

EFFECT OF GAMIFICATION ON E-LEARNING TO SUPPORT LEARNING ACHIEVEMENT AND LEARNING MOTIVATION

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ABSTRACT

Gamification is a use of game elements in contexts other than games to motivate and enhance user activity. With the recent rapid use of gamification for e-learning, an interesting open question for educators is, can it motivate and improve the achievement of students? The purpose of this study is to measure the effect of gamification on e-learning to support learning achievement and learning motivation. This is done by comparing the traditional learning method (class) and the method of e-learning gamification. The researcher will develop a prototype of e-learning gamification to support his research. There are several game mechanics conducted by researchers into e-learning such as, points, levels, challenges, and leaderboards. The data of this research were taken from the questionnaires distribution and the result of study report of 24 students in one of junior high school. Questionnaires were made into two kinds, pre-questionnaire and post-questionnaire respectively for traditional method and e-learning gamification. While the learning reports are obtained from student's semester report and report during the use of e-learning gamification. The data is processed with the help of software SmartPLS v.3.2.6 and Microsoft Excel 2016 and analyzed using paired t-test. The results obtained are e-learning gamification does not give a positive effect or improvement on student motivation in terms of behavioral, emotional and cognitive. Furthermore, e-learning gamification also does not give a positive effect on improving student's learning achievement. The role of teacher and one time use of e-learning gamification are the causes that e-learning gamification does not give a positive impact. The challenge for further research is, how we substitute the teacher role.

Keywords: *Gamification, E-Learning, Learning Motivation, Learning Achievement, Game Mechanics*

1. INTRODUCTION

Along with the rapid development of the game industry, many school children spend more time playing games than learning. Elements of the game such as level, score, leaderboard, avatar, achievement, etc., is one factor that can make the game players feel at home. The study results from duniaku.net (2014) states that Indonesia has at least 19.8 million unique user online games. When viewed from the demographics of users, 70% of online game players in Indonesia aged 13-17 years and 18-24 years, ie still the age of students or college students [1].

In addition to the rapidly growing game industry, e-learning is also experiencing rapid development. In 2015, a survey from Ambient Insight stated that the growth of e-learning Indonesia ranked 12th in Asia Pacific [2]. Although there is growth, e-learning itself has a challenge in increasing the motivation of its users (learners). A gamification

approach can be done to improve the motivation of e-learning users [3].

Gamification is a use of design game elements in contexts other than games to motivate and enhance user activity [4]. In recent years, the adoption of gamification has been done in various fields such as business, marketing, corporate management, finance, health, education, etc. Some successful programs that implement gamification are foursquare, nike +, eBay, stackoverflow.com, codecademy.com [5]. For education, there is a successful example of the application of gamification, codecademy.com. In codecademy every time the user successfully completes the material, then the user will get a gift of badge. By using gamification e-learning is expected to be an interesting and fun learning tool.

Associated with this, the researchers wanted to measure how much the influence of gamification on the quality of learning. In this study the quality of learning can be seen from two factors, namely

motivation and learning achievement. Researchers will conduct a survey to one junior high school by comparing the usual learning process with the learning process of e-learning using gamification. In this study, researchers will focus on a single subject area, namely mathematics.

The research question is: will the application of gamification to e-learning can increase learning motivation and achievement?

2. LITERATURE REVIEW

2.1 E-learning

E-learning as a form of technologically supported learning is usually characterized as applying knowledge, information, and educational technology to connect people to each other and or with educational materials, for educational purposes (formal or informal) [6]. The use of technology in e-learning is usually in the form of online learning, virtual learning, distributed learning, network learning, and web based learning. But the term e-learning is more than that, e-learning incorporates all educational activities performed by individuals or groups in the form of online or offline, synchronous or asynchronous through computers or other interconnected and standalone electronic devices [7].

2.2 Gamification

The growing number and increasing number of game players (gamers) in the world make the potential of innovative learning methods are also increasing [8]. Researchers have been trying to figure out why games are so attractive. According to them, it can happen because of a combination of fantasies, challenges and curiosities, and the level of interest that makes gamers un-distracted [9]. Jane McGonigal argues that the use of games does not have to focus on entertainment alone and the ability created by games can be useful for solving real problems [10]. Zichermann and Cunningham also agree that this process can increase the level of user engagement and interest in order to solve the problem [11].

