

# Game-Based Learning (GBL) Success Factors in the Public Higher Education Learning System

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**Abstract**—Game-based learning (GBL) is a form of gaming that leads to learning outcomes. It is designed to align the subject matter with how we play the game and the willingness of the player to apply and execute the matter in real-life circumstances. GBL defines a modern form of teaching technique where students are discovering a significant feature of the game in a teacher-related learning environment. The goal of this study is to investigate the performance of GBL in the quality of learning at higher public institutions. The questionnaires were distributed to the target respondents and the data collected was analyzed using quantitative analysis methods to identify the study objectives and its performance. Results have shown that usefulness, perceived intention to use, and architectural design have a positive influence on the relationship to the efficiency of higher education learning systems. In conclusion, the outcome reveals that usefulness is the most important factor affecting the efficacy of the higher education system.

**Keywords**—Game-based learning, Usability, Usefulness, Effectiveness of Learning

## I. INTRODUCTION

THE uses of technology in teaching and learning plays an important role in improving understanding among students. The use of Game-based learning (GBL) helps to produce results by using the gaming approach. The game that has been used in GBL is designed to build a balance within the learning

area between how we play the game and how the player can treat the real-life scenario by applying and implementing it. By using GBL in our learning framework, we benefit a lot not just from the facts, but also from why and how we learn it. The acquisition of information through GBL makes us better understood, completely equipped to perform reliably, and effective in the new and unexpected situations [1].

Students are quickly bored by a typical lecture class and lose their interest. During their reading hours, they quickly lose concentration. In higher education, through the introduction and use of game-based learning, students become more participative and intuitive [2].

In the 21<sup>st</sup>-century, the criteria for skills vary from the skills provided before by our exiting (or exciting?) learning system [3]. The innovative and learning skills needed in the 21<sup>st</sup> century include critical thinking, imagination, teamwork, and communication. Moreover, it is difficult to estimate skills for the 21<sup>st</sup> century through traditional evaluation practices such as common standardized tests [4]. On the other hand, games need enhanced skills that are valued by the digital economy in the 21<sup>st</sup> century and provide a way to test certain skills that can be difficult to evaluate [5].

In other continents, GBL is commonly used. In Asia, too, it is a rising trend. We can see that game-based learning of Hong Kong and Singapore has already been extended to their curricula. Implementing GBL can be an interactive educational system tool in teaching at a higher educational level. Thus, this research aims to study the usability, usefulness, and perceived intention of GBL in the effectiveness of the learning system in higher education.

## II. LITERATURE REVIEW

### A. Learning System in Higher Education

Learning is the method where information is made through the transformation of experience. Additionally, the mixture of grasping and transforming experience will result in knowledge acquisition [6]. Learning systems could be a system that acknowledges the mutuality of variable individuals like principals, assistant principals, teachers, coaches, lecturers, syllabus and instruction workers, research and accountability workers enjoying completely different roles inside advanced institutions [7]. Different researchers mentioned that a learning system is a collection of artefacts that are 'brought together' to make an atmosphere that may facilitate numerous sorts of learning methods. It will take a range of various forms like a book, a computer, a web forum, a college, and a university. To attain specific learning outcomes, most learning systems can offer lots of learning resources and outline of procedures [8].

At present, world education centres on a world-class standard program, accenting on digital literacy from grade school to higher education. Traditional teaching provision has never served all groups in society [9]. While access has greatly improved within the last decades, the constraints of cash, time, and location still preclude groups of learners from collaborating in higher education. This trend we can see within the case for adults and a continuous learner. Students in higher education are a generation that can bring the country to better progress and will be developed to be an expert if higher education supports their learning constantly. In conclusion, teachers in the higher education system must have a deep understanding, wide information access, broad digital literacy, and handy online learning management. From this skillset, to promote effectiveness, they can accommodate advancement and are well prepared to teach students in the 21<sup>st</sup> century [10].

