# A STUDY ON THE RELATIONSHIP BETWEEN GAME-BASED LEARNING AND SECONDARY SCHOOL STUDENTS' MATHEMATICS ACHIEVEMENT IN SMK KOMPLEKS GONG BADAK

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## ABSTRACT

*Digital game-based learning (DGBL) is an instructional method that incorporates educational content or learning principles into video games with the aim of engaging learners. The teaching techniques in schools are mostly still teacher-centered where the practice of exercise and memorization of tips and formulas are emphasized in learning. This research studied the relationship between game-based learning with the achievements of students in SMK Kompleks Gong Badak, specifically in Mathematics. Quantitative approach-based research and a single cross-sectional design were employed. A set of questionnaires were used for data collection. Data samples were collected from approximately 100 students in the selected school. The result shows that DGBL significantly affects student's achievements, indicating a good perception of its application. Gender also plays a role in this case, where a significant difference was also found in the mean usage of game-based learning toward mathematics achievement between male and female students. Due to these results, it can be concluded that DGBL does affect students' achievement in mathematics. In addition, one of the most effective approaches to achieving a student-centered learning process is through the use of DGBL.*

**Keywords**:*Game-based Learning, Gender, Mathematics Achievement, Perception.*

## 1. Introduction

Education is a constant effort to generate outstanding human capital physically, emotionally, spiritually, intellectually, and socially (MOE, 2013) and this is all done in the teaching and learning process. The teaching techniques in schools are mostly still teacher-centered where the practice of exercise and memorization of tips and formulas are emphasized in learning (Kassim & Zakaria, 2015). Traditional teaching in schools does not completely help the students to understand mathematical concepts because the learning process is only focused in the classroom without other teaching aids. There are some practical ways by which mathematics teachers can make a difference in the academic life of students who find no intrinsic motivation in mathematics. This is something more that must be done and taken into

greater account to be able to improve the academic performance of high school students in mathematics (Jose & Ruth 2020). Game-based learning GBL is a mathematics teaching technique that creates a balance between classroom learning and educational games while enhancing learning efficiency through student-centered learning activities (Lasut & Bawengan, 2020). One of the most effective approaches to achieving a student-centered teaching and learning process is game-based learning (GBL). Game-based learning (GBL) promotes active learning processes by providing students with the possibility of solving problems in the form of games. This teaching aid is a game in which a combination of games in learning is applied among students where the students can feel the excitement of the learning session (Ismail & Ahmad, 2014). The advancement of technologies has rapidly risen for the past few years, which brings a lot of benefits especially to the users (Ramli *et al*., 2020). The implementation of game-based learning in any subject, especially Mathematics, which is often considered a boring subject may help to boost the academic achievement of students. This is because game-assisted learning gives students advantages in increasing their learning skills not only in exams, but also improves their oral communication, social interaction skills, creative thinking skills, imaginary and divergent thinking skills, and problem-solving skills.

The Ministry of Education of Malaysia already launched 21st-century learning where Malaysia will embark on a new level of learning that incorporates the use of technology in the classroom. According to (Wahid, 2020) the GBL and gamification are used together in 21st century learning. Both have similar approaches to applying a culture of innovation in making the teaching and learning process more interactive and consequently should be able to improve the quality of national education (Wahid, 2020). According to (Sedig, 2008), many students including secondary school students agreed that learning Mathematics poses a variety of difficulties. The International Student Assessment Program (PISA) in 2018 and Descriptions of the International Benchmarks of Mathematics Achievement (TIMSS), stated that in Malaysia, student's scores in Mathematics were below the Organization for Economic Cooperation and Development (OECD) average. The lack of interest is also shown by Malaysia's younger generation in Science, Technology, Engineering, and Mathematics (STEM) subjects (Kannan, 2019). It was found that most students perceived Mathematics as a difficult subject due to the challenges in understanding and remembering the concepts (Gafoor & Kurukkan, 2015). Lack of interactive game-assisted learning in Mathematics class may also affect student's Mathematics performance.