There are several kinds of notions of gamification. Gamification is a use of design game elements in contexts other than games to motivate and enhance user activity [12]. Gamification can also be interpreted as a concept that uses mechanics, aesthetics, and game thinking to attract people, motivate, increase learning interest, and solve problems [13].

In the game, players are willing to engage in game activity. The game has a beginning, a mid, an end, and of course winning conditions / conditions.

Games also typically contain many elements such as challenges, mechanisms to try again, reward systems, and goals that players must achieve. While in gamification, game elements such as points, badges, freedom to fail, and challenges are used to increase interest and get results to be achieved. Game elements used in gamification can be one element only.

2.3 Game Mechanics and Dynamics

Gamification is a process that integrates game dynamics and game mechanics into a website, business service, online community, portal, or marketing campaign to gain participation and engagement [14]. Game mechanics is a diverse set of mechanisms, actions, behaviors, and controls used to "gamify" activities. Game mechanics will make users have an interesting and motivated experience. While game dynamics is the need and desire generated by game mechanics. These needs and desires are usually sought by people or users as pleasure and self-motivation. There are 6 game mechanics and game dynamics [14]. The game mechanics are points, levels, challenges, virtual goods, leaderboards, gifting & charity. And the game dynamics are reward, status, achievement, self expression, competition, and altruism.

2.4 Learning Motivation

Motivation is a reason to act or act and can be conceptualized as the direction, intensity, quality, and perseverance of a person [15]. Learning motivation can come from internal and external drives. This encouragement will affect behavior to support the learning process [16].

Fredricks dan McColskey (2012) said that there are three types of student engagement to the lesson. These three types of student engagement are Behavioral, Emotional, and Cognitive Engagement [17].

a. Behavioral engagement

Behavior can be seen from the behavior and activities undertaken to achieve a positive learning objectives. Indicators of behavioral attachment are participation in learning, coming on time, execution of duties, obeying rules, concentration.

b. Emotional engagement

Emotional attachment can be seen from reactions or feelings to friends, schools, teachers, or lessons.

c. Cognitive engagement

Cognitive attachment can be seen from the awareness of the achievement of learning objectives. Indicators that can be seen from cognitive attachments such as willing to do additional tasks, learn more deeply, curiosity is high.

Voelkl explains that student attachment acts as a link between motivation and achievement [18]. Agreeing with Voelkl, Pekrun and Linnenbrink-Garcia consider student attachment to be a mediator between emotion and achievement [19]. Meanwhile Ainley explains that motivation will produce achievement through student attachment [20].

3. METHODOLOGY

3.1. Theoretical Framework

Hamari and Koivisto explain that the application of gamification can make users more motivated [21]. In addition, according to Landers and Armstrong gamification can also improve learning outcomes on users who have had experience playing the game [22]. Therefore, this study was conducted to find the effect of gamification on e-learning on learning motivation and learning achievement of junior high school students. The frame of mind for this study is like the picture below.

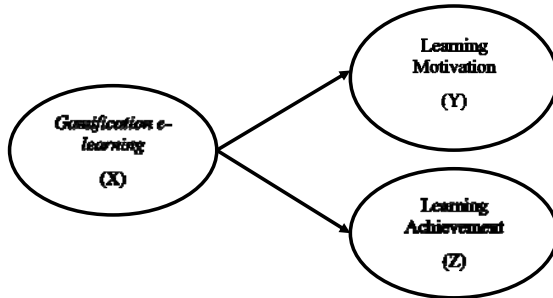


Figure 1: Research Framework

3.2. Hypothesis

Based on the formulation of the problem and the frame of mind, the hypothesis to be tested in this study are as follows:

H0: there is no effect of e-learning gamification on improving learning motivation.

H1: there is a positive influence between e-learning gamification to increase learning motivation.

H0: there is no effect of e-learning gamification on improving learning achievement

H1: there is a positive influence between e-learning gamification to the increase of learning achievement.

3.3. Procedure

In this study, researchers will design a method of e-learning based game (gamification). Researchers

will use Bunchball approach to design e-learning gamification. Bunchball uses some game mechanics as the element of gamification [14]. The game mechanics that we use are points, levels, challenges, and leaderboards.

After that researchers will determine a group of students with junior high school level grade 8 or 9. Subjects will be taught through e-learning is the Mathematics. Researchers will examine the motivation and achievement of learning with experimental methods. This method will compare the motivation and learning achievement between the traditional way of learning and the way of e-learning gamification.