### B. Game-Based Learning (GBL)

A game is a physical or mental contest that has specific rules with the aim to amuse or reward

the gamers [11]. A game is also defined as an activity that was designed artificially with a specific aim, rules, and constraints located in a specific context [12].

Different from the definition of game, Game-based learning (GBL) is a medium of gaining knowledge and skill acquisition via gameplay where game activities require the player to solve problems and challenges provided to gain achievement [13]. GBL is the use of the power of entertainment by games to be used inside the learning system. It is also referred to as the consequences of a balance between learning and gaming elements [14].

### C. Types of GBL Games

GBL can be divided into two types of games. The first one is the special purpose games. It is a game that has been developed for educational purposes. The second type is a game that designed to be used in an educational context with the fun factor being implemented inside it that is called Commercial-Off-The-Shelf games [15].

There are three types of special-purpose games that can be defined. Some games aim to achieve knowledge transfer (cognitive learning outcomes), skill acquisition (skill-based learning outcomes), and/or attitudinal behavioural change (affective learning outcomes). For games that are designed to achieve knowledge transfer, it is applied in education such as math or language typically [15]. Games to aid skill acquisition are usually for practice or training session such as in military or corporate training. Some studies have already studied the impact of playing games to culture managerial skills because of the second type of games [16]. Finally, governments and NGOs use the third special-purpose game type, used to gain an understanding of a particular subject. In the health care industry, games to improve behaviour are usually found. For instance, some games encourage physical activity and children's healthy food. The primary emphasis of GBL has on targeted a certain form of learned result; secondary learning output cannot be excluded. For example, a game that mainly aims to teach English to children (cognitive results)

may also lead to a more favourable attitude towards the learning of English or English as a subject (affective learning outcomes) [15]. For this research, researchers think that the best game type is skill acquisition because students can improve their soft skills in higher education since higher education requires a student to be skilful and resourceful.

#### *D. Traditional Learning System VS Game-Based Learning*

The majority of researchers now acknowledge the advantages of digital learning games in terms of motivation and engagement based on the results. They found that games and simulations that are effective and educational give a more positive impact on learning quality rather than normal conventional learning. Besides, students showed a positive attitude in a learning system that used games as its base compared to the conventional ones. But we cannot easily jump to a conclusion where GBL and simulation have a positive effect on learning and motivation.

#### *E. Usability*

Usability is defined as the degree of learnability of the game [17]. Users deal with the games easily and naturally. Most of them did not face game-related issues and did not get instructions from observations. Usability is often described in conjunction with the playability of a user and is characterized as the user's operational ability to perform a special task known as the human-computer interface or human agent [18]. Designing educational software needs usability as a significant agent. It is the capacity that the product can be used for specialist users for specific purposes by delivering the satisfaction, efficiency, and effectiveness of a limited field of usage. Usability can be implemented in the education field by focusing on designing learning activities, user interaction, and ensuring that learning goals are achieved. Intuitiveness is a must for the interface in educational software because the purpose of GBL is to make users play games that have a learning context implemented in it [17].

#### *F. Usefulness*

There are a lot of advantages of GBL in technological implementations in various fields of knowledge. Usefulness is the function provided by the system. GBL technology gave an advantage to users to feel motivated where it uses cognitive methods, differentiating the alternatives of the solution, giving examples, and significant results of experience. Educational games have benefits in education where it can give people motivation to enroll in local courses and make them as an instructor, build a learning group in the area and request needed resources from the local government and fully implement them inside educations [17]. A combination of entertainment and education in GBL makes it convenient for instructors and easy to use. Plus, edutainment applications can be manipulated in pedagogical environments. GBL grants skills for students such as the ability to manage complicated missions, finish work in time, and fast adaption to the change of environments. Students will take part repeatedly in the educational operations when they perceive a relationship between their daily routines and games aspect. If they are submitted as a challenge or quiz, they will pay more attention to edutainment games. Some studies also said that GBL would lower the development cost and give a vast experience that is intuitive for students where the educational content is presented in games [18].

