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DEVELOPMENT OF "X-MATH" GAME-BASED LEARNING MEDIA TO INCREASE STUDENT'S MATHEMATICS LEARNING INTEREST

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Abstract

The decline in students' interest in learning mathematics due to the lack of variety in teaching media used in learning results in low student learning outcomes. One of these problems occurred in class VIII students at SMP Negeri 2 Bojonegoro. There are still educators who only focus on books when learning. Besides, educators who deliver material, especially Cartesian coordinates, only use a whiteboard. The use of this media is certainly not optimal if implemented in continuous learning because apart from spending a lot of time just drawing, it also results in monotonous and boring classes. Therefore, this research aims to develop X-MATH learning media, which is the application of game-based learning to class VIII Cartesian coordinate material that meets valid and practical criteria to increase students' interest in learning. This research uses the Borg and Gall model, which only carries out seven of the ten stages of the development procedure. The research results show that material expert validation results obtained a percentage of 95%, while media validation results obtained a percentage of 91.6%. Both results meet the level of validity, namely very valid and suitable for use. Besides that, based on field trials conducted with mathematics educator respondents and students, the average score percentage was 83.3%, so the media was categorized as quite practical. Based on the results of this research, the game-based X-MATH learning media developed is very valid and quite practical to use in learning Cartesian coordinates.

Keywords: Cartesian coordinates, development, game-based media

Abstrak

Turunnya minat belajar matematika peserta didik yang disebabkan kurang bervariasinya media ajar yang digunakan dalam pembelajaran mengakibatkan rendahnya hasil belajar peserta didik. Permasalahan ini terjadi salah satunya pada peserta didik kelas VIII SMP Negeri 2 Bojonegoro. Masih dijumpai pendidik yang hanya terfokus pada buku saat pembelajaran. Selain itu, pendidik dalam penyampaian materi khususnya koordinat kartesius bahan ajar yang digunakan hanya papan tulis. Penggunaan media tersebut tentu kurang optimal jika dimplementasikan dalam pembelajaran berkelanjutan karena selain menghabiskan banyak waktu hanya untuk menggambar juga mengakibatkan kelas monoton dan membosankan. Sebab itu, tujuan dari penelitian ini adalah mengembangkan media pembelajaran X-MATH yang merupakan penerapan dari pembelajaran berbasis game *pada materi koordinat kartesius kelas VIII yang memenuhi kriteria valid dan praktis guna meningkatkan minat belajar peserta didik. Penelitian ini merupakan penelitian pengembangan menggunakan model* Borg and Gall *yang hanya melaksanakan tujuh dari sepuluh tahapan prosedur pengembangan. Hasil penelitian menunjukkan bahwa hasil validasi ahli materi memperoleh persentase sebesar 95%, sedangkan hasil validasi media memperoleh persentase sebesar 91,6%. Kedua hasil tersebut memenuhi tingkat validitas yaitu sangat valid dan dapat digunakan. Selain itu, berdasarkan uji coba lapangan yang dilakukan dengan responden pendidik matematika dan peserta didik menghasilkan persentase skor rata-rata sebesar 83,3% sehingga media dikategorikan cukup praktis. Berdasarkan hasil penelitian tersebut maka media pembelajaran X-MATH berbasis* game *yang dikembangkan sangat valid dan cukup praktis digunakan dalam pembelajaran koordinat kartesius.*

Kata kunci: *koordinat kartesius, media berbasis* game*, pengembangan*

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INTRODUCTION

Mathematics is a source of other sciences (Muhlisotin et al., 2021). Mathematics can train students' concentration abilities, where students will be introduced to concepts, skills and thinking strategies for solving problems (Wulandari, 2020). So education, especially in the field of mathematics, can be an effort to improve human resources (Cindarbumi, 2018).

In reality, there are still many students who, after studying mathematics, think that mathematics is a difficult and boring subject. Moreover, in learning mathematics material on Cartesian coordinates for class VIII SMP students must first understand several basic concepts. These concepts relate to units and measurements, the order of positive and negative numbers on a number line, the concept of a number line, coordinate axes, center points (0,0) and drawing number lines, either horizontal and vertical, on a plane in coordinates (Nopriyani, 2018).

Based on observations, students' interest in learning mathematics has decreased. This is because the only media used in learning are books. Of course, this makes students feel bored and lazy to participate in learning, resulting in low learning outcomes. Beside that, students also have difficulty thinking abstractly in visualizing or illustrating images and concepts of Cartesian coordinate material.

Boedi Utomo, one of the mathematics subject educators at SMP Negeri 2 Bojonegoro, said on September 21 2022 that in teaching mathematics, the way educators manage the class greatly influences the success of the learning. Based on the statement above, it turns out that there are still educators who only focus on books when teaching mathematics at SMP Negeri 2 Bojonegoro. Apart from that, when delivering the material itself, educators only use whiteboards because educators have not been able to develop their media. The use of less varied media is certainly less valid and practical and tends to be monotonous if implemented continuously.

