Mathematics Game as Interactive Learning Media In COVID-19 Pandemic Era

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Abstract. The COVID-19 Pandemic requires teachers to innovate. Mathematics game on computer or android platform is one of the utilization of technology in the 4.0 era as interactive learning. This type of research is research and development which aims to produce a proper and interesting mathematics game application based on multimedia for junior high school students. Appropriate learning media here is learning media that has valid, practical and effective criteria. The mathematics game application in this research was developed by Microsoft PowerPoint software. This research was using preliminary study and product development stages. The subjects of this research were the seventh-grade students of junior high school in Tuntang Sub-district. The scoring results by the material expert get the average score 42 then categorized as very feasible, while the scoring results by the design or display expert get the average score 44 then categorized as very feasible. On the limited scale trial test get the score of 42 then categorized as very good, and on the wide scale trial test get a score of 43 then categorized as very good. Based on the results can be concluded that the mathematics game is very feasible and interesting for junior high school students.

1. Introduction

From the theory development, methodologies and solutions are needed to resolve educational interference [1]. To optimize educational opportunities in the future, the educational paradigm needs to move to effective competencies in resolving education problems that are happening right now [2]. COVID-19 pandemic that is happening right now has impacted the world in various sectors, including the educational sector. Education in Indonesia also felt serious impacts from this pandemic, thus demanding teachers to innovate. During this pandemic, all kinds of learning activities must be done online to prevent the spread of the corona virus itself. On the other hand, mathematics subjects often become student's least preferred subject in learning, as found in the low student's achievement and students' responses were easily bored in learning mathematics. It is really challenging for a teacher to teach online or without meeting the students directly. Teacher experienced many difficulties delivering the materials and the student felt difficult to understand the given materials.

In offline learning there are many students who misunderstand in terms of mathematical equations [3], and during online learning it would be more difficult for students to understand mathematical equations without meeting the teacher directly. Students often complain because there are a lot of given tasks and they often can’t resolve the question of it. Moreover, the teacher also complained about the decreasing student learning achievement. This becomes a serious problem in mathematics learning during the COVID-19 pandemic because online learning has limited learning media. We never know when the COVID-19 pandemic will end so that the situation will be normal again and learning activities...
can be back offline. In this current situation, interactive learning media has an important role to support the online learning activities.

The important role of learning media is supported by several previous research theories. Based on the 21st century competency framework which expects students can absorb information, recognize media, and Information and Communications Technology (ICT). Integration technology in the classroom can bring positive impacts on motivation, involvement, and student interest in learning while encouraging the development of active, explorative, and investigative learning styles to have better knowledge in mathematics [4]. Learning media has a contribution in improving students' quality of learning, not only applied in modern and expensive learning media, but also in simple and cheap learning media [5]. Combining learning game-based diagnostic mechanisms can not only reduce mathematical anxiety levels of students but also increases interest in learning and problem solving skills, thereby increasing the learning performance [6]. The development of knowledge indicates that the use of technology can be positively influencing student learning [7]. It shows that the interesting and innovative learning media that can be accessed via computer or android is needed for students to learn mathematics, in order that students can apply all their learning experiences in solving problems and motivating students to learn through play therefore students do not feel burdened. From the perspective of technology, The solution in mathematics problem is more images will look better in a learning environment [8]. Concrete studies on creation and evaluation of educational games should be designed according to the principles of instructional design game [9]. Accordingly, in designing a learning media the game must have criteria that are appropriate for a game. Based on the descriptions, the learning of mathematics can be done by using learning media in the form of a game to support students in order to make interactive and fun learning.

