

**Relationship Between Knowledge and Attitude of Game-Based Mathematics Learning Approach among Pre-Service Teachers in Perak**  
*[Hubungan antara Pengetahuan dan Sikap Terhadap Pendekatan Pembelajaran Matematik Berasaskan Permainan dalam Kalangan Guru Pelatih di Perak]*

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**Purpose and Research Question** - Game-based learning (GBL) is where game characteristics and principles are embedded within learning activities. GBL could be one of the learning approaches that can be used to remedy the shortcomings of traditional teacher-centered instruction, which has been commonly accused of ignoring the needs of students with low achievement. The main purpose of this study is to investigate the relationship between knowledge and attitude towards the game-based mathematics learning approach among UPSI pre-service teachers.

**Methodology** - A survey study with quantitative approach using questionnaire as the instrument has been conducted involving 100 pre-service teachers in the AT14 Bachelor of Education (Mathematics) course in Semester 7 from UPSI. The statistical method used in this study is descriptive statistics. Mean and inferential statistics through Pearson's correlation were used to study the relationship between knowledge and attitude towards game-based mathematics learning approach.

**Findings** - The findings show that the level of knowledge and attitude of pre-service teachers on the use of GBL is significantly high. The results showed that there was a strong positive significant correlation between the knowledge and attitude of pre-service teachers towards the use of GBL ( $r = .749$ ,  $p = 0.00$ ,  $p > 0.05$ ).

**Significance and Contribution in Line with Philosophy of LSM Journal** – The results of this study are significant to educational researchers who are considering the use of game-based learning to boost mathematics achievement in school. In conclusion, this study shows some potential to be a reference toward improvement of GBL execution to get involved in the aim and goals on behalf of Ministry of Education's intention to improve the quality of education.

**Keywords:** *Game-based learning; Knowledge; Attitude; Pre-service teacher*

### Abstract

Game-based learning (GBL) is where game characteristics and principles are embedded within learning activities. GBL could be one of the learning approaches that can be used to remedy the shortcomings of traditional teacher-centered instruction, which has been commonly accused of ignoring the needs of students with low achievement. The main purpose of this study is to investigate the relationship between knowledge and attitude towards the game-based mathematics learning approach among UPSI pre-service teachers. A survey study with quantitative approach using a questionnaire as the instrument has been conducted involving 100 pre-service teachers in the AT14 Bachelor of Education (Mathematics) course in Semester 7 from UPSI. The statistical method used in this study is descriptive statistic. Mean and inferential statistics through Pearson's correlation were used to study the relationship between knowledge and attitude towards game-based mathematics learning approach. The findings show that the level of knowledge and attitude of pre-service teachers on the use of GBL is significantly high. The results showed that there was a strong positive significant correlation between the knowledge and attitude of pre-service teachers towards the use of GBL ( $r = .749$ ,  $p = 0.00$ ,  $p > 0.05$ ). The results of this study are significant to educational researchers who are considering the use of game-based learning to boost mathematics achievement in school. In conclusion, this study shows some potential to be a reference toward improvement of GBL execution to get involved in the aim and goals on behalf of Ministry of Education (MoE's intention to improve the quality of education.

