Jurnal Theorems (*The Original Reasearch Of Mathematics*)
Volume 9, Nomor 1, Juli 2024
URL: http://ejournal.unma.ac.id/index.php/th

e-ISSN: 2528-102X
p-ISSN: 2541-4321

DEVELOPMENT OF FLIPPITY-BASED EDUCATIVE GAME APPLICATIONS AS A MEDIA FOR MATHEMATICAL LEARNING

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Article Info:
Received 2024-07-01
Revised 2024-07-12
Accepted 2024-07-19

How to Cite:
Sukiyanto., Anggraeni, D., Wijayanto, Z,. & Putri, A. (2024). Development of Flippity-Based Educative Game Applications as a media for mathematic learning. *Jurnal Theorems (The Original Reasearch of Mathematics*, *9*(1), 198-209.

ABSTRACT

Mathematics learning is a learning process or interaction process between teachers and students which involves developing students' thinking patterns in understanding or solving existing problems so that students are expected to be able to apply them in everyday life. Educational games are currently an appropriate alternative for media development, especially mathematics learning. On this basis, this research developed a Flippity-based educational game application in mathematics learning which is expected to help improve students' quality and abilities in learning. This type of research is development research. The research model used by this researcher is the ADDIE model. Data collection in this research used observation and questionnaire methods, while the instruments used were questionnaire sheets to obtain assessments from experts and questionnaire sheets for student response data. Flippity-based educational game learning is analyzed using descriptive analysis, namely qualitative descriptive analysis and quantitative descriptive analysis. The results of this research show that the average percentage (%) given by validators is 84.5%, which is in the very feasible category, so that the Flippity-based mathematics learning media (website) is very valid and can be tested. The average percentage result (%) given by students was 93.04%, which was included in the very practical category, so the Flippity-based mathematics learning media (website) was very practical.

Keywords: Flippity, Mathematics, Educational Games, Learning Media,

INTRODUCTION

The development of the Industrial Revolution 4.0 era is not just a discourse. In this era, information technology has become the basis of human life. This is both a challenge and an opportunity for educational development. The rapid development of technology has had a major impact on the world of education. This impact can be felt in the learning process, especially in accessing information as a learning resource, both in online and offline learning contexts. So that during the learning process we can access all the information needed and with various conveniences in using digitalization in this era (Pradana & Pratama, 2022). Thus, the learning system in schools must be ready to make changes to face the challenges of the industrial era 4.0 (Baiduri, 2019).

e-ISSN: 2528-102X
p-ISSN: 2541-4321

On this basis, the average child born in the 2000s is a child belonging to the millennial category who is no stranger to using digital technology (Rosiyanti et al., 2020). Children are used to using technology in the form of smartphones, whether used for playing, communicating with other people or for social media. Apart from that, in learning at school, teachers are also required to develop skills in creating learning media (Siwi et al., 2018). There are various ways that teachers can use to make the learning that takes place interesting for students, one of which is by using learning methods and media in the form of educational games (Wahyono et al, 2020).

One learning model that can improve students' abilities and motivation in learning is a digital game-based learning model or game-based learning (Twiningsih, 2022). Game based learning is a game-based learning technique that can help increase the potential and quality of students in absorbing knowledge (Mewengkang et al., 2018). Game-based learning is a tool that can help students solve problems, improve critical thinking and make assessments in the learning process (Edo & Samo, 2017; Pranoto, 2020).

One of the educational games that can be an appropriate alternative for media development, especially mathematics learning, is Flippity. Flippity is a free, page-based app that can convert content from templates in Google Sheets into educational activities or games that can be accessed easily without any hassle. Using flippity is quite easy so it is highly recommended as a learning medium (Tetty, 2023). Learning media also influences students' learning motivation, which is why teachers are expected to be creative in choosing learning media (Azzizatunnisa, 2022). Learning mathematics is a scientific discipline that can improve thinking and argumentation skills, contribute to solving daily problems and in the world of work, and provide support in the development of science and technology. Apart from that, mathematics learning is a teaching and learning process that contains two types of activities which are inseparable, namely learning and teaching (Sukiyanto et al, 2024). These two aspects will collaborate in an integrated manner into an activity when there is interaction between students and teachers, between students and students and between students and the environment when mathematics learning is taking place.