#### *G. Perceived Intention to Use*

Since the mid-1970s, understanding an individual's behaviour for using a lot of information technology systems and tools has been an essential topic of research. Intention to use is derived from behavioural intention and is defined as "the strength of one's intention to perform a specified behaviour". Behavioural intention is a significant determinant of user behaviour in technology acceptance since usage is significantly correlated to behavioural intention to use. Plus, behavioural intention is a significant predictor of action [19]. To simplify, previous research has shown that behavioural intention to use GBL is both a valid and reliable measure of GBL usage in the future.

Moreover, students may increase their basis of technology acceptance effectively using GBL. The application of the TAM model would seem to be favourably indicated for understanding conceptual issues related to GBL use.

H. Architectural Design

The architecture permits users to act his/her preferred characters in RPG (Role-Playing Game), these ingredients react with realistic world patterns, and that they manage the domain pattern of the game and spread of the multimedia system. It is hard to balance how to teach and what to teach, what kind of game is needed in education for the education system to become more practical [20].

Evaluation of the architectural design is crucial in making games usable in the learning system includes usability, character design, the efficiencies of narrative pattern, and reaction facilities. The directives of edutainment software need to match with the cognitive architecture of individuals and human differences GBL has a utility for academic content [21].

I. Research Framework

In this research framework, the main target is to study the key factors, concept or variables, and the presumed relationship among them. Thus, a research framework is produced as below. The framework shown in Figure 1 are the independent variables such as usability, usefulness, effectiveness, perceived intention to use, and architecture design that affecting the learning system of higher education.

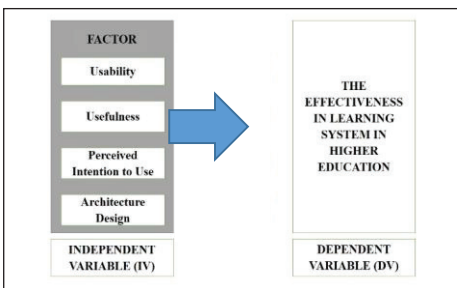


Fig. 1. Research Framework

III. RESEARCH METHODOLOGY

To accomplish the aims and objectives of the study, this research used a survey for research strategies. The questionnaire is developed in English to ensure that the respondents fully understand what the questions are about. Plus, the researcher decides to use the simple random sampling method. The questionnaire paper is divided into two sections that are the demographic section and the statement about the variable of the research for the respondent to answer. This questionnaire is a close-ended type and it was distributed through the Internet by using Google Form and directly to the targeted sample.

For data analysis, descriptive statistical analysis, Pearson's's correlation analysis, and multiple linear regression analyses were used.

IV. DATA ANALYSIS

A. Pilot Test

A pilot test is a method used by researchers to determine the validity of the questionnaire distributed to the respondent. This research study was conducted with the pilot test of 30 respondents before the actual questionnaire was distributed. The respondent consists of university and college students around Melaka. A total of 20 questions in the questionnaire were distributed to respondents engaged in a pilot test. All the data were collected in a Microsoft Excel spreadsheet. Questions in the questionnaire were modified based on the results contained in the pilot test.

For the pilot test testing, the reliability test was conducted using the Statistical Package for Social Science version 20. Cronbach's Alpha was used to examine the internal reliability of the pilot test. Reliability was considered weak when alpha coefficient scores below the range of 0.6. If the alpha coefficient scores in the range of 0.6 to 0.8, it is considered as being moderately strong. Lastly, if the alpha coefficient was in the range of 0.8 to 1.0, it is considered very strong.

TABLE I. RELIABILITY STATISTICS

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.980	.980	20

Table 1 shows the total number of independent variables and the dependent variable in Cronbach's alpha. In this table, Cronbach's alpha showed more than > 0.9 with a value of 0.980. This shows that all the question of the independent and dependent variable is reliable and can be used in the pilot test.

