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Research Article

Game based learning in mathematics: Future teachers' viewpoint

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Abstract

The purpose of this research is to describe the views of future teachers towards the practice of game-based learning in mathematics. This research is descriptive quantitative-qualitative research. Data obtained through a questionnaire about game-based learning. Research participants are mathematics education undergraduate students who were in the final semester (104 participants). The results showed that 91.35% of participants agreed if learning in the classroom is based on game and 89.42% of participants agreed that students would easily learn through game. The future teachers state that game-based learning is necessary because mathematics learning must follow current technological developments. In addition, games can be useful to improve various abilities of students from the cognitive, affective, and psychomotor domains and mathematics learning becomes effective and efficient. A small number of participants disagreed with game-based learning in mathematics because of several things, including the adverse effects of using mobile phones, the class is not conducive, and students only focused on playing games, not on the topic.

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Introduction

Game based learning is learning that is designed by involving aspects of the game in the classroom. The characteristics of playing games can be interesting situations for students to learn (Wijaya, 2019). This will have a positive impact on learning, especially mathematics leaning. Game entertainment in learning activities can increase student activity and motivation (Sorathia & Servidio, 2012). It can be said, aspects of the game in learning are important.

The combination of game-based learning with technological tools for innovation is well suited to the current digital situation. The teacher needs to realize that the use of game technology is very much needed as an alternative learning media. In addition to teacher awareness, the ability of teachers to use technology also needs to be improved. Brown (2017) revealed that teachers must participate in the use of technology to create technological change in mathematics education. For example, educational games on mobile phones or computers can be alternatives to help teachers.

Brezovszky, McMullen, Veermans et al. (2019) revealed that the mobile phone application can be used as a learning tool for mathematics. Moreover, children or students today are very familiar with using mobile phones. Various activities can be carried out by students today through mobile phones. Making phone calls, sending messages, watching videos, and playing games on a mobile phone are common for students. Based on data provided by Selular ID (2019), mobile game players in Indonesia reached 52 million. This data shows that the game is a very famous and familiar application for the public.

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It is undeniable that the game is very popular among young people. There are three things that make players interested in playing games, among others (Suartama, Suciptawati, & Asih, 2019):

- satisfaction and pleasure obtained when playing;
- the quality of mobile phone devices and internet services;
- playmates

Some of the points mentioned earlier can be an advantage of games that can be used as a learning medium. Whitton (2010) revealed the difference between entertainment games and educational games, namely from the design and purpose of making games.

However, the application of game-based learning in mathematics classes is still low, especially the use of game technology applications. The teacher has not fully realized that games can be used as an educational tool (Korkmaz & Avci, 2016). In addition, the mathematics education curriculum has not yet integrated learning in the classroom with games. This is very unfortunate, even though games can be used as useful learning tools.

Several studies have shown that game-based learning can improve students' abilities in learning mathematics. Abdullah and Yunianta (2018) found that mathematics learning media based on educational games proved to be effective on trigonometry material. Game media is also proven to be able to increase students' knowledge and affective in mathematics material (Kiili & Ketamo, 2017). Based on these results, the use of games in mathematics learning is necessary.

Problem of Research

This research aims to answer the question: "How the viewpoint of future teachers about game-based learning in mathematics?". Game based learning in this research emphasizes the use of mobile phone games or computer games in the classroom. Researchers investigate whether or not future teachers agree with the use of games. Then, their opinions about the ease of students in using games as learning media.

Method

Research Model

This research used a mixed-method research design by using quantitative and qualitative data. The data in this research were obtained through a questionnaire about the viewpoint of future teachers of mathematics to game-based learning in mathematics. Quantitative data were obtained from questions part one of the questionnaire, while qualitative data were obtained from questions part two.

Participants

The subjects or participants in this research were 7th semester mathematics education undergraduate students who were future teachers of mathematics. Participants were 104 undergraduate students, 18 were men (17%) and 86 were women (83%). They were aged between 20-22 years. Most of them have attended professional placement courses, so they already have teaching experience at school. Some participants also have teaching experience in private course, additional course, and other places.

Data Collection Tools

The first part of the questionnaire is a closed question related to the participant's personal information, namely gender and teaching experience. While the second part contains open questions. The following questions are presented:

- Do you agree if learning mathematics in the classroom using games?
- Will students easily learn if learning mathematics in class using games?

In the second part of the question, the participants must choose between two answer choices, namely agree or disagree. Then they state the reason for the answer.

Data obtained from questionnaires were processed with descriptive statistics using MS Excel, then analyzed. The qualitative answers of the participants were coded to provide the conclusions of the research. The results of this research are to uncover the viewpoint of participants on the use of games in the classroom.

Results

Table 1 shows the frequency and percentage data of participants' teaching places. While Table 2 shows what media data the participants used when teaching mathematics. Both of these data aim to know the background of the participants.

Table 1.