**Keywords:** game-based learning, knowledge, attitude, pre-service teacher

### Abstrak

Pembelajaran berasaskan permainan (GBL) merupakan satu kaedah pengajaran dan pembelajaran. GBL boleh menjadi salah satu pendekatan pembelajaran yang boleh digunakan untuk memperbaiki kelemahan pengajaran tradisional berpusatkan guru. Tujuan utama kajian ini adalah untuk mengkaji hubungan antara pengetahuan dan sikap terhadap pendekatan pembelajaran matematik berasaskan permainan dalam kalangan guru pelatih UPSI. Kajian tinjauan dengan pendekatan kuantitatif menggunakan soal selidik sebagai instrumen telah dijalankan dengan 100 orang guru pelatih dari kursus AT14 Sarjana Muda Pendidikan (Matematik) pada Semester 7 di UPSI. Kaedah statistik yang digunakan dalam kajian ini ialah statistik deskriptif. Min dan statistik inferensi melalui korelasi Pearson untuk mengkaji hubungan antara pengetahuan dan sikap terhadap pendekatan pembelajaran matematik berasaskan permainan. Dapatan kajian menunjukkan tahap pengetahuan dan sikap guru pelatih terhadap penggunaan GBL adalah ketara tingginya. Hasil kajian menunjukkan terdapat korelasi signifikan positif yang kuat antara pengetahuan dan sikap guru praperkhidmatan terhadap penggunaan GBL ( $r = .749$ ,  $p = 0.00$ ,  $p > 0.05$ ). Hasil kajian ini adalah signifikan kepada penyelidik pendidikan yang mempertimbangkan penggunaan pembelajaran berasaskan permainan untuk meningkatkan pencapaian matematik di sekolah. Kesimpulannya, kajian ini menunjukkan beberapa potensi untuk dijadikan rujukan untuk penambahbaikan pelaksanaan GBL bagi merealisasikan hasrat Kementerian Pelajaran Malaysia (KPM) untuk meningkatkan kualiti pendidikan.

**Kata kunci:** permainan berasaskan permainan, pengetahuan, sikap, guru pelatih

## Introduction

Mathematics is a field of knowledge that trains the mind to think logically and systematically in problem-solving and decision-making (Cresswell & Speelman, 2020). Nowadays, education is prospering, with several new theories and techniques claiming to solve learning problems. One of the new ways being applied in the teaching and learning process is the game-based learning methodology.

In one study, Justin et al. (2016) examined that there was a significant improvement in the achievement of students taught using the game-based method. Students should be encouraged to learn algebra using the game-based method. Mathematics teachers have a lot to do by incorporating games into the teaching and learning process, as students who were taught using the game-based method scored higher than those who were taught using the traditional method. Meanwhile, Findings by Hung et al (2014) inferred that learning with digital games on e-books can attract the attention of students and engage them in mathematical practices, which could be the reason why some students had significantly better mathematical achievements than others. A classroom activity that promotes student-driven exploration is the use of gaming in the classroom.

Multiple studies have been conducted in this research field, however none of empirical studies substantiate the relationship between knowledge and attitude towards game-based mathematics learning approach among pre-service teachers in UPSI. There exist some studies that have investigated the students' view of GBL in educational settings (Larsson, 2012), but less studies on the teacher perspective. This research presents a GBL approach, which is a form of new teaching and learning activity that has not been actively practiced in the formal education system in Malaysia (Sayed Yusoff, Wee & Muhammad Zaffwan, 2014). Games support learning by allowing students to develop knowledge and cognitive skills, to learn by problem-solving, and to experience situational learning (R. Raja & P.C. Nagasubramani, 2018). With this huge increase in game-based learning applications come natural questions about their effects on students.

The research objectives for this study aim to determine the knowledge level towards game-based mathematics learning approach among UPSI pre-service teachers, to determine the attitude level towards game-based mathematics learning approach among UPSI pre-service teachers as well as to determine the relationship between knowledge and attitude towards game-based mathematics learning approach among UPSI pre-service teachers.

### Research Questions

In this study, a game-based mathematics learning approach is conducted on UPSI pre-service teachers to investigate the following research questions:

Q1: What is the percentage of pre-service teachers in UPSI who used a game-based mathematics learning approach before?

Q2: What is the knowledge level towards the game-based mathematics learning approach among UPSI pre-service teachers?

Q3: What is the attitude level towards the game-based mathematics learning approach among UPSI pre-service teachers?

Q4: What is the relationship between knowledge and attitude towards the game-based mathematics learning approach among UPSI pre-service teachers?