One of the educational games that can be an appropriate alternative for media development, especially mathematics learning, is Flippity. Flippity is a free, page-based app that can convert content from templates in Google Sheets into educational activities or games that can be accessed easily without any hassle. Using flippity is quite easy so it is highly recommended as a learning medium (Tetty, 2023). Learning media also influences students' learning motivation, which is why teachers are expected to be creative in choosing learning media (Azzizatunnisa, 2022). Learning mathematics is a scientific discipline that can improve thinking and argumentation skills, contribute to solving daily problems and in the world of work, and provide support in the development of science and technology. Apart from that, mathematics learning is a teaching and learning process that contains two types of activities which

e-ISSN: 2528-102X
p-ISSN: 2541-4321

are inseparable, namely learning and teaching (Sukiyanto et al, 2024). These two aspects will collaborate in an integrated manner into an activity when there is interaction between students and teachers, between students and students and between students and the environment when mathematics learning is taking place.

Several studies have used educational games, namely (Mulyati & Evendi, 2020; Pramuditya, et al. 2018; Arifah et al: 2019). In research conducted by Mulyati & Evendi, (2020) entitled "Mathematics Learning through Quizizz Game Media to Improve Middle School Mathematics Learning Outcomes" explained in the results of their research that there was an increase in learning outcomes, the average learning outcomes in cycle I was 63% and the II of 78%. In line with this, research conducted by Pramuditya et al (2018) entitled "Android Based Educational Game Design on Mathematical Logic Material" explains the results of their research, namely that the results obtained by educational games are very valid with an average rating of 93.76% of the total. overall validator value. The Android-based math educational game created is also very practical. This is shown by the average percentage for students with a high ability level of 94.8%, students with a medium ability level of 94.2%, and students with a low ability level of 92.2%. Furthermore, research conducted by Arifah et al (2019) entitled "Development of a Bilomatics educational game to improve student learning outcomes in grade 1 elementary school mathematics subjects" whose research results showed that based on the pre-test and post-test before and after playing the Bilomatics game was conducted on 25 students of SD N 77 Nayu Surakarta, the N-Gain normality test value was obtained with an average increase of g=0.72. Thus, it can be concluded that the Bilomatics educational game application is feasible and effective for use as an alternative learning media in grade 1 elementary school.

Of the several previous studies, no one has examined the development of educational game applications based on Fippity. This development research is important because it can help students solve math problems more quickly and easily, and students will be actively involved and create fun learning.

METHOD

This type of research is development research. The research model used by this researcher is the ADDIE model, which stands for Analysis, Design, Development or Production, Implementation or Delivery and Evaluation. The ADDIE model was developed by Mark and Cry (1996) to design learning systems. Where the steps in developing learning media must go through several stages, namely: (1) Analyze, (2) Design, (3) Development, (4) Implementation, and (5)) Evaluation (Evaluation).

In order to produce product specifications that can help students when learning and train students' abilities to think quickly and critically, several situation analyzes or identifications need to be carried out, including: Identifying Student Needs, Identifying Learning Goals, and Identifying Content/Learning Materials.

e-ISSN: 2528-102X
p-ISSN: 2541-4321

Table 1 Identification of problems

No	Identification	Problems found
1.	Student needs	Students need media that can stimulate enthusiasm for learning
		Students need media that is very easy to use
2.	Learning objectives	Mathematics learning outcomes have not been maximized
3.	Content/Learning Materials	Students have not been able to solve problems in integer arithmetic operations

Product development testing activities are carried out as a formative evaluation consisting of trials by material experts and media experts, and trials by small groups of 5 students.

The instruments used to collect data are: First, a questionnaire sheet to obtain assessments from experts including peer reviewers and teachers. Aspects of the Flippity-based educational game learning media assessment criteria used in this assessment are: 1) material presentation aspect, 2) curriculum aspect, 3) activity or experiment aspect, 4) learning evaluation aspect, 5) implementation aspect, 6) display quality aspect , 7) linguistic aspects, and 8) aspects of sentence clarity.

Second, the questionnaire sheet used to obtain student response data. Aspects of student response criteria collected in this research are: 1) Ease of understanding the lesson, 2) Independence in learning, 3) Interest in Flippity-based educational game learning media, 4) Usefulness of the media, and 5) Ease of use.