The procedure to be performed by the researcher is to spread the questionnaire (pre-questionnaire) to the students regarding their motivation during learning mathematics in the traditional way. Furthermore, the students will try to use the application of e-learning gamification to learn math. After completing the application, the students will refill the questionnaire about their experience using e-learning gamification application. Meanwhile, to measure learning achievement, researchers will compare the value of student report cards with the value of exercise questions on e-learning gamification applications.

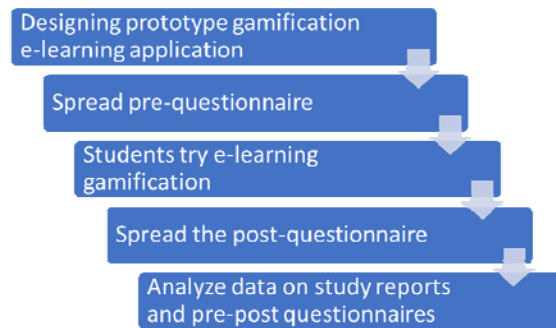


Figure 2: Procedures

To measure learning motivation, Tillery and Fishbach (2014) say that we need to categorize motivations by type [23]. Fredricks and McColskey (2012) also say that there are three types of attachments of a student to the lesson. This attachment can be classified as a criterion or a measure of the students' motivation in learning. These three types of attachments are Behavioral, Emotional, and Cognitive Engagement [17].

This study will measure the motivation and achievement of primary school students. In measuring motivation, researchers will refer to research from Fredricks and McColskey. Based on the research Fredricks and McColskey, researchers will measure the motivation of learning a student

with 3 types of attachment through the indicators in table 1. While for learning achievement, the researcher will measure by comparing student study report which got from written test result with e-learning gamification.

Table 1: Table of Motivation Indicators Against Types of Engagement.

Variable	Indicator	
Behavioral (B)	B_1	Learners actively ask or help answer questions
	B_2	Learners diligently do the exercises / task / homework
	B_3	Learners do the exercises / task / homework on time
	B_4	Learners are prepared before the lesson or exam
	B_5	Learners concentrate during the lesson
	B_6	Learners relearn the material that has been taught
	B_7	Learners continue to learn until they can
Emotional (E)	E_1	Learners feel happy when understood
	E_2	Learners feel happy when they get good grades
	E_3	Learners feel happy when doing the task / practice / homework
	E_4	Learners feel happy when faced with challenges
	E_5	Learners feel happy to compete
Cognitive (C)	C_1	Learners continue to learn to really master the material

C_2	Learners are willing to seek additional exercises to improve understanding
C_3	Learners continue to study the material despite having mastered
C_4	Learners want to master the whole material
C_5	Learners try to be number 1
C_6	Learners have high performance standards
C_7	Learners care about his achievements

From the table above, each indicator on the variable of this study will be a reference in making the research questionnaire. The indicators will be measured using a Likert scale. Likert scale form in this study are:

- Strongly agree / Always; given a score of 5
- Agree / Often; given a score of 4
- Neutral / Sometimes; given a score of 3
- Disagree / Rarely; given a score of 2
- Strongly disagree / Never; given a score of 1

4. ANALYSIS AND DISCUSSION

4.1. Data Description

In research conducted by the author, there are two types of data sources, namely the questionnaire and the results of junior high school students. The questionnaire distributed in this research is in the form of hardcopy. Questionnaires are divided into two types, namely questionnaires for traditional methods (pre-questionnaire) and questionnaires for the method of gamification e-learning (post-questionnaire). Total questionnaires filled were 24 questionnaires for each questionnaire. While for the data result of student study report taken from school mathematic report and mathematics report from gamification e-learning.

4.2. Validity Test

In this research will be tested the validity to check whether the indicators in this study have a significant contribution in explaining the latent variables. Validity test is done by evaluating outer model that is see the value of loading factor. The value for each indicator must be above 0.7 to the

latent variable. But in the development stage, values above 0.5 are still acceptable [24]. Testing will use SmartPLS v.3.2.6.

4.3. Validity Test for Traditional Method

The table below is the result of the validity test after some invalid indicators are omitted.

Table 2: Table Validity Test for Traditional.