## Research Questions

$H_0$  : There is no relationship between knowledge and attitude towards game-based mathematics learning approach among UPSI pre-service teachers

$H_1$  : There is a relationship between knowledge and attitude towards game-based mathematics learning approach among UPSI pre-service teachers

## Literature Review

Every nation's educational system, as a social institution, is critical to the survival and well-being of society's needs. Education should not only be comprehensive, affordable, and of excellent quality, but it should also be evolving to meet the needs of a rapidly changing and volatile globalised environment (Serdyukov, 2017). To be labelled as innovation in education, it must bring about a desirable and meaningful change. Most of the time, this idea will be met with opposition from a variety of people. Innovation must be capable of enhancing the current condition over the prior one. Innovation is a changing process and activity that is always focused on experimentation and knowledge advancement (Dayang Rafidah, Khalip & Hamidah, 2020).

Game-based learning methods might take the form of physical or digital environments in the classroom (Hung, CM., Huang, I. & Hwang, GJ, 2014). In a physical setting, teachers incorporate game components into existing physical game-based materials, which blend fun and excitement into learning (Fouze, A. Q., & Amit, M, 2017). Good teaching contains three basic components namely content, pedagogy, and technology, as well as the relationship between these three components. These three components form the core framework of TPACK (Technology knowledge, pedagogy, and content). The development of the TPACK framework is critical to providing effective teaching. Based on the Tricomponent Model (Ahmad, M. F., 2018), attitudes are categorized into three components, namely affective (feelings), cognitive (beliefs), and behavioral (perceptual tendencies).

To motivate students to actively participate and remember what they have learnt, educational games are used to assist them in recall. Although learning does not imply memorization, students can utilise the game to memorise key facts that can be applied in real-life situations through exams (Tawafak, & Romli, Ruzaini & Sohail, 2019; Mathew, Malik & Tawafak, 2019; Alfarsi, Jasiya, Ragad, Abir & Maryam, 2019; Tawafak, 2019). Through a series of game rules and conditions, GBL can help to enhance critical thinking and problem-solving. Using games that are beneficial to students with attention difficulties is a fun way to learn, and it can help students pay attention. Web-based games have been found to aid students with attention problems (Clustering, 2019; Tatnall, 2020). Another positive outcome of the gaming experience was the strengthening of the student team's relationship and cohesion, which was especially important given that the game began early in the semester and there was a lot of team activity and results later in the course (Alfarsi, Sulaiman, Tawafak, Malik, Jabbar & Alsidiri, 2019). Through the reduction of the fear of failure and inaccuracy, games provide opportunity for developing positive attitudes toward mathematics and developing self-concept (Abu & Miriam, 2018).

## Methodology

### Research Design

Correlation studies were used to investigate and measure levels of relationships between knowledge and attitude of game-based mathematics learning approach among UPSI students.

By conducting a correlational design study, researchers can share benefits that illustrate the relationship and allow generalizations to populations, where possible declare the relationship between the variables.

### **Population and Sample**

The population of this study consisted of AT14 Bachelor of Education (Mathematics) course students in Semester 7 from Universiti Pendidikan Sultan Idris (UPSI). There are approximately 127 undergraduate students updated in 2022. According to Krejcie and Morgan (1970), on average if the total study population was 127 students, then the required study sample size was 97 students. 100 pre-service teachers were chosen as the sample for this study.

### **Sampling Technique**

In this study, the researcher had chosen a simple random type sampling procedure. The researcher chose this simple random sampling method so that everyone had the opportunity to be sampled for the study in addition to reducing sampling errors.

### **Instrument**

In this study, the researcher used a questionnaire consisting of three parts. Part I of the research instrument gathered respondents' profiles such as their gender, experience of using GBL, and type of GBL application that they had used before. Part II of the research instrument consisted of the questionnaire to collect information of their knowledge of game-based mathematics learning approach from the aspect of content, pedagogical and technological. Part III of the research instrument was about the attitude of the sample towards game-based mathematics learning approach from the aspect of domain affective, cognitive and behaviour. Each of the items was a 4-point Likert – type-rating scale with four response options. The options were: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly disagree (SD) rated 4, 3, 2 and 1.