*B. Descriptive Analysis*

This section explains the demographic profile of respondents includes their gender, age, ethnicity, levels of higher education, and frequency of game playing. Besides, this section also analyzed the respondents' opinions on whether the game can be used as a good learning tool or not. Table 2 shows the result of 384 collected questionnaires. There is no so much different in terms of gender. Moreover, the highest respondent range of age is from 18 – 25 years old at the percentage of 90.6% which equivalent to 348 respondents. From this result, it shows that almost the entire respondent is aged between 18 – 25 years old since that is the standard age for the student that involved with this GBL. Based on ethnicity, the majority of the respondent's ethnicity is Malay at the percentage of 62.8% that consists of 241 respondents. The result for the ethnicity follows the percentage of the ethnic group in Malaysia. In terms of education, most of the respondents were degree holders and they are quite positive on the usage of GBL in higher education. The majority of respondents also spend about once a week playing the game for entertainment and leisure. This shows that respondents like to play games repetitively. This data is good input that can be used to implement GBL in teaching and learning at higher education. Also, to examine relationships within the data that might not be readily apparent when analyzing total respondents, we conducted the cross-tabulations analysis. This analysis presents the result of the entire group and subgroups of respondents as shown in Figure 2.

Results show that both male and female respondents with a total of 229 respondents agree with the use of the game as a learning tool in higher education with a percentage of 65.94% (151 respondents) and 34.06% (78

respondents) respectively. Results also show that both male and female respondents with a total of 90 respondents are either agree or disagree with the use of the game as a learning tool in higher education with a percentage of 38.89% (35 respondents) and 61.11% (55 respondents) respectively. From this analysis, it can be deduced that both males and females positively approve the usage of the game as a learning tool in higher education. This suggests that they perhaps want a new way of pedagogy in our current learning system

TABLE II. DEMOGRAPHIC FACTORS

Demographic Factors		Percentage (%)
Gender	Male	57.3
	Female	42.7
Age	18 - 25 Years	90.6
	26 - 33 Years	8.1
	34 - 41 Years	1.0
	42 - 50 Years	0.3
Ethnicity	Malay	62.8
	Chinese	27.3
	Indian	5.2
	Others	4.7
Level of Higher Education	Diploma	21.1
	Degree	75.3
	Master	2.9
	PhD	0.8
Responses of the respondent about the game as a learning tool in higher education	Strongly Disagree	1.3
	Disagree	4.2
	Neutral	23.4
	Agree	59.6
	Strongly Agree	11.5
Frequency of respondents playing game	Many times a day	4.3
	About once a day	31.3
	A few times a week	8.9
	Once a week	6.5
	A couple of times	4.9
	Rarely	5.5

Analysis Between Level of Higher Education and Responses of Respondents about Game as a Learning Tools in Higher Education shown in Figure 3. Results show that diploma, degree, and master respondents with a total of 229 respondents agree with the use of the game as a learning tool in higher education with the percentage of 22.27% (51 respondents), 72.93% (167 respondents), and 4.37% (10 respondents) respectively.

Results also show that diploma and degree respondents with a total of 90 respondents are either agree or disagree with the use of the game

as a learning tool in higher education with a percentage of 21.11% (19 respondents) and 77.78% (70 respondents) respectively. From this analysis, it can be assumed that both diploma and degree respondents positively approve the usage of the game as a learning tool in higher education.

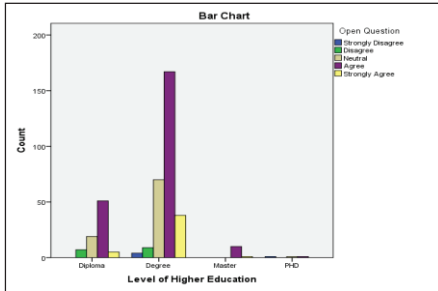


Fig. 2. Cross-Tab Analysis Between Respondents Level of Higher Education and Responses of Respondents about Game as a Learning Tools in Higher Education