The product quality test data analysis technique aims to determine the quality of learning media using Flippity-based educational game learning media based on responses from material experts and media experts and a reviewer group consisting of 2 lecturers. Apart from that, a limited trial data analysis technique was also carried out on junior high school students with the aim of finding out the effectiveness of Flippity-based educational game learning media based on their responses.

Middle school students' responses to Flippity-based educational game learning media were analyzed descriptively, namely qualitative and quantitative descriptive analysis. The qualitative descriptive analysis method is data processing carried out by arranging it systematically in the form of sentences or words, categories to find conclusions (Agung, 2014). Qualitative descriptive analysis techniques are used to group qualitative data such as interview results, product feasibility values, criticism, comments and suggestions that will be used to improve the product being developed. The quantitative descriptive method is data processing carried out by arranging it systematically in the form of numbers or percentages to find conclusions (Agung, 2014). Quantitative descriptive analysis techniques are used to process data obtained through questionnaires in the form of scores in the form of percentage descriptions.

e-ISSN: 2528-102X
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The product validation questionnaire grid by experts and the adapted student response questionnaire grid are as follows:

Table 1. Product Validation Questionnaire Grid by Material Experts

No	Aspect	Indicator
1	Quality of Content and Purpose	Compatibility with KD Clarity of learning objectives Clarity of learning flow Material suitability Clarity of the material presented The depth of the material presented Ease of understanding the material Quality of practice questions Accuracy of language use
2	Quality of learning	Clarity of instructions for media use Accuracy of feedback on practice questions Ease of learning Means of interaction between teachers and students Independent learning The desire to study other material with similar media

Table 2. Product Validation Questionnaire Grid by Media Experts

No	Aspect	Indicator
1	Integration	Color combination Ease of navigation Clarity of instructions
2	Balance	Button placement Writing layout
3	Letter Shapes	Font type suitability Appropriate font size Variations in font size and type Text/sentence readability
4	Color	Matching background color Matching color of writing Button color matching Attractive images and animations
5	Language	Language accuracy Sentence accuracy

Table 3. Student Response Questionnaire Grid

No	Aspect	Indicator
1	Quality of Content and Purpose	Clarity of instructions for use Clarity of material discussion Clarity of learning flow
2	Engineering Quality	Clarity of display, color, navigation Text readability Practice questions and feedback Ease of use of the application
3	Quality of learning	Ease of learning Providing assistance in learning Independent learning The desire to study other material with similar media

The analysis technique for this research is product validation analysis and student practicality analysis. The percentage in the validation questionnaire is found using the following formula:

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e-ISSN: 2528-102X
p-ISSN: 2541-4321

$$Percentage = \frac{the\ number\ of\ scores\ given\ by\ the\ validator}{maximum\ score} \times 100\%$$

The resulting product validation criteria are in Table 4.

Table 4. Validity Criteria for a Product

Value weight	Category	Evaluation
5	Very worthy	$80 < N \leq 100$
4	Worthy	$60 < N \leq 80$
3	Not Worth It	$40 < N \leq 60$
2	Not feasible	$20 < N \leq 40$
1	Totally Not Worth It	$0 < N \leq 20$

If the validation results obtained are more than 60% then the product meets the appropriate criteria so it can be said to be valid and can be tested and if the student response results obtained are more than 60% then the product can be said to be practical. The practicality criteria for the products produced are stated in Table 5:

Table 5. Practicality Criteria for a Product

Value weight	Category	Evaluation
5	Very Practical	$80 < N \leq 100$
4	Practical	$60 < N \leq 80$
3	Less Practical	$40 < N \leq 60$
2	Impractical	$20 < N \leq 40$
1	Very Impractical	$0 < N \leq 20$

Each stage in media development is always evaluated by collecting data that is used to improve the resulting development product. This evaluation is carried out to measure and assess learning products resulting from validation questionnaires by experts and practicality questionnaires by students to determine the level of product feasibility.