As measuring reliability and validity of questionnaire was one of the most important criteria of a study, hence, before the execution of the process the same was measured through appropriate techniques. The panel mathematics education expert examined the appropriateness of the questionnaire based on the objective of the research. Based on the expert's feedback, some amendments were made to the instruments such as the wording and the content of the instruments. The Cronbach Alpha ( $\alpha$ ) was used to estimate the internal consistency (reliability) of the instrument. The choice of Cronbach Alpha ( $\alpha$ ) method was because the responses did not entail right or wrong, pass or fail answers but the level of agreement or disagreement with each statement of the given items in the instrument. The study instrument was considered to have an acceptable internal consistency if the Cronbach's alpha value for each instrument internal scale exceeded the value of 0.7 ( $> 0.7$ ) (George & Mallery, 2003).

### **Data Analysis**

The data obtained from the questionnaire were analyzed using IBM Statistical Package for the Social Sciences software. Descriptive analysis was performed on the first and second research questions to determine and view percentage, knowledge and attitude of game-based mathematics learning approach among UPSI pre-service teachers. Pearson correlation was used in correlation analysis to determine the relationship between knowledge and attitude of game-based mathematics learning approach among UPSI pre-service teachers.

## Results and Discussion

### Analysis of Respondents by Gender

This study involved a total of 100 respondents from the AT14 Bachelor of Education (Mathematics) course consisting of 34 males and 66 females. The findings of the study showed that 34% of respondents are male pre-service teachers while 66% of respondents are female pre-service teachers.

### Analysis of Respondents by Experience in Using Game-Based Learning

Most respondents had experience using the application, which is 96 people (96%) while 4 people (4%) had no experience using game-based learning applications. This means that most of the pre-service teachers at UPSI have experience in using game-based learning applications.

### Analysis of Respondents According to the Type of Game-Based Learning Application That Has Been Used

Most respondents used the Kahoot application which is 30 respondents (30%). 12 respondents used the WordWall (12%) and 10 respondents used the Quizizz application (10%). 44 respondents (44%) used other applications such as Puzzle, BINGO, Quizlet and so on. Another 4 respondents (4%) had not use any game-based learning application before.

### Analysis of Pre-Service Teachers' Knowledge of the Use of Game-Based Learning Applications from Content, Pedagogy and Technology Aspects

The following Table 1 is the summary of the abovementioned findings.

Table 1 Analysis of Pre-Service Teachers' Knowledge of the Use of Game-Based Learning Applications from the Aspects of Content, Pedagogy and Technology

Knowledge Aspects	Mean Score	Mean Interpretation
Content	3.45	High
Pedagogical	3.48	High
Technological	3.37	High
Knowledge Construct	3.43	High

Based on Table 1, the teacher's knowledge of the use of game-based learning applications from the aspects of content, pedagogy, and technology is high, which was 3.43. Of the three aspects, the aspect of pedagogical knowledge had the highest score while the aspect of technological knowledge had the lowest score. This illustrated that teachers have a high knowledge of the use of game-based learning applications from the pedagogical aspect. Pre-service teachers that able to provide appropriate activities or assignments to develop analytical, critical and creative skills among students. Directly, this practice can encourage the independent learning process among students and stimulate their interest and curiosity. The integration of entertainment game-based elements promotes engagement to learners' active participation in learning (Pesare, Roselli, Corriero, & Rossano, 2016).

Pre-service teachers' technology knowledge was seen to be still at a low level compared to content and pedagogy knowledge. This happened because teachers were seen as less know how to solve technical problems related to the technology used in game-based learning in

mathematics classroom, even less know different types of technology that can be used in game-based learning applications in mathematics classroom.

High technological knowledge was needed to further improve the teaching and learning process and interaction between instructors and students (Muhammad & Finley, 2016). Pre-service teachers need to be given sufficient opportunities to increase their interest and skills in using game-based learning applications which must start from the training they get from their lecturers during teaching training.