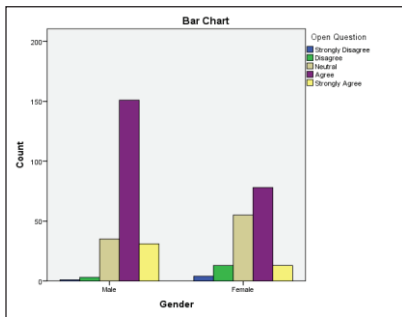


Fig. 3. Cross-Tab Analysis Between Gender and Responses of Respondents about Game as a Learning Tools in Higher Education

Cross-Tab analysis between respondents' gender and their gaming frequency has shown in Figure 4. Results indicate that most of the male respondents playing games many times in a day with a total of 138 respondents while most of the female respondents playing games about once a day with a total of 58 respondents. From here, we can conclude that male respondents like to involve themselves and spend their time playing the game. Unlike the female, they might have less interest in the game due to their interest in books, cosmetic, and social media.

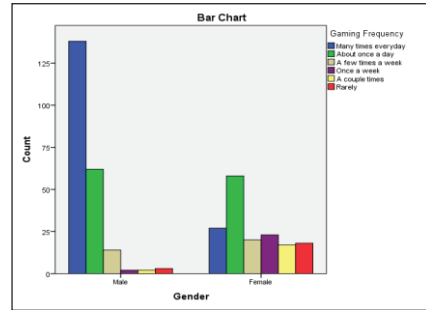


Fig. 4. Fig. 4.9: Cross-Tab Analysis Between Respondents Gender and Their Gaming Frequency

C. Descriptive analysis for Independent Variable.

The items in the research questionnaire have been interpreted by using the Likert Scale. To determine the minimum and the maximum length of the 5-point Likert type scale, the range is calculated by using this formula:

Afterwards, number one of the least value in the scale was added to identify the maximum of this cell. The length of the cells is determined in table 4.3.3 below:

Based on the descriptive analysis from Figure 5 until Figure 8, all the independent variables mean is located in the high range section that ranges between 3.67 and 5. This shows that majority of respondents agreed with the statement in the questionnaire regarding the independent variables respectively.

TABLE III. RANGE TABLE

Scale	Strength
1 – 2.33	Low
2.34 – 3.67	Moderate
3.67 - 5	High

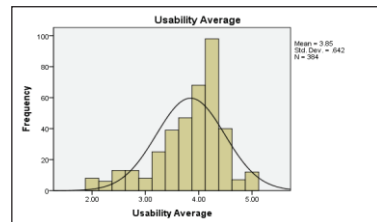


Fig. 5. Independent Variable: Usability

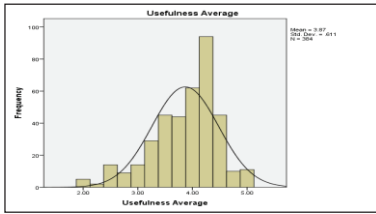


Fig. 6. Independent Variable: Usefulness

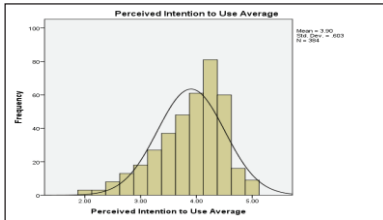


Fig. 7. Independent Variable: Perceived Intention to Use

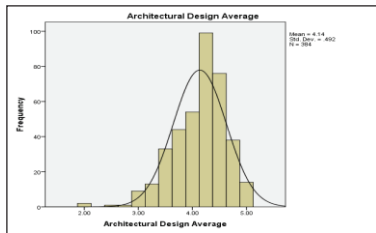


Fig. 8. Independent Variable: Architectural Design

D. Pearson’s Correlation

In this research, the researcher intended to study the factors (usability, usefulness, perceived intention to use, and architectural design) that influence the effectiveness of the learning system in higher education. Pearson’s goal to make the correlation analysis in this study is to find the relationship between the independent variable is whether it is positive, negative, or zero.