Thus, this research was conducted to find out if the application of game-based learning in Mathematics subject will have an effect on secondary school students in SMK Kompleks Gong Badak. This study aims to fulfill the objectives below:

1. To investigate the effect of game-based learning on Mathematics achievement of students in SMK Kompleks Gong Badak.
2. To identify the perception of students in SMK Kompleks Gong Badak towards game-based learning in their Mathematics achievement.
3. To compare the mean usage of game-based learning towards Mathematics achievement between male and female students in SMK Kompleks Gong Badak

## 2. Literature Review

### 2.1. Game-Based Learning Effect in Secondary School Students' Mathematics Achievement.

Taclay (2013) studied the effects of Mathematical games on the scores of students in Geometry in Nueva Vizcaya. They found that the students exposed to the mathematical games approach achieved a higher achievement score compared to students who were exposed solely to the traditional way (classroom) teaching. There was also a significant relationship between game-based learning and mathematics achievement. He also advocated that the employment of the mathematical games method during the presentation and discussion of Geometry classes had successfully ensured students grasped and internalise the Mathematical ideas and

ultimately enabled them to earn higher scores. This was further confirmed by the findings of a study by Abonyi *et al.* (2014), on the influence of Mathematical games on students' achievement in quadratic expressions, which found that the Mathematical game techniques outperformed the conventional way. Additionally, the research revealed that using mathematical game methods resulted in increased mathematics achievement, particularly in quadratic expression. Another study carried out by Anderson in 2016 stated that mathematics games promote strategic and logical thinking which can help to improve mathematics achievement It was proposed that game-based learning might be an excellent method of presenting learning experiences in an appealing and inspiring manner, hence increased students' interest in STEM fields and academic achievement (Musselman, 2014). Mathematics video games contributed to a higher degree of Mathematics achievement compared to traditional instructional methods (Tokac, 2019). However, many teachers consider games as a waste of time. Hence they often fail to achieve the educational objectives contained in the curriculum. Their main concern is the lack of time to complete the syllabus and the fear of not being able to adequately prepare students for the final exams (Hassan, 2012).

## 2.2. Students' Perception Towards Game-Based Learning on Mathematics Achievement

Youngsters find it easier to accept change in various fields, especially from aspects of innovation in education. Teachers play an important role in DGBL, which may be helpful to pupils in school, particularly in the topic of Mathematics. Based on research by Rambely *et al.* (2014), indicated that the students showed more interest in Mathematics-related topics when game-based learning was used in Mathematics classrooms. Mathematical games are used to pique students' interest in the topic of Mathematics in past research. Most students find it difficult to describe something in the abstract if they only learn in traditional classroom ways without other teaching aids. As supported by Wang *et al.* (2020), students easily get bored with traditional lecture classes and tend to lose their interest in class. During reading time, students also may quickly lose focus. Based on Bakhsh (2016), it was mentioned that game-based learning is one of the ways that can be implemented in the classroom in order to avoid boredom. Contemporary studies have already recognized the ability of digital games to catch children's attention and drive them to push the boundaries of their competence, abilities, and knowledge in the digital era (Fokides & Samioti, 2023). Engaging games in the classroom was seen as a helpful tool for learning and it was intended to include students in educational experiences in order to achieve particular learning objectives and outcomes (Zirawaga *et al.*, 2017). Smiderle *et al.* (2020) also studied the significance of applying game elements to their study to create an enjoyable learning environment and concluded that gamification can increase students' edutainment and enhance their understanding of learning materials.

## 2.3. The Usage of Game-Based Learning Towards Mathematics Achievement Between Genders

Games are played by young and old, male, and female, and all over the universe. Games have become an accepted instrument for educational purposes. Most of the research shows that boys love games more than girls do, and both genders have different gaming reasons (Leonhardt & Overa 2021). In general, it shows that boys and girls have different learning preferences (Arnup *et al.*, 2013). The results also indicate that there are significant differences between men's and women's preferences for gaming material. Boys prefer action games, whereas girls prefer simulation games such as puzzle games. Boys and girls appear to have different motivations for playing games, resulting in these differences in preferences. Girls are less motivated by both performance and mastery-achievement goals, but boys are more motivated to outperform other players. Results on gender differences in various gaming behaviours and tactics, including peer collaboration, social interaction, roleplaying, and tactical behaviour, are equivocal. Girls prefer gameplay that emphasizes teamwork, community, rich storytelling, creativity, and positive acts, whereas boys favor games that emphasize competitiveness, individual use, drill, and practice. To sum up, a research study has stated that the results showed that there were indeed significant differences in participants of different genders in terms of gameplay flow, test anxiety and gameplay progress

performance, but there was no significant difference in the continuance gameplay intention (Wang *et al*., 2022).