One of the most important things in the industrial revolution 4.0 is online learning that means learning independently [10]. Mathematics learning in the 4.0 era requires students and teachers can perform interactive learning activities using media and technology that is already developing rapidly. Ideal education is inherently natural, anticipatory and preparatoristic, namely always referring to the future and always preparing a young generation for a better quality, and better future life [11]. Utilization of computers and android is the main choice to make a learning media, because its orientation refers to the future and according with current technological developments. Game learning media is interactive and fun learning media. Therefore, the author aims to develop mathematics learning media in the form of games that are valid, practical, and effective also can be accessed by students either using personal computer or smartphone.

2. Method
This research uses research and development methods. The research stages that are used are the preliminary study stage and the product development stage. The preliminary study was carried out in three phases, namely: initial research, needs analysis, and literature study. Product development stages are carried out in three phases, namely: planning, prototypes, and testing of products. At the prototype-making stage, the validity test was carried out by two validators, while at the product testing stage, practicality and effectiveness tests were carried out with five students as the subject for limited scale testing and 20 students for the wide scale test. To obtain the validity of data used a questionnaire and submitted to the validator and obtained data in the form of validity scores, while to obtain data on the practicality and effectiveness is using questionnaires and student opinion sheets about the product. The sample in this study were junior high school students in the Tuntang District area.

3. Result and Discussion
Based on the preliminary study which consists of initial research, needs analysis, and literature studies are followed up with product development which consists of planning, making prototypes, and testing the products. The results of the research will be discussed based on the following research stages.
3.1. Preliminary investigation
The cause of the problem in this research is there are many gaps in mathematics learning class from the seventh-grade junior high school students at Tuntang Sub-district in this current pandemic. Based on the problem, researchers conducted the preliminary investigation to conduct field analysis for estimating the cause of the problem. The statements based on preliminary investigation, such as: (1) There is no active mathematics learning computer- or android-based, (2) There is mathematics learning media only for giving the tasks and questions with low quality of it. From these statements, it found out that there is no interactive learning media based on android as a mathematics game application. Android media have been used but only for giving the tasks and questions.

3.2. Needs analysis
To develop the learning media, it needs to be adjusted with what the seventh-grade of junior high school students in Tuntang needs. That is why we do a stage called need assessment. Based on the need assessment, in need assessment obtained: (1) during the covid-19 pandemic students can conduct online learning activities only at home, (2) learning media development needed to improve the quality of learning in the covid-19 pandemic, (3) students need an interactive and fun learning media to avoid them being bored in learning, (4) media that might be developed, viewed from the theoretical angle and its practice is learning media that based on Android games because almost all students have an android smartphone, (5) supported facilities and infrastructure which possibly to develop is using computer with Microsoft PowerPoint software that familiar among teacher and students. The needs assessment was carried out together with the preliminary investigation and obtained that the students really need an interactive and fun learning media, therefore mathematics game application can be used as a solution to help the students.

3.3. Study of literature
A literature study is required to obtain a variety of information on game applications mathematics that will be developed. The design of a learning application is necessarily reviewed from four fields, namely: the quality of mathematical content, feedback and scaffolding, richness of interactions, and adaptability of applications [12]. Learning through play can go beyond extracting basic facts and skills, also encouraging players to develop thinking and mathematical identity [13]. Students will feel the experience of playing gives them an opportunity to see mathematics in a new light, learning mathematics can be fun, creative, and contextual [14]. The results of these studies show that using games in mathematics learning can encourage students' thinking to see mathematics is fun, interesting, creative, and contextual. Interactive game character provides students with opportunities for self-prediction and explanation, and the process of entry supports students in reorganizing their understanding [15]. Students' abilities both high and low with the approach of Game Based Learning make students' confidence abilities in mathematics can increase significantly [16]. Many benefits of digital technology can be exploited in the field of education by using game based learning, that is effective with the experience flow result [17]. The benefits of learning through play can be developed to exploit the field of education and to have an effective, interactive and fun learning experience for students [18].

3.4. Product development planning
In this planning framework, researchers have formulated the aims of product development is to support the online learning activities during the covid-19. Learning media that will be developed has specifications as mathematics game-based android. The facilities and infrastructure used in the development process is computer, while in its application using an android smartphone.