### **Analysis of Pre-Service Teachers' Attitudes Towards the Use of Game-Based Learning Applications from the Affective, Cognitive and Behavioral Domains**

The following Table 2 is the summary of the abovementioned findings.

Table 2 Analysis of Pre-Service Teachers' Attitude on the Use of Game-Based Learning

Knowledge Aspects	Mean Score	Mean Interpretation
Affective	3.46	High
Cognitive	3.47	High
Behaviour	3.45	High
Attitude Construct	3.46	High

Based on Table 2, the pre-service teachers' attitude toward the use of game-based learning applications from the aspects of affective, cognitive, and behaviour domains is high, which was 3.46. Of the three aspects, the aspect of the cognitive domain had the highest score of 3.47 while the aspect of the behaviour domain had the lowest score of 3.45. This illustrates that teachers had a high attitude toward the use of game-based learning applications from the cognitive domain because most teachers think that game-based learning methods can improve the quality of work. In addition, teachers think game-based learning was one of the latest learning methods which is one of the 21st century teaching methods.

Although the three domains of teacher attitude have a high mean, but the attitude from the domain of pre-service teachers' behavior is seen to be in a low place. The item with the lowest mean score where the teacher may access game-based learning applications when using the internet. This practice caused teachers to feel that game-based learning applications are complicated. If teachers always explore game-based learning applications, attitudes from the behavioral domain will not be at the lowest level. Most teachers were also seen as not always ready to use the game-based learning application to the best of my ability. This may be because they may think that mathematics subjects are not suitable for using game-based learning.

Through attitudes from the affective domain found the affective domain found that teachers are comfortable discussing with students using game-based learning applications. The mean score showed the level of attitude from the teacher's affective domain was at a high level. Game-based learning has gained popularity as an effective and innovative instructional strategy among 21st century mathematics teachers (Lavin-Mera, Torrente, Moreno-Ger, Vallejo-Pinto, & Fernández-Manjón, 2009; Mansour & El-Said, 2009).

## Analysis of the Relationship Between Knowledge and Teacher Attitudes Towards the Use of Game-Based Learning Applications

The following Table 3 is the summary of analysis.

Table 3. Analysis between the Pre-service Teacher's Knowledge and Attitude towards the use of Game-Based Learning Applications

		<b>Knowledge</b>	<b>Attitude</b>
<b>Knowledge</b>	Pearson Correlation	1	.749**
	Sig. (2-tailed)		<.001
	N	100	100
<b>Attitude</b>	Pearson Correlation	.749**	1
	Sig. (2-tailed)	<.001	
	N	100	100

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

Table 3 shows that there was a strong positive significant relationship ( $r = .749$ ,  $p = 0.00$ ,  $p > 0.05$ ) between knowledge and attitude. This means that the knowledge score had a strong positive relationship with the attitude score, i.e., the higher the knowledge score, the higher the attitude score. High knowledge in using game-based learning applications can provide a positive attitude such as interest, and confidence in the teacher. This result means that a teacher who has high knowledge is also likely to tend to have a high attitude. All respondents have carried out teaching training and easily integrated technology in teaching. According to Hashim (2012), educators who have teaching experience and solid knowledge in pedagogy may find it easier to integrate technology in teaching. Fred D. Davis (1989) states that the ease of use for a system can encourage a person's attitude to use it. Therefore, the level of a pre-service teacher's attitude can be expected through his level of knowledge. So,  $H_0$  is rejected.

### Conclusion

Through pre-service teachers' knowledge of the game-based learning approach, the results of the study showed that the mean score of pedagogical knowledge was at the highest level compared to the aspects of content knowledge and technology knowledge. For pre-service teachers' attitudes towards the use of game-based learning approach, the cognitive domain was ranked highest compared to the affective domain and the behavioral domain. The results of the study show that there was a strong and significant relationship between knowledge and attitude to game-based mathematics learning approaches among pre-service teachers. To realize the Ministry of Education's desire to improve the quality of global education, the practice of implementing game-based learning by pre-service teachers needs to be improved from time to time.

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