Indicator	Behavioral Traditional	Cognitive Traditional	Emotional Traditional
B 1	0,523		
B 2	0,551		
B 5	0,786		
B 6	0,619		
B 7	0,833		
C 1		0,592	
C 3		0,598	
C 4		0,868	
C 5		0,673	
C 6		0,785	
C 7		0,811	
E 2			0,649
E 3			0,849
E 4			0,861
E 5			0,855

4.4. Validity Test for Gamification E-learning Method

The table below is the result of the validity test after some invalid indicators are omitted.

Table 3: Table Validity Test for E-learning.

Indicator	Behavioral E-learning	Cognitive E-learning	Emotional E-learning
B 2	0,758		
B 5	0,843		
B 6	0,674		
B 7	0,776		
C 1		0,727	
C 2		0,760	
C 3		0,811	
C 4		0,725	
C 5		0,751	
C 6		0,800	
E 1			0,727

E 2			0,807
E 3			0,849
E 4			0,894
E 5			0,633

4.5. Reliability Test

After the indicators are said to be valid, the reliability test is then performed. Reliability test aims to see the reliability and consistency of the data. To test the reliability of a variable need to see the value of Composite Reliability (CR) and Average Variance Extracted (AVE). The value of the composite reliability should be > 0.7 and the average variance of extracted should be > 0.5 [24].

Table 4: Table Reliability Test for Traditional.

Variable	Composite Reliability	Average Variance Extracted (AVE)	Description
Behavioral Traditional	0,801	0,454	Reliable
Cognitive Traditional	0,869	0,531	Reliable
Emotional Traditional	0,882	0,653	Reliable

Table 5: Table Reliability Test for E-learning.

Variable	Composite Reliability	Average Variance Extracted (AVE)	Description
Behavioral E-learning	0,849	0,586	Reliable
Cognitive E-learning	0,893	0,582	Reliable
Emotional E-learning	0,890	0,620	Reliable

4.6. Latent Variable

After doing the validity and reliability test, then can be done assessment on each latent variable.

Table 6: Table Latent Variable for Traditional.

Traditional		
Behavioral_T	Cognitive_T	Emotional_T
0,531	1,482	1,771
0,402	0,182	0,650
-0,967	-0,104	0,947
-1,107	-0,001	0,354
0,673	0,170	-1,086
0,612	0,389	-0,047
0,365	0,206	-0,047
-0,164	-0,835	0,079
-2,866	-3,114	-3,009
0,401	0,170	-0,111
0,920	0,358	1,073
-0,718	-0,519	-0,809
-0,847	0,076	-0,745
2,038	1,990	1,771
1,226	-0,703	-0,047
-0,051	0,715	0,249
-0,553	0,546	0,249
0,011	-0,835	-0,047
-0,330	-0,439	-0,047
-0,684	-0,346	-0,408
1,226	1,592	0,545
-1,063	-0,827	-0,344
0,059	-0,852	-1,591
0,884	0,699	0,650

Table 7: Table Latent Variable for E-learning.

E-learning Gamification		
Behavioral_E	Cognitive_E	Emotional_E
-0,280	-1,266	0,333
-1,289	-0,614	-0,004
-0,281	0,585	0,460
0,461	0,486	0,953
0,389	-0,015	-1,062
0,875	1,025	0,639
1,362	1,025	0,639
-0,616	0,337	-1,085
-2,587	1,025	-0,669
0,623	0,266	0,917

-0,934	-1,148	0,287
-0,609	-0,818	-1,469
0,551	0,088	0,901
0,775	1,025	1,589
1,110	-0,186	-0,669
1,045	1,025	1,589
-0,765	-1,909	-1,283
1,193	1,025	1,080
1,193	1,025	1,080
-0,195	-1,518	-1,069
-0,764	0,739	0,333
-0,778	-2,155	-1,444
0,875	0,585	-1,469
-1,355	-0,630	-0,576

4.7. Hypothesis Test

In testing the hypothesis, the researcher will use paired t-test. The sample to be compared is the latent variable of both types of methods. The requirement for the accepted H1 hypothesis is the t-stat > t-table value. The t-table value (df = 23) with the 5% alpha is 1.714.

1. Hypothesis 1 (behavioral)

Table 8: Paired t-test for Behavioral.