TABLE IV. THE RANGE OF THE CORRELATION MATRIX OUTPUT AND STRENGTH OF RELATIONSHIP

Correlation Coefficient (r)	Strength of Relationship
<0.20	None
0.21 – 0.35	Weak Positive
0.36 – 0.60	Moderate Positive
0.61 – 0.80	Very Strong Positive
=1	Perfect Positive

TABLE V. TABLE 4: STRENGTH OF PEARSON CORRELATION COEFFICIENT

Variables	Pearson Correlation	Strength of Correlation
Usability	0.677	Very Strong
Usefulness	0.725	Very Strong
Perceived Intention to Use	0.708	Very Strong
Architectural Design	0.616	Very Strong

From the result in table 4, the highest correlation is between the usefulness and the effectiveness of the learning system in higher education with a positive correlation of 0.708. The lowest Pearson Correlation value belongs to the relationship between architectural design and the effectiveness of the learning system in higher education. Its correlation coefficient is 0.616. The other variables correlation between the independent variable (IV) and the dependent variable (DV) mostly are positive. Therefore, the positive linear relationship will cause an increase in one variable if the other is increased.

E. Multiple Regression Analysis

Multiple regression analysis is utilized to test the hypothesized relationship between independent variables that are usability, usefulness, perceived intention to use, and architectural design towards the dependent variable that is the effectiveness of the learning system in higher education.

TABLE VI. MODEL SUMMARIES OF MULTIPLE REGRESSIONS

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.761 <sup>a</sup>	.579	.575	.34904

a. Predictors: (Constant), Architectural Design Average, Usefulness Average, Usability Average, Perceived Intention to Use Average

From the research analysis by using multiple regression analysis in Table 5, R is 0.761, which is a high correlation (strong correlation) between the independent variable and dependent variable. It is strong because the value is more than 0.5 and shows the

respondent is good on the key success factor of the game-based learning in the effectiveness of the learning system in higher education. Other than that, the coefficient of determination, that represent, as  $R^2$  is the proportion of variance in one variable associate with the variability in a second variable. From the result, it shows  $R^2$  is 0.579 which means 57.9% of the variation was explained by the independent variable, while the rest is explained by other causes. That's means 42.1% of the different factors that influenced the effectiveness of the learning system in higher education used for this study.

TABLE VII. ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	63.508	4	15.877	130.319	.000 <sup>b</sup>
Residual	46.174	379	.122		
Total	109.682	383			

a. Dependent Variable: Dependent Variable Average  
 b. Predictors: (Constant), Architectural Design Average, Usefulness Average, Usability Average, Perceived Intention to Use Average

The F-ratio ( $F=130.319, p=0.000$ ) indicates that the result of the regression model could occur by chance. However, the significance of ANOVA and the p-value of the coefficient must indicate  $p<0.05$ . It shows that the model was significant with 0.000 significant values.

TABLE VIII. COEFFICIENTS

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.789	.153		5.173	.000
Usability Average	.075	.055	.090	1.362	.174
Usefulness Average	.302	.062	.345	4.888	.000
1 Perceived Intention to Use Average	.205	.059	.231	3.460	.001
Architectural Design Average	.184	.052	.169	3.539	.000

a. Dependent Variable: Dependent Variable Average

Based on the table 4.5.3, the linear equations were developed as following where

$$y = .789 + .075 x_1 + .302 x_2 + .205 x_3 + .184 x_4$$

In the discussion of the coefficient, the beta value of the unstandardized coefficient will be used for the regression equation. If the p-value of the test statistic is  $<0.05$ , the test statistic has a statistically significant relationship and if the p-value of the test statistic is  $>0.05$ , the test statistic is not statistically significant [22].