### 2.4. Conceptual Framework

The associations between the variables in this study are DGBL and secondary school mathematics achievement. Figure 1 shows the suggested conceptual framework.
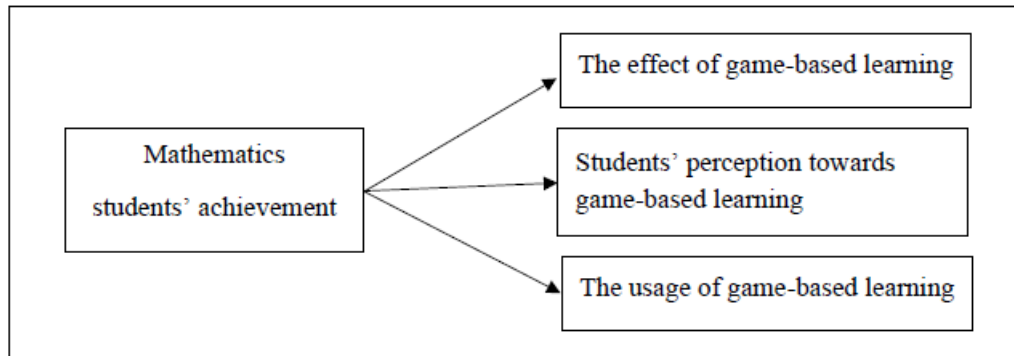


Figure 1. Conceptual Framework

### 3. Methodology

This study used quantitative approach-based research. The type of research design used in this study was a single cross-sectional design. Single cross-sectional design refers to the study in which only one sample is gathered from the population and the data is obtained only once. The target population for this study was all students taking Mathematics in SMK Kompleks Gong Badak.

     The population of students at SMK Kompleks Gong Badak was 994. The margin of error chosen was ±5%, and the sample size needed was 100 based on Figure 2. Stratified and simple random sampling were used in this study as a sampling technique. In stratified sampling, the population was divided into several mutually exclusive strata. In this case, the population was the students from Form 1 Ibnu Khaldun, Form 2 Ibnu Majjah, Form 3 Ibnu Sina, Form 4 Ibnu Abbas, and Form 5 Ibnu Sina. Meanwhile, simple random sampling is a sample drawn from a population in such a way that every member has an equal probability of getting chosen. For random sampling, the sample was randomly selected from all secondary students in SMK Kompleks Gong Badak within each stratum. This sampling approach has the potential to reduce bias associated with the same probability of selecting a sample and to increase the generalizability of findings. First and foremost, the name list of 994 secondary students was obtained from the management of SMK Kompleks Gong Badak, Terengganu. Then, the sample needed for each stratum was calculated. The total sample for each stratum was 100, thus 100 questionnaires were randomly passed to respondents.
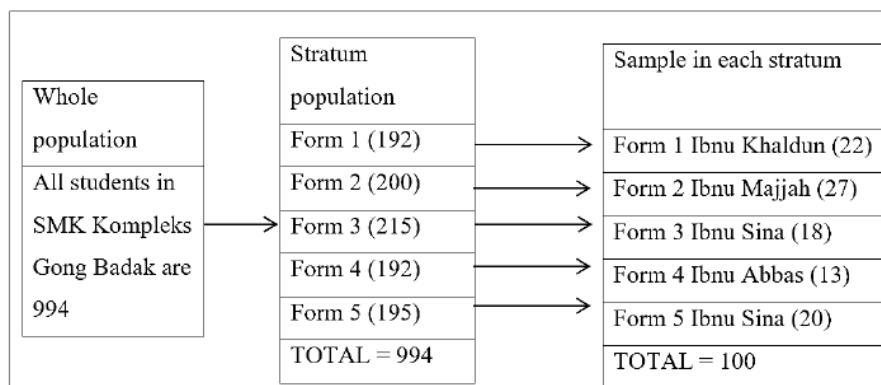


Figure 2. Sample Size

A structured questionnaire was used in this study. The questionnaire is summarized in Table 1 below. It was divided into three sections where section A consisted of demographic information of respondents such as gender, Form, and their Mathematics results. Section B was the response of respondents on '*Game-Based learning*' and Section C collected the perception of respondents on '*The relationship between game-based learning and students' Mathematics achievement*'.