Participant Teaching Place Data

Teaching Place	Total	Percentage
School	92	88.46%
Private Course	33	31.73%
Additional Course	21	20.19%
Others	8	7.69%

Based on table 1 shows that as much as 88.46% of participants have teaching experience in schools. The participants in this research had mostly taken professional placement courses for one semester (6 months) at school. As many as 8 participants had teaching experience in other places, such as teaching at home (teach the family) and participating in volunteer activities (organization).

Table 2.

Learning Media that Have been Used by Participants

Media	Total	Percentage
Book	94	90.38%
Worksheet	89	85.58%
Powerpoint	49	47.12%
Props	48	46.15%
Mobile phone	15	14.42%
Educational Game	11	10.58%
Computer	8	7.69%
Others	1	0.96%

Table 2 shows that more than 85% of participants most often use media books and student worksheets as a medium for learning mathematics. As many as 10.58% of participants have used the game while teaching. Then, a participant chooses the 'others' option (chart).

The second part of the questionnaire consisted of two questions. The results of question 1 show that as many as 95 (91.35%) participants agreed if learning mathematics in class using games, while 9 (8.65%) participants disagreed (see table 3).

Table 3.

Participant's Agreement to the Use of the Game

	Question 1		Question 2	
	Agree	Disagree	Agree	Disagree
Total	95	9	93	11
Percentage	91.35%	8.65%	89.42%	10.58%

The reasons for participants who agreed with the game-based learning in mathematics resulted in 15 points stated in various codes. Each code consists of arguments that state the participant's reasons. These results can be seen in table 4.

Table 4.
The Details of Participants' Reasons about Games

No	Code	Total (*N*=104)	Percentage (%)	Argument
1	Enjoyment	39	37.50	Learn becomes enjoyable and exciting
2	Interest	20	19.23	Games increases student learning interest
3	Technology	19	18.27	Learning must use technological development
4	Boredom	19	18.27	Learn becomes not boring
5	Motivation	17	16.35	Games increase students' motivation to learn
6	Understanding	14	13.46	Easier to understand the material through games
7	Psychomotor	7	6.73	Students are more active in learning activities
8	Relaxation	4	3.85	Learn becomes relax
9	Cognitive	3	2.88	Games facilitate the cognitive aspects of students
10	Monotony	3	2.88	Instructional in class becomes not monotonous
11	Efficiency	2	1.92	Instructional becomes efficient
12	Tool	2	1.92	Games as learning tools
13	Effectiveness	1	0.96	Learning goals can be achieved
14	Practicality	1	0.96	Practical learning media
15	Curiosity	1	0.96	The game enhances the curiosity of students

From the table above it can be seen that most participants stated that learning mathematics on a game-based basis would make learning enjoyable. A few participants answered in terms of effectiveness, practicality, and curiosity. One of the participants' opinions related to the use of game technology is as follows: "Nowadays students are very active in using technology and their activities are mostly spent on gadgets (mobile phones). Educational games can attract students' interest in the learning process. Especially if students can complete the game mission to get rewards. That will be a pleasant motivation".

Some participants disagreed with game-based mathematics learning (9 future teachers), while some of the reasons stated were as follows:

- Students can access other applications (such as social media, other games) if learning in class using mobile phone games.
- Students only focus on the mission in the game, so they don't pay attention to the material or the teacher's explanation.
- Not all students are easy to understand the material when using games. It depends on the character of the student.
- Students become lazy in reading books because there are other applications for learning, which are educational games.
- Not all students have adequate media (such as mobile phones, computers, or laptops). Especially in schools where students have less economy. Game based learning is more suitable for elite schools.
- Not all schools can facilitate learning with games
- Classes become noisy or less conducive. Students can be busy each with their mobile phones.
- Wasting learning time because the teacher needs to face unexpected obstacles.

Furthermore, in the second question of part two most participants agreed (89.42%), while 10.58% of participants disagreed (see table 3). The obstacles that can occur when learning to use games (such as the reasons put forward by participants who disagree with game based learning) cause some participants to answer disagree. Some participants who agreed stated several reasons, including:

- Children or students today are accustomed to using technology (such as mobile phones, computers, laptops, etc.). Most of them also like to play games, so they are already familiar with the game. Therefore, students will easily accept educational games.
- Students are more interested in playing games than reading books (textbooks/worksheets).

- Students can more easily obtain information about mathematics. Learning becomes practical, the material is easily accessible, and students can study at any time.
- Games must be well presented and the game instructions must be explicit, so students will easily learn.
- Depending on the ability of students.

The following are various examples of comments from future teachers of game based learning in mathematics (see table 5).

Table 5.

