of variance is not statistically significant, and the ability to confirm the fit is the same. One-way analysis of variance (ANOVA) was performed to examine and evaluate whether students' academic majors influenced their perceptions when three variables related to the GBL model were considered. The results showed no significant difference between the study fields regarding motivation (p =. 733), participation (p =. 830) or usability (p =. 768). These findings reflect students' consistent experiences with GBL, which are not influenced or dependent on their major. The analysis process examining differences by gender or major shows that students' overall perceptions of GBL are positive and that it is accepted and shared among students, regardless of demographic factors. This finding suggests that GBL values are designed to be effective and can provide an inclusive and diverse learning environment for various groups of learners. Besides, identifying usability and motivation as fundamental factors of GBL, it can overcome personal factors such as gender or academic expertise. Previous studies also suggest that the effectiveness and suitability of GBL depend heavily on the process of conceptualizing the design framework and incorporating educational and academic elements, rather than focusing on evaluating demographic variables.

Table 5. Results of regression model

Criteria	N	R Square	Adjusted R Square	F	Sig.
Learning Effectiveness (LEA)	150	.712	.702	96.558	.000

Table 6. Results regression coefficient

Criteria	N	B	Beta	Sig.
Motivation (MOT)	150	.255	.221	.007
Engagement (ENG)	150	.090	.085	.330
Usability of GBL Design (USA)	150	.356	.347	.000

Regression model results demonstrate the impact of Motivation (MOT), Participation (ENG), and Usability (USA) on Learning Effectiveness (LEA) in the application of the GBL model. The model is statistically significant, $F(3.146) = 96.558$, $p < 0.001$, showing that all factors are meant to explain the learning performance variable and the indicators clearly show the factors that have a strong influence. The R-squared value is 0.712 and the Adjusted R-squared is 0.702, indicating that about 70.2% of students think academic performance can be considered for three independent variables. In parallel in the Table, factors, motivation ($B = 0.255$, $\beta = 0.221$, $p = 0.007$) and Usability of the GBL Design ($B = 0.356$, $\beta = 0.347$, $p < 0.001$) contribute significantly to the model. In contrast, Engagement ($B = .090$, $\beta = .085$, $p = .330$) has an impact but not too significant. The results show that both motivation and usability of GBL design are

variables analyzed with a dominant index and it is an important premise in improving learning effectiveness. Usability was promoted and was the strongest factor, suggesting that when learners perceive a game-based learning design as easy to implement and understand, they are more likely to be confident in familiarizing themselves with the model and accept experimentation, leading to better learning outcomes. Motivation also contributed significantly, highlighting the view that motivated learners are more effective in perceiving and applying knowledge.

Table 7. Results of regression model

Criteria	N	R Square	Adjusted R Square	F	Sig.
Satisfaction(SAT)	150	.720	.715	95.445	.000

Table 8. Results regression coefficient

Criteria	N	B	Beta	Sig.
Motivation (MOT)	150	.251	.248	.012
Engagement (ENG)	150	.128	.097	.229
Usability of GBL Design (USA)	150	.383	.350	.000

Regression analysis was performed with these observed variables to examine the influence of Motivation (MOT), Engagement (ENG) and Usability of Design (USA) on Satisfaction (SAT) in the GBL model. The model was statistically significant, $F(3,146)=95.445, p<.001$, F(3,146)=95.445,p<.001, with $R2=.720$R2=.720 and adjusted $R2=.715$R2=.715, indicating that 71.5% of student satisfaction was clearly explained by the analysis of the observed variables of the model. The results showed that Motivation ($\beta = .248$, $p = .012$) and Usability of GBL Design ($\beta = .350$, $p < .001$) had a significant positive impact on Satisfaction. However, Engagement ($\beta = .097$, $p = .229$) had a lower index which indicated that the variable did not show a statistically significant impact. These findings suggest that student satisfaction may be influenced by motivation and usability as they can directly perceive the GBL (game-based learning) design. Reusability was the strongest factor, highlighting the need to focus on designing models that students find familiar and enjoyable to learn with. These are factors that can help accelerate the process of innovation and development of GBL models in user-friendly learning environments.

4.2 In-depth interview results

Q1

In the previous semester's course, I had a language assignment with a group. The way we learned for this assignment was that the teacher used role-playing games. We were divided into different roles to adapt and practice speaking English. I'm excited because

this activity is very interesting and the results are better than traditional exercises. Through this, each group can engage in healthy academic competition to win, and group assignments can gain the teacher's approval. This is a motivation I have gained through GBL learning. I find myself engaging with a more positive attitude because the game helps me practice my language speaking reflexes, not just play. (participants 1 – Q1).

Q2

.In my opinion, the most effective factor is the challenge combined with teamwork. For example, in science class, there's a lesson that uses a digital game, which helps us understand each step of the experiment and practice it in a detailed and systematic way. Clear rules and quick feedback help me get information quickly and resolve issues promptly. Learning together through group games made me feel closer to and more understanding of everyone. (participants 4 – Q2).

Q3

During my GBL experience, I applied what I learned from a business game to a group exercise. In the game, we must come up with spending plans for pricing, marketing, and product design. After that, we had a strategic analysis project for a real company. I realized that my gaming experience had prepared me mentally and taught me how to handle problems when they occurred in real life. If I hadn't experienced previous game models, I might not have been as well-prepared mentally when preparing my business plan. Experiencing the GBL model is like practicing in a safe environment before applying and practicing in real life. (participants 2 – Q3).

Q4

If I could suggest an improvement, I think it would be necessary to have a close link between the game and the test content, so that the direct benefits of GBL can be seen during the training process. Second, I would like to suggest adding the ability to receive feedback, not only from the system but also from teachers, to connect the gaming experience with the theory that teachers are teaching. These changes will make GBL more suitable for students' self-learning process and will be more meaningful when students themselves are the ones actively learning and drawing their own conclusions from the lesson. (participants 3 – Q4).

5 Conclusion

This study focuses on exploring the creation of a Game-Based Learning (GBL) framework, analyzing variables to understand the impact on student learning outcomes and satisfaction when applying the GBL model. These findings highlight the importance of creatively designing and appropriately ensuring the GBL framework, which is essential for the model to function in alignment with the core educational theoretical content educators aim to convey to students. GBL will be a preferred tool in

the future as it ensures the design framework is suitable for student needs and will likely thrive if updates are made effectively. This is a game model with the primary purpose of creatively and flexibly supporting students' learning process, meeting the changing needs of education and society.

6 Limitations

This study still has some limitations: the sample size for analysis is small (n = 150) and is primarily drawn from students in information technology and business fields. This may limit the breadth of coverage across disciplines, preventing a comprehensive and all-encompassing view of GBL analysis in general educational settings. and in-depth interviews can sometimes make participants hesitant to answer, which can lead to unreliable information and results that don't accurately reflect the reality of the issue. The research subjects are only students from one university, so sometimes it may not be possible to fully represent the views of other students in a general educational environment. Whether learning with their models and their perceptions of the effects of GBL can bring value to students or educators is still a question that cannot be answered with certainty. In the future, it is necessary to focus on developing teaching designs with GBL, as neglecting this issue will create a significant shortcoming and affect the effective operation of the model and bring value to students. Finally, the study relied solely on student perceptions and did not incorporate objective performance indicators such as grades or system log data. Future research should address these issues by expanding the survey model and designing a survey framework that meets common criteria.

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