In Section B, the respondents were provided with a Likert scale from 1 to 5. The rating scale started from (1. Strongly Disagree, 2. Disagree, 3. Neutral, 4. Agree and 5. Strongly Agree). Section C consisted of questions on respondents' perception of '*game-based learning*' and their '*usage of game-based learning*'. A similar Likert scale as in Section B was also provided. In both sections, the respondents need to tick their answers from 1 to 5 based on their views of the given statements.

Table 1. Summary of the Questionnaire by Section

| Section | Construct | No. of Item |
|---|---|---|
| A | Respondents' information | 3 |
| B | Game-based learning | 6 |
| C | The relationship between game-based learning and students' mathematics achievement<br>• Game-based learning and mathematics achievement.<br>• Perception on game-based learning<br>• Usage of game-based learning | 8<br>5<br>5 |

### 3.1. Validation of the Questionnaire

The pilot or preliminary test was done to gauge the reliability of the study's questionnaire. 10 people were initially chosen to respond to this questionnaire prior to distribution. A reliability test (Cronbach's alpha) was performed. The questionnaire for this study comprises 22 items and has a Cronbach's alpha score of 0.984 overall which indicates that the developed instrument has good validity and reliability

### 3.2. Research Analysis

The data was analyzed using IBM Statistical Package for Social Science version 23 (IBM SPSS Statistics 23.0). This SPSS helps to facilitate data clearing and checking for logical inconsistencies. Table 2 shows the research analysis that was conducted in this study.

Table 2. Research Analysis Table

| Research Objective | Instrument | Respondent | Types of Analysis |
|---|---|---|---|
| 1. To investigate the effect of game-based learning on secondary school students' mathematics achievement in SMK Kompleks Gong Badak. | Questionnaire | Form 1-5 students | Descriptive Statistics: Mean and Standard Deviation<br><br>Pearson Correlation Coefficient |
| 2. To identify the secondary students' perception in SMK Kompleks Gong Badak towards game-based learning | Questionnaire | Form 1-5 students | Descriptive Statistics: Mean and Standard Deviation |

| | | | |
|---|---|---|---|
| on mathematics achievement. | | | |
| 3. To compare the mean usage of game-based learning towards mathematics achievement between male and female student in SMK Kompleks Gong Badak | Questionnaire | Form 1-5 students | Independent sample t-test |

## 4. Results

### 4.1. Does game-based learning affect secondary school students' Mathematics achievement in SMK Kompleks Gong Badak?

Table 3 shows the mean and standard deviation for the effect of game-based learning on secondary school students' mathematics achievement. The effect of game-based learning on mathematics achievement, descriptive analysis was conducted by using a Linkert scale question. It has shown that the overall mean score of game-based learning affecting Mathematics achievement is 3.93 (SD = 0.824). The highest rating was obtained for Item 1 (I can understand the content of the lessons more effectively). This means that most of the students believed that they could understand the content of the lesson easily (Mean = 3.99, SD = 0.759).

They also claimed that through the use of game-based learning, the mathematical concepts were well taught (Item 5, with the Mean = 3.98 and SD = 0.724). Next is Item 2, (The use of technology-based gamification as teaching aids in teaching helped them to remember better) with the Mean of 3.96 and SD of 0.777). This is followed by Item 4- *'The use of technology gamification-based teaching aids gave a clear picture of complex numbers'*(Mean = 3.91, SD = 0.842), subsequently by Item 3- *'The use of gamification-based teaching aids in teaching can improve understanding'* (Mean = 3.89, SD = 0.815).

The lowest mean is the last item- *'The students believe their mathematics scores are getting better with the use of play activities during learning'* (Mean = 3.86, SD = 1.025). The Pearson correlation coefficient to determine the relationship between the effect of game-based learning and students' mathematics achievement shows a positive weak correlation and signifies a significant relationship (r=0.203, p= 0.043<0.05) between these variables. This means that there was a positive relationship between the effect of DGBL and the Mathematics achievement of the students in SMK Kompleks Gong Badak.