	Behavioral_E	Behavioral_T
Mean	-1,0177E-16	1,34152E-16
Variance	1,043478261	1,043478261
Observations	24	24
Pearson Correlation	0,37806014	
Hypothesized Mean Difference	0	
df	23	
t Stat	-9,54806E-16	
P(T<=t) one-tail	0,5	
t Critical one-tail	1,713871528	
P(T<=t) two-tail	1	
t Critical two-tail	2,06865761	

Based on Table 8. T-stat value <t-table; 9.54806E-16 <1.713871528. Therefore it can be concluded that H0 received, ie no effect of e-

learning gamification on student behavioral improvement.

This result is contrary to research conducted by Paul Denny. Paul Denny said that gamification on e-learning has a positive influence on the contribution and behavior of a student [25]. However, these results are in line with the research of Li et al in 2014. The results suggest that there is no significant behavioral change between traditional classroom methods and e-learning. One factor that might be causing this is the presence of teachers in the traditional classroom. Teachers in traditional classes have an important role in maintaining and improving behavioral students. For example teachers can provide open questions so that students can engage in discussion and opinion [26]. A student who is behaviorally increased will have better behavior, such as always doing the task, concentrate during learning, and actively ask questions.

2. Hypothesis 2 (emotional)

Table 9: Paired t-test for Emotional.

	Emotional_E	Emotional_T
Mean	-2,59052E-16	0
Variance	1,043478261	1,043478261
Observations	24	24
Pearson Correlation	0,458342605	
Hypothesized Mean Difference	0	
df	23	
t Stat	-1,40679E-15	
P(T<=t) one-tail	0,5	
t Critical one-tail	1,713871528	
P(T<=t) two-tail	1	
t Critical two-tail	2,06865761	

Based on Table 9. T-stat value <t-table; 1.40679E-15 <1.713871528. Therefore it can be deduced that H0 is received. There is no positive emotional change between traditional methods and e-learning gamification. This result conflicts with a study by Domínguez et al. Domínguez et al. Said that gamification has a positive effect on students' emotional improvement [27].

This is probably due to several factors. Singh et al. Believes that e-learning is less effective to apply

to younger students and is more suitable for adults as it is considered more independent. E-learning is considered difficult to use because there is no direct interaction with teachers. Interaction between teachers and students is needed to address ambiguity among young learners [28].

Increased emotional students are more likely to feel happy and valuable during the lesson. In the absence of direct interaction with the teacher on e-learning, the students will emotionally dislike e-learning, because it is considered more difficult in studying the material.

3. Hypothesis 3 (cognitive)

Table 10: Paired t-test for Cognitive.

	Cognitive_E	Cognitive_T
Mean	6,93889E-17	-6,4763E-17
Variance	1,043478261	1,043478261
Observations	24	24
Pearson Correlation	-0,072939194	
Hypothesized Mean Difference	0	
df	23	
t Stat	3,63473E-16	
P(T<=t) one-tail	0,5	
t Critical one-tail	1,713871528	
P(T<=t) two-tail	1	
t Critical two-tail	2,06865761	

Based on Table 10. t-stat value <t-table; -3,63473E-16 <1.713871528. Therefore it can be deduced that H0 is received. There is no positive cognitive change between traditional methods and e-learning gamification.

According to Rotgans and Schmidt, students' cognitive motivation did not rise significantly in the first lesson, but in the second and so on [29]. Students who regularly follow the learning and are joined in a discussion group, will have an increase in cognitive motivation. The students can discuss and exchange ideas about what they understand and master. This is what makes the results of this study does not increase cognitive motivation, because this research is only done once and not done continuously.

Hashim, Ahmad, and Ahmad also added to stimulate cognitive motivation from students, the

material provided should support real application in everyday life [30]. Materials such as problem solving, case examples, or real projects can make students understand the meaning of the learning objectives. A student whose cognitive is on the rise, has signs like trying to be the best, willing to make more effort to achieve the best results, and wants to have a high achievement.

4. Hypothesis 4 (learning achievement)

Table 11: Math Score for Traditional and E-learning.

Math Score Traditional	Math Score E-learning
94	100
96	100
93	73,33333333
99	73,33333333
97	100
89	86,66666667
94	86,66666667
98	80
86	100
86	80
96	80
92	60
87	100
96	100
94	60
86	86,66666667
98	93,33333333
91	66,66666667
93	73,33333333
98	66,66666667
85	86,66666667
83	40
78	66,66666667
99	80

Table 12: Paired t-test for Learning Achievement.