Future Teachers' Opinions

Subject	Opinion
S2	Because most of the recent students enjoy playing, students are more active in learning with playing.
S3	Students need to understand the use of technology in digital age. So that with technology-based learning students will be technology literate. Games increase student interest.
S6	Because students are more interested in playing games than studying. so learning with games can increase student interest.
S9	Because by using educational games learning media will make learning more interesting and students' attention will be more focused on learning.
S11	Students will more quickly obtain information, students are more interested in something new. Students will pay more attention and feel more motivated to learn and also do not get bored.
S12	Using mobile phones with games will improve children's cognitive and psychomotor understanding. Students not only play also learn. This can increase the usefulness of cellphones in the hands of students.
S18	Because the game is able to increase student interest in learning. Game Media can be more interesting.
S19	Because in this modern era, with the use of educational game media can facilitate students in learning new things and students do not feel bored quickly.
S21	If students use educational game media, learning will be more interesting, so students will be more enthusiastic in learning mathematics.
S24	Game based learning increases learning enthusiasm and curiosity in mathematics learning.
S28	Learning mathematics becomes not boring. Student learning interest will increase.
S33	Students will be more excited and happy when learning because indeed in this era there are many students who play various games on cellphones or computers. They will catch the material faster
S60	Because learning games become more interesting and exciting so students don't get bored.
S69	Because technology is now sufficiently supportive to utilize game media in learning mathematics and students also like understanding so it will be easy to understand the lesson.
S79	Because technology has increasingly developed and children like something related to games. So, if learning is applied in the form of games it will be easier for student to learn and remember.
S85	Because most students these days prefer to learn while playing
S89	Learning mathematics using interactive media in the form of educational games etc. will make students happy and not tired of learning.
S104	With the existence of educational games, students' intention to learn is higher.

Discussion and Conclusion

Based on the results previously shown (see table 1 and table 2), it can be seen that most participants have had teaching experience in various places. They have also used various media in learning mathematics. Some participants even used the game as a learning media. It can be said of those who have taught with games, have experience related to how students interact when learning with games. However, this research has not shown what types of games participants use to teach. In addition, further analysis is needed to determine the response of future teachers who have taught using games. This can be done in further research.

The results also showed that most future teachers agreed with the game-based learning in mathematics class (see table 3). This shows the potential of using games in the classroom, but for the teacher's readiness to use the game, further research is needed. The number of participants who agree to use the game, in line with the results of Schrader, Zheng, & Young's research (2006). The study found that participants responded positively to the use of technology

in education and games as a necessary tool. In addition, Korkmaz and Avci's research (2016) also shows that most future teachers think that games have the potential to improve learning in the classroom.

Table 4 shows that most participants believed that game-based learning could provide various advantages from various aspects. The reasons given by participants can be used as positive beliefs of teachers when implementing game-based learning. Based on the results of the analysis it can be concluded that the various advantages include:

- Game based learning is the way of utilizing technology that is developing at this time.
- Game based learning can improve various aspects of students: cognitive (understanding of the material), affective (interest, motivation, curiosity), and psychomotor (activeness).
- Learning becomes fun, relaxed and not boring.
- Effective and efficient learning can be achieved.
- Games can be one of the media that helps teachers in learning in class, so learning is not monotonous.

Various advantages that have been stated above are in accordance with various researches that have been conducted. Herro and Quigley (2017) revealed that the teacher's belief that technology can effectively help students learn, can encourage teachers to combine learning with technology. This is certainly in accordance with the participant's statement that it is important to use the game as a form of integrating technology.

Furthermore, other research revealed that games can work well to help to learn mathematics in cognitive and affective outcomes (Kiili & Ketamo, 2017; Bano, Zowghi, Kearney, Schuck, & Aubusson, 2018). The use of entertainment elements (such as games) in learning can increase student interest, motivation, and competence (Bertacchini, Bilotta, Pantano, & Tavernise, 2012). This is also in accordance with the results of Schrader, Zheng, & Young's research (2006), it was found that the majority of prospective teachers thought the game was a motivational tool for learning. The evidence that has been shown in previous research can support effective and efficient mathematics learning. In addition, the research results that most participants also assumed that students would easily learn through games. learning mathematics through games also allows students to improve their abilities in the cognitive, affective, and psychomotor domains. This will support the learning process in the classroom.

In addition to the positive beliefs expressed, some future teachers also believe that there are various obstacles encountered in the classroom when implementing game-based learning. This relates to student focus, student understanding, facilities, and classes that are not conducive. Too many students in the class also find it difficult for teachers to use technology games (Korkmaz & Avci, 2016). To deal with various obstacles that can occur, the teacher needs to pay attention to several things, including:

- The teacher must make an agreement to the students before learning, that the mobile phone is only used to open educational game applications, not to open other applications
- The teacher must pay attention to how to present a good material in the game so that students not only play but also understand the material
- The game media used must also facilitate student discussion activities in the classroom so that student-centered learning can occur

Future research is needed to look more broadly at the potential application of game-based learning in mathematics. Participants' beliefs must also be proven through empirical research. It is also important to increase teacher awareness and experience in utilizing game technology in the future. Next research also can be carried out various experiments to see the effects of the use of games on mathematics learning.

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