From the equation, the coefficient of usability is 0.075 which means that every unit increase in each factor, there will be an increase in the effectiveness of the learning system in higher education with value 0.055, and the standard coefficient value of beta 0.090 with a t-value of 1.362. The p-value of this factor was not significant with 0.174 values. Perhaps the respondent didn't see the benefits and the effectiveness of GBL in the higher education system. Therefore, [17] mentioned that usability can be implemented in the education field by focusing on designing learning activities, user interaction, and ensuring that learning goals are achieved.

For the second factor, which is usefulness, the beta value of the unstandardized coefficient is 0.302, and the standard coefficient value of beta 0.345 with a t-value of 4.888. The p-value of this factor was significant with 0.000 values. The third factor is the perceived intention to use which the beta value of the unstandardized coefficient is 0.205 while the standard coefficient value of beta 0.231 with a t-value of 3.460. The p-value of this factor was significant since the value was 0.001.

The last factor is the architectural design. The unstandardized coefficient beta value is 0.184 while the standard coefficient value of beta is 0.169 with a t-value of 3.539. This factor was significant since the p-value is 0.000.

#### F. Hypothesis Testing

In discussing the research finding of hypotheses 1, 2, 3, and 4, the analysis was done using the Multiple Regression Analysis. Only three independent variables that are usefulness, perceived intention to use and architectural design were significant towards the effectiveness of the learning system in higher education.



G. Summary of Finding

Overall from the hypothesis testing from table 4.7, the p-value of hypothesis H1 was rejected because of  $t\text{-table} < t\text{-calculated}$  while the p-value of hypothesis H2, H3, and H4 were accepted because of  $t\text{-table} < t\text{-calculated}$ .

TABLE IX. SUMMARY RESULT OF HYPOTHESIS TESTING

Y = value of dependent variable  
 variable a = constant  
 b, c, d, e = coefficients  
 $X_1, X_2, X_3, X_4$  = value of independent variable

IV	df	$\alpha$	t <sub>table</sub>	t <sub>calculated</sub>	Hypothesis Test	Result
Usability	379	0.05	1.649	1.362	t <sub>table</sub> < t <sub>calculated</sub>	Rejected H1
Usefulness				4.888	t <sub>table</sub> > t <sub>calculated</sub>	Accepted H2
Perceived Intention to Use				3.460	t <sub>table</sub> > t <sub>calculated</sub>	Accepted H3
Architectural Design				3.539	t <sub>table</sub> > t <sub>calculated</sub>	Accepted H4

Finally, the multiple regression analysis was used and all of these results also were proven that the most influencing factor is usefulness, perceived intention to use, and architectural design with a p-value of 0.000. The significant relationship can be represented as the following equation from the analysis as a multiple regression equation:

$$Y = a + cx_2 + dx_3 + ex_4$$

where  $Y = .789 + .302x_2 + .205x_3 + .184x_4$

V. CONCLUSION

The study suggested recommendations that are based on the study findings. Firstly, usefulness, perceived intention to use and architectural design shows significant positive towards the key success factor of game-based learning (GBL) in the effectiveness of the learning system of higher education. The Minister of Education or those who are involved in applying GBL in the education system may take into consideration the factor of usefulness, perceived intention to use, and architectural design. For the usefulness factor, they need to study what is the best method to present the game in a useful manner of education. Some studies mentioned

that GBL would lower the development cost and give a vast experience that is intuitive for students where the educational content is presented in games. This could be one way for the education system to be more effective in the future. The process of implementation does not have to be instantaneous, but slowly in step. As a recommendation, our education system can take a deep look at this matter and try to implement GBL in higher education since most of the respondents are positive towards the implementation of GBL.

Concerning the usability factor which failed to achieve positive significance toward the effectiveness of the learning system of higher education, respondents may well have been had at least experienced in using the game as a learning tool. [17] mentioned that usability can be implemented in the education field by focusing on designing learning activities, user interaction, and ensuring that learning goals are achieved. Perhaps the respondent didn't see the benefits and the effectiveness of GBL in the higher education system. If the government wants to implement GBL in the future, it highly recommends that they do marketing to promote the ideology of GBL to ensure that people are well aware of what is GBL.

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