3.5. Making prototypes
In this phase the researchers created a prototype using a computer with Microsoft PowerPoint software. The making of this mathematics game prototype contains displays of media design and mathematics materials. Output of this mathematics prototype is in the form of PowerPoint Slide Show, so that it...
allows users to open it directly and the game application is ready to play. The following pictures are the display of the mathematics game application which has been developed.

![Game start screen](image1)

**Figure 1.** Game start screen

![Game screen 1](image2)

**Figure 2.** Game screen 1

![Game screen 2](image3)

**Figure 3.** Game screen 2

![Game screen 3](image4)

**Figure 4.** Game screen 3

![Game screen if students answer correctly](image5)

**Figure 5.** Game screen if students answer correctly

![Game screen if students answer wrong](image6)

**Figure 6.** Game screen if students answer wrong

After the making of this mathematics game application prototype is done, afterwards it is validated by the experts by the appropriateness of this mathematics game application to be used as learning media with material aspects and display/design material aspects. The results of experts’ assessments about this math game application can be seen in Table 1 below.

| Scoring Component                  | Maximum Score | Average Score | Category       |
|-----------------------------------|---------------|---------------|----------------|
| Material Aspect                   | 50            | 42            | Very Feasible  |
| Display/Design Material Aspect    | 50            | 44            | Very Feasible  |
| **Total**                         | **100**       | **86**        | **Very Feasible** |

Table 1. The validity results of mathematics game application by the experts
Based on the scoring results by the experts on Table 1, it can be concluded that this mathematics game application is very feasible to use.

3.6.  Test of practicality and effectiveness
In this phase, a limited scale trial and a wide scale trial was carried out to determine the importance and effectiveness of this product to be used by the seventh-grade students of junior high school in Tuntang Sub-district. The results of the practicality test can be seen in Table 2 and the results of the effectiveness test can be seen based on the student opinion sheet as shown in one of the student responses in Table 3.

| Table 2. The results of the product testing practicality |
|--------------------------------------------------------|
| **Students Scale** | **Maximum Score** | **Average Score** | **Category** |
| Limited Scale     | 50              | 42.5              | Very Feasible |
| Wide Scale        | 50              | 43                | Very Feasible |

| Table 3. One student's response about math games |
|--------------------------------------------------|
| **Code** | **Interview Result** |
| Researcher | Does this math game application have an attractive appearance? Give your reasons! |
| Subject | Yes, it is interesting because the image is good. |
| Researcher | Did this math game app interest you to learn math? Give your reasons! |
| Subject | Yes, it’s fun. |
| Researcher | Is this math game application easy to understand? Give your reasons! |
| Subject | Yes, because it is not complicated. |
| Researcher | Does this math game make it easier for you to learn math material? Give your reasons! |
| Subject | Yes, because it helps me learn. |
| Researcher | Do you agree if a math game application is compiled for your study material? Give your reasons! |
| Subject | Agree, because I am motivated to study mathematics. |

Based on the Table 2 about the results of the product testing practicality, it can be categorized that the application of mathematics games is practical to be used. Based on the Table 3 about student opinion sheets, it finds positive responses from students, which means that this mathematics game application is effective to be used in the students learning process.

4.  Conclusion
Based on the scoring by the experts of this mathematics game application, it is categorized as very feasible. This game got a score of 42 for material aspects and 44 for display / design aspects. The results of the product testing in limited scale and wide scale show that students are very interested and enthusiastic with the innovations in learning in the form of this mathematics game application, with the feasibility result score of 42.5 for the limited scale and 43 for the wide scale and categorized as very feasible to use. Therefore, it can be concluded that this mathematics game application is very feasible to be used in supporting mathematics learning during the COVID-19 pandemic.

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**Acknowledgments**

We would like to give our thanks to all participants from junior high school students in Tuntang Sub-district.