Table 3. Descriptive statistics for the effect of game-based learning

| No | The effect of game-based learning | Mean | Standard Deviation |
|---|---|---|---|
| 1 | I can understand the content of the lesson more easily. | 3.99 | 0.759 |
| 2 | The use of technology-based gamification as teaching aids in teaching helped me to remember better. | 3.96 | 0.777 |
| 3 | With the use of gamification -based teaching aids in teaching can improve my understanding. | 3.89 | 0.815 |
| 4 | The use of technology-based gamification-based teaching aids gave me a clear picture of complex numbers. | 3.91 | 0.842 |

| 5 | I was able to master well-taught mathematical concepts. | 3.98 | 0.724 |
| 6 | My math scores are getting better with the use of play activities during learning. | 3.86 | 1.025 |
| | **Average Mean** | **3.93** | **0.824** |

Table 4 shows the Pearson correlation coefficient to determine the relationship between the effect of game-based learning and students' mathematics achievement. The results show a positive weak correlation and there is a significant relationship ($r = 0.203$, $p = 0.043 < 0.05$) between these variables. Thus, the null hypothesis is rejected. This means that there is a relationship between the effect of game-based learning and secondary school students' mathematics achievement in SMK Kompleks Gong Badak.

Table 4. Relationship between the effect of game-based learning and students' mathematics achievement.

| | | Highest Mathematics achievement | Mean Effect |
|---|---|---|---|
| **Highest Mathematics achievement** | Pearson Correlation | 1 | 0.203 |
| | Sig. (2-tailed) | | 0.043 |
| | N | 100 | 100 |
| **Mean Effect** | Pearson Correlation | 0.203 | 1 |
| | Sig. (2-tailed) | 0.043 | |
| | N | 100 | 100 |

## 4.2. What is the secondary student's perception in SMK Kompleks Gong Badak towards game-based learning on Mathematics achievement?

Table 5 shows the mean and standard deviation for the students' perception of DGBL on Mathematics achievement. The overall mean for students' perception of game-based learning on mathematics achievement is 4.16 (SD = 0.787). The highest mean is for Item 3- *'The students enjoy when teachers use technology-based teaching aids in mathematics teaching'* (Mean = 4.25, SD = 0.809). Next is Item 2- *'The video and audio used in the gamification teaching aids are interesting and appropriate'* (Mean = 4.20, SD = 0.804). The average mean in this part is Item 4-'*The use of technology-based in the teaching of Mathematics is able to increase my interest in the subject of mathematics'* (Mean = 4.14, SD = 0.766), followed by Item 5- '*The students also feel that teaching that uses technology-based teaching aids should be implemented in every Mathematics lesson'* (Mean = 4.13, SD = 0.837). The lowest mean is Item 1- *'The student's perception towards all the game-based learning that they have experienced is the gamification-based teaching aids use appropriate background colours'* (Mean = 4.10, SD = 0.718). Table 8 shows the mean and standard deviation for the students' perception of DGBL on Mathematics achievement.

Table 5. Descriptive statistics for student's perception towards game-based learning

| No | Perception towards game-based learning | Mean | Standard Deviation |
|---|---|---|---|
| 1 | The gamification -based teaching aids use appropriate background colors. | 4.10 | 0.718 |
| 2 | The video and audio used in the game-based learning teaching aids are interesting and appropriate. | 4.20 | 0.804 |
| 3 | I enjoy it when teachers use technology-based teaching aids in mathematics teaching. | 4.25 | 0.809 |

| | | | Mean | SD |
|---|---|---|---|---|
| 4 | The use of technology game-based in the teaching of mathematics is able to increase my interest in the subject of mathematics. | | 4.14 | 0.766 |
| 5 | I feel that teaching that uses technology-based teaching aids should be implemented in every mathematics lesson. | | 4.13 | 0.837 |
| **Average Mean** | | | **4.16** | **0.787** |

### 4.3. Is there any significant difference in the mean usage of game-based learning towards Mathematics achievement between male and female students in SMK Kompleks Gong Badak?