RESULTS AND DISCUSSION

In general, the media model has a main menu in the form of a Wordwall when you enter the website. This page displays the material and practice questions presented. Users can go directly to the main menu. Where the main menu consists of evaluations for working on practice questions from the entire material by clicking on the various templates that are available. The templates presented include learning in mazes, quizzes, random wheels, and others. The evaluation will display the score obtained by the student after completing all the questions contained in it. The following is a partial display of the resulting Flippity (Website) based learning media:

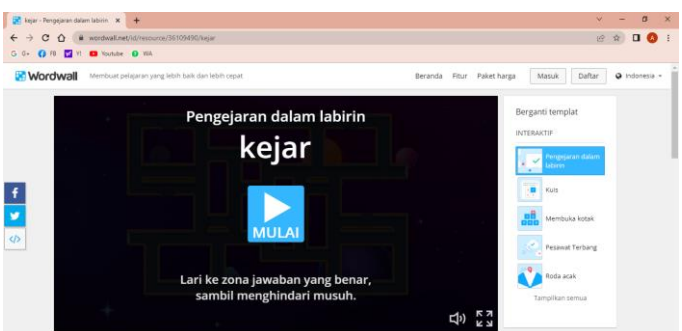

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Figure 1. Main Menu Page

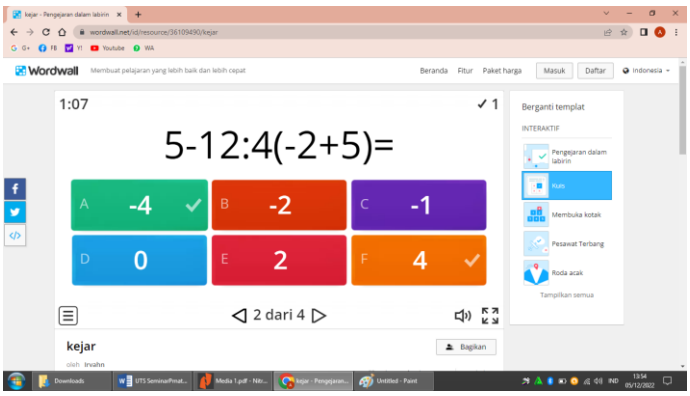


Figure 2. Example Question Page

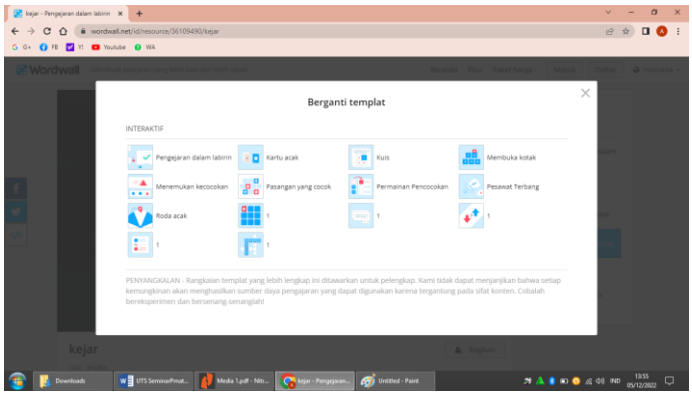
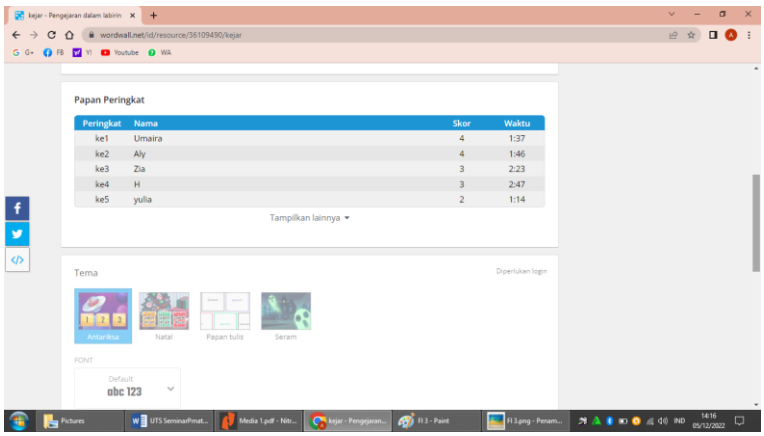


Figure 3. Template page



e-ISSN: 2528-102X
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Figure 4. Score page

Based on the results of validation carried out by 4 validators, namely 2 material experts and 2 media experts. The results of the validation of the data obtained by experts are as follows:

Table 6. Material Validation Questionnaire Result Data

Validator	Criteria	Percentage	Value
Validator 1	60	80%	Worthy
Validator 2	68	90,67%	Very worthy
Validator 3	59	78,67%	Worthy
Amount	187	83%	Very Worth It

Table 7. Media Validation Questionnaire Results Data

Validator	Criteria	Percentage	Value
Validator 1	59	78,67%	Worthy
Validator 2	70	93,3%	Very Worth It
Validator 3	65	86,67%	Very Worth It
Amount	194	86%	Very Worth It

Table 8. Average Percentage Level of Learning Media Appropriateness

Validator	Percentage	Value
Ahli Materi	83%	Very Worth It
Ahli Media	86%	Very Worth It
Rata-Rata	84,5%	Very Worth It

The average percentage result (%) given by the validator is 84.5% which is in the very feasible category, so the Flippity-based mathematics learning media (website) is very valid and can be tested.