	Math Score E-learning	Math Score Traditional
Mean	80,83333333	92
Variance	252,4154589	33,13043478

Observations	24	24
Pearson Correlation	0,212365598	
Hypothesized Mean Difference	0	
df	23	
t Stat	-3,482891305	
P(T<=t) one-tail	0,001005061	
t Critical one-tail	1,713871528	
P(T<=t) two-tail	0,002010122	
t Critical two-tail	2,06865761	

Based on Table 12. t-stat value < t-table; 3,482891305 < 1,713871528. Therefore it can be concluded that H0 received, that there is no positive influence between e-learning gamification to increase student achievement.

Dominguez, et al. argue that the effect of gamification on improving student achievement is limited, so it takes a design and structure that can make these students motivated [27]. In addition Singh et al. argue that e-learning will make students feel difficulty, in the absence of the role of a teacher. Students who feel difficulty in learning the material, would require the guidance of a teacher to answer the ambiguity as well as improve student achievement [28].

5. DISCUSSION

The result of the analysis obtained is e-learning gamification does not give positive impact to the improvement of behavioral, emotional, cognitive motivation and student achievement. Our explanation is self-paced e-learning approach is less suitable to be applied to junior high school students. School students at the age of 13-17 are considered still need the guidance of a teacher.

The role of a teacher is very important in maintaining and improving behavioral motivation students. For example teachers can provide open-ended questions so that students can discuss and share their arguments. Teacher also acts as a parent for students at school. Ethics and morals are also taught to the students so that their behavioral can get better.

For the emotional side of the students, teachers also have an important role. Example when a student has difficulty in understanding a lesson, a teacher can help or guide the student. The absence of a teacher's role in self-paced e-learning will make the students feel difficult and confused in understanding the lesson. Students tend to hate

lessons that he finds difficult. In addition to impact on emotional students, it also affects student achievement.

Use of e-learning gamification which only one time does not give a significant effect on the improvement of students' cognitive motivation. The use of e-learning gamification needs to be done periodically. Periodic usage can trigger students to exchange opinions, knowledge, and ideas. In addition, materials related to daily life, can trigger aspects of cognitive motivation of students.

6. CONCLUSION AND FUTURE WORK

This work has analyzed the effect of gamification to improve learning achievement and motivation among students of junior high school. The measurements were made by comparing pre-post questionnaires and study reports from both traditional methods and e-learning gamification. The investigation has shown that gamification does not provide a positive influence or improvement on student achievement and motivation. This is evidenced from the results of paired t-test between traditional methods with e-learning gamification method.

We argue that the role of a teacher in junior high school is still very important. A teacher can guide, improve achievement, and motivate students. The instructor-led e-learning approach is thought to accommodate the needs of junior high school students to the role of a teacher.

In addition we also argue that the use of e-learning gamification that only one time has less influence on students. Students need to use e-learning gamification periodically so they can feel the effect of e-learning gamification.

To support further research there are several suggestions that are proposed based on this research, that is:

1. Increasing the number of samples for further research results expected to be more accurate.
2. Suggested use of e-learning gamification is not done at one time only, but on a regular basis, for example for 3-6 months. Regular use has the intention that students can better feel the difference between traditional learning methods and e-learning gamification. In addition, regular use can stimulate students' cognitive motivation for the better [29].
3. It should be investigated more deeply from e-learning gamification design in order to replace the role of teachers that exist in

traditional learning. Because one of the main factors of poorly motivated students is the loss of the teacher's role in the gamification of e-learning [26].

4. Change the e-learning approach model of self-paced e-learning to be an instructor-led and facilitated e-learning. This could be a suggestion in subsequent research so that the role of teachers can remain in the gamification of e-learning.
5. Use of Artificial Intelligence (AI) as a tutor can be one of the proposals and breakthroughs in subsequent research to replace the teacher's role in e-learning gamification.
6. The learning process provided by e-learning gamification in this research is only limited to material explanation along with practice questions. In the next research, can be added a variety of real application of every material in everyday life [30]. This aims to improve student motivation.
7. The additional feature of e-learning gamification is not found in this research such as discussion groups or forums as a means of exchanging opinions and knowledge among students.
8. This research is only done in junior high school and one subject only that is mathematics. For further research is also suggested to be done for other education levels and different subjects.

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