As can be seen from Table 6, it shows the mean usage of game-based learning towards mathematics achievement between genders among students in SMK Kompleks Gong Badak. Based on Levene's test, the homogeneity of variance failed to be achieved since the value is less than 0.05. Hence, the result indicates that there is a significant difference in the mean usage of game-based learning towards mathematics achievement between male and female students in SMK Kompleks Gong Badak with t (100) = 2.560, p-value = 0.012 < 0.05. That is, the mean usage of game-based learning by males (M = 4.285, SD=0.576) was significantly different from the mean usage of females (M = 3.909, SD = 0.847). This indicates that both male and female students among SMK Kompleks Gong Badak have significant differences in the usage of preferences in game-based learning.

Table 6: Mean usage of game-based learning towards mathematics achievement between gender

| | Gender | N | Mean | Standard Deviation | t | df | Sig. (2 tailed) |
|---|---|---|---|---|---|---|---|
| Mean Usage of Game-Based Learning | Male | 47 | 4.285 | 0.576 | 2.560 | 98 | 0.012 |
| | Female | 53 | 3.909 | 0.847 | | | |

## 5. Discussion

### 5.1. Does game-based learning affect secondary school students' Mathematics achievement inSMK Kompleks Gong Badak?

The findings of this study revealed there is a relationship between the effect of game-based learning and students' Mathematics achievement for the students of SMK Kompleks Gong Badak. This is due to the use of computer games for teaching which has increased students' active participation and motivation as well as their socialisation in the classroom. As cited in a study by Tokac (2019), he suggested that Mathematics games contributed to a higher degree of Mathematics achievement compared with traditional instructional methods. The students get the opportunity to discuss Mathematics with their friends freely and without fear through Mathematical games. Educational games have a positive impact on high-level thinking skills and enhance learners' engagement when compared to traditional learning methods (Sezgin *et al.,* 2018). The effect of DGBL can boost the cognitive skills of students, such as sustained attention, solving problems, logic, and reasoning, and also working memory which enables students to cope with homework and learning challenges well and enthusiastically. As consistent with the highest mean of this study where the students can understand the content of the lesson more easily followed by the students being able to master well-taught Mathematical concepts and the use of technology-based gamification as teaching aids in teaching helped them to remember better. Research by Game-based learning can make students more creative and focus better on their studies, facilitating the learning process with their friends, encouraging collaborative behavior through problem-solving, and maintaining the students' interest in the learning process (Khairuddin & Mailok, 2019). Mathematics games promote strategic and

logical thinking which can help to improve mathematics achievement (Anderson, 2016). It also fosters problem-solving abilities and mathematical fluency. (Hui & Mahmud, 2023) also recommended the use of DGBL to assist students in addressing their misconceptions, improve learning engagement, and have a good impact on student learning to support the findings. As such, the use of GBL, which promotes an environment that combines game content with knowledge, will enhance the students' learning progress. Studies by Ferguson (2014) contradicted current research results, this might be due to some students may not respond effectively to game-based learning because they have some misconceptions about the process. Many game platforms have their own features and limitations that can influence how learners interact with games, and accordingly influence student achievement (Thompson & Gillern, 2020). Somehow, in contrast to 56% of studies that measured the effectiveness of games on learning achievement, 32% of studies on GBL resulted in better student performance (Chu & Hung, 2015), consistent with our current findings.

### 5.2. What is the secondary student's perception in SMK Kompleks Gong Badak towards game-based learning on Mathematics achievement?

The highest students' perception toward DGBL on Mathematics achievement is students enjoy the class when teachers use technology game-based and teaching aids in Mathematics teaching. Students easily get bored with traditional lecture classes and tend to lose their interest in class. In addition, during reading time, students tend to quickly lose focus. Hence, through the introduction and use of game-based learning, students become more participatory and intuitive. Followed by the second higher mean which is student's satisfaction with the video and audio used in the game-based teaching aids, and agrees they are interesting and appropriate. Hence, it shows that visual, special effects, sound effects, excellent interface design have an incredible influence on the overall gaming experience including educational games. As mentioned in the research, an established and well-designed computer game is a significant motivator for learning mathematics (Khairuddin & Mailok, 2019). Next, the perception towards game-based learning is students agree that the use of technology game-based in the teaching of Mathematics can increase their interest in Mathematics. Effective learning techniques can offer chances for students to be interested in learning and to put out significant effort to achieve success. One of the reasons for students' difficulties in learning Mathematics is that they have a negative perception of the teachings that they are being taught. The result is a coefficient with a study where the results indicated, using electronic cooperative surroundings had an impact on developing positive attitudes toward Mathematics which strengthened their motivation and interest in learning it (Al Khateeb, 2019). Lastly, the students also agree with the statement that they feel teaching using game-based learning should be implemented in every Math lesson. As supported in an article, traditional teaching in schools does not completely help the students to understand Mathematical concepts because the learning process is only in the classroom without other teaching aids. One of the most effective approaches to achieving a student-centered teaching and learning process is the use of DGBL (Coleman & Money, 2020).