Presentation and analysis of data from the results of small group trials on the development of Flippity-based educational game products as learning media. The subjects for the small group trial consisted of 5 students in the form of a student response questionnaire presented in Table 9.

Table 9. Student Response Data in Small Group Trials

Students	Amount	Percentage	Description
1	67	89,3%	Very Practical
2	70	93,3%	Very Practical
3	73	97,3%	Very Practical
4	67	89,3%	Very Practical
5	72	96%	Very Practical
Amount	**349**	**93,04%**	**Very Practical**

The average percentage result (%) given by students is 93.04% which is included in the very practical category, so the Flippity-based mathematics learning media (website) is very practical.

Based on the research results obtained, it can be seen that the learning media that have been validated by experts and tested, namely small group and large group trials with questionnaire

e-ISSN: 2528-102X
p-ISSN: 2541-4321

assessments, have been revised. These revisions are in accordance with comments or suggestions given by validators and students who have been declared worthy because their validity has been tested by practical validators because they have been tested on small and large groups until they meet very practical criteria so that the Flippity-based mathematics learning media (website) is easily accessible and can be supports the learning process both inside and outside the classroom. In addition, Flippity provides board game templates that can be utilized by teachers in face-to-face and online learning, enabling screen sharing and game implementation during online learning (Aribowo, 2024). So Flippity can support abilities and help students solve problems during online learning (Gerovasiliou & Zafiri, 2017).

Furthermore, the test results are limited to table 9, namely the highest score and stated to be very practical at 97.3%. It can be seen that Flippity-based learning media (website) can attract students' interest in the learning process, because learning becomes fun. Apart from that, learning in the current technological era has become mandatory for educators to utilize technology. Educational games act as learning tools that can encourage active and participatory learning. These results are also in line with the results of research conducted by Dewi & Sadjiarto (2021) which states that educational games act as learning tools that can encourage active and participatory learning. Apart from that, educational games can also influence students' learning motivation (Nisa & Susanto, 2022). Educational games are games that have been specially prepared to direct students (users) to selected learning activities, apart from that, these educational games can help students in a fun learning process (Novaliendry, 2013). Learning using the concept of learning while playing makes students more active in the learning process (Suryawirawati, et al., 2018; Naimah et al, 2019).

The results of the analysis carried out by researchers found that this Flippity (website) based learning media had several advantages and obstacles during the research. The advantage is that this media has an attractive design appearance, both in terms of color, writing, images and animation. This media is easy to operate, understand and easy for students to understand, the buttons in this media can function properly according to the instructions for using the media. The material and practice questions are in accordance with KD and are accompanied by pictures and animations so that students do not feel bored when using them.

Another advantage is that this media can be used independently both at school and outside of school because this media is easy to obtain via the website. This media is also equipped with a discussion and at the end of the evaluation there are results of student assessment scores using this learning media. However, apart from these advantages, there are several obstacles that arise when using Flippity-based learning media, one of which is that during the research, students were hampered by unstable internet networks and so on. Apart from that, students who have low abilities will find it

e-ISSN: 2528-102X
p-ISSN: 2541-4321

difficult to learn independently using Flippity-based learning media so that students must always be accompanied when learning..

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of research data analysis and discussion, it can be concluded that the assessment carried out by validator experts was 84.5% and the results of trials with students were 93.04%, so it can be concluded that the Flippity-based educational game application is declared valid and practical so that it can facilitate students in the learning process both inside and outside the classroom. Apart from that, this Flippity-based educational game application can make it easier for students to learn independently and easily understand the content of the material being taught.

Meanwhile, in the research that has been carried out, there are several recommendations that teachers need to use game applications in every learning process so that students are more creative and can export technology-based learning media.

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e-ISSN: 2528-102X
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