### 5.3. Is there any significant difference in the mean usage of game-based learning towards Mathematics achievement between genders in SMK Kompleks Gong Badak?

The results of this study showed there is a significant difference in the usage of game-based learning towards Mathematics achievement between male and female students in SMK Kompleks Gong Badak. This indicates that the usage of game-based learning, and Mathematics achievement is also affected by gender. The study results shown here are associated with previous research which shows significant differences in preferences between boys and girls seem to be related to a different motivation to play games (Lukosch *et al*., 2017). Following a research study has stated that the results showed, there were indeed significant differences in participants of different genders in terms of gameplay flow, test anxiety and gameplay progress performance (Wang *et al*., 2022). This study finding shows that male students likely tend to like the usage of game-based learning in the classroom compared to female students. This major difference between both genders happened due to the attitude towards game-based learning. The majority of past studies show that males like to play games more than female students do, and

both genders have different gaming reasons (Jhan *et al.*, 2022). The male students not only spend more time than females playing games, but they also prefer different types of games such as action games, whereas female students prefer simulation games like puzzle games. Hence, the male shows a positive attitude towards DGBL due to the game emphasise competitiveness, individual use, drill, and practice. Meanwhile, female students prefer games that emphasise teamwork, community, storytelling, and creativity. As a whole, it appears that boys and girls have different learning preferences (Arnup *et al.*, 2013). For example, males prefer to be game-based in terms of challenges, competition, or social interactions, compared to females who prefer creative games. It can be concluded that male students prefer the usage of DGBL in the classroom compared to female students, in contradiction with the research done by Almusharraf *et al.* (2023), who showed that motivation when using GBL is not confined to one gender over the other but rather showed that both female and male students reacted similarly, and both exhibited a great interest in the game.

## 6. Conclusion

It can be summarized that there is a significant relationship between the effect of game-based learning and the mathematics achievement of students in SMK Kompleks Gong Badak. It shows that there is a good perception towards game-based learning on Mathematics achievement. This study also indicates gender does play a role in this matter, as there was a significant difference in the mean usage of game-based learning towards mathematics achievement between male and female students. Due to these significant results, we can conclude that DGBL does affect students' achievement in Mathematics. All research objectives have been successfully addressed in this research. In a nutshell, it is important to consider DGBL in the teaching and learning process. DGBL can help in producing an enjoyable, and fun class environment, and at the same time it can help students with strategic and logical thinking.

Hence, one of the most effective approaches to achieving a student-centered teaching and learning process is the use of DGBL. Consequently, it will help to fulfill the aim of pedagogy by the Malaysian Ministry of Education to live the new norm of learning in the 21st century.Although the findings from this study can be applied to a variety of DGBL activities, several research limitations, such as research methods or data, must be improved in the future. First, the sample size selected consisted of only 100 respondents. According to Memon *et al.* (2020), for the best data analysis, the sample size should be at least 100 respondents. As a result, future researchers should keep in mind that increasing the sample size of respondents will result in more significant and reliable data. In addition, it is advisable for future researchers to go for a quasi-experimental research design to measure the effect of game-based learning more accurately and precisely. This is due to the opportunity to compare students' achievement in one respective subject through pre and post-tests before and after the implementation of game-based learning in their learning session.

**Author Contribution**

Author1 prepared the literature review, oversaw the article writing, wrote the research methodology and performed fieldwork. Author1 and Author2 conducted the statistical analysis and interpreted the results. Author2 prepared and presented the paper at the conference, I-CReST 2023.

**Conflict of Interest**

The authors have no conflicts of interest to declare.

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