The application of various learning strategies including the use of appropriate media is also an important part of learning (Chandra Sari & Kurniawati, 2020). Learning mathematics requires several strategies to foster students' activeness in learning activities, one of which is by using learning media (Ulumiyah & Ilmiyah, 2022). The success of a lesson can be helped by the use of learning media in the teaching and learning process (Widyasari & Lestari, 2023). Learning media is an innovation that can integrate multi disciplines which is expected to improve the quality of education (Risqii, 2023).

One of the media that can be used to visualize work objects from mathematics, especially Cartesian coordinate material is Microsoft PowerPoint. Previous studies have shown that PowerPoint-based games are effective in developing math skills (Warmansyah, 2019), the use of PowerPoint-integrated media in learning Cartesian coordinates has proven to be practical and effective (Asmal & Taufik, 2021), with the development of educational PowerPoint games for learning, it can help and increase students' enthusiasm for learning, students become enthusiastic and participate actively during learning activities (Eveline Siregar & Frista D. Ramadhani, 2022), makes it easier for students to remember learning and the learning process becomes more meaningful (Hartutik et al., 2022).

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One method that can be used in learning mathematics is game-based learning, where apart from being used as a direct object delivery, games can be used to achieve high-level cognitive learning goals (Heru, 2018). Learning with games is fun and can motivate students, especially junior high school students who are still categorized as children who like to play (Sulistiyawati et al., 2021). Therefore, this research aims to develop X-MATH learning media which is an application of game-based learning in class VIII Cartesian coordinate material in order to increase students' interest in learning.

RESEARCH METHODS

The R&D (Research and Development) method is the method used in this research to develop a learning media. The development model used is Borg and Gall, namely 7 of 10 development stages. These stages include research and information collecting, planning, developing the preliminary form of a product, preliminary form testing, main product revision, main field testing and operating product revision. The details of the flow can be seen in Figure 1.

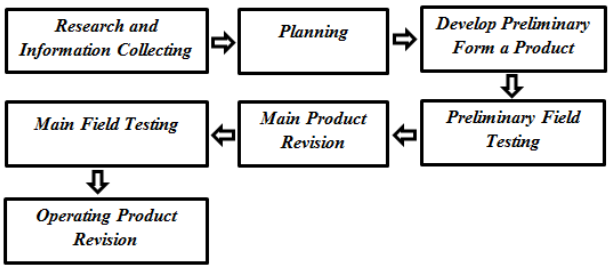

Figure 1. The Borg and Gall Development Model (7 of 10 stages)

The procedure in media development, as shown in Figure 1, states that the Borg and Gall model has a classification of steps at each stage, namely: First, research and information collecting, collecting information in the form of potentials and problems through observation and interviews and conducting preliminary studies on previous research conducted relevant. Second, planning, formulating objectives for creating media, analyzing needs and reference material, and preparing research instruments. Third, develop a preliminary form of a product, prepare a media design plan that begins with creating a media conceptual framework, collecting the necessary materials such as teaching materials, image designs, animations, background sound, and practice questions, and then combining all the materials that have been collected, editing rework the media developed independently, create a media usage manual, validate the product with material expert validators and media expert validators and revise the design if necessary according to expert validator suggestions and input. Fourth, preliminary form testing, the media was tested on a limited sample, namely 5 class VIII students at SMP Negeri 2 Bojonegoro noted deficiencies and obstacles when the media was tested, distributed practicality questionnaires to respondents and analyzed the questionnaire results. Fifth, main product revision, revising products that have been tested on limited samples according to the results of the questionnaire that has been distributed

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and suggestions and input from respondents. Sixth, main field testing, a field trial was carried out with a larger number of students than the limited sample trial as well as grade VIII mathematics subject educators, noting deficiencies and obstacles when the media was being tested, distributing practicality questionnaires to respondents and analyzing the results of the questionnaire. Seventh, operating product revision, making improvements to the product based on the results of observations and analysis of practicality questionnaires during field trials.

The research instrument is in the form of a questionnaire which is adapted from previous research instruments and has been validated with an answer column in the form of a Likert scale. The research instruments include a validity questionnaire and a media practicality questionnaire. The validity questionnaire sheet consists of a validation questionnaire by media expert lecturers and material expert lecturers. Meanwhile, the media practicality questionnaire sheet consists of practicality questionnaires by mathematics educators and students.

Testing the validity of the expert team questionnaire was carried out by comparing the total score of the validator (∑JSV) with the highest total score of the validator (∑JSTV) which is formulated in formula (1).

$$PS = \frac{\sum JSV}{\sum JSTV} \times 100\% \qquad \text{... (1)}$$

Information:
PS = Score percentage
$\sum JSV$ = The total score of the answers from each validator
$\sum JSTV$ = The sum of the validator's highest scores
(Purwatiningsih & Yundra, 2019).

The validity criteria for the expert team validation questionnaire are shown in Table 1.

Table 1. Validity Criteria for the Expert Team Validation Questionnaire

Validity Criteria	Validity Level
$85\% < kv \leq 100\%$	Very valid, or usable without revision
$70\% < kv \leq 85\%$	Fairly valid, or usable but needs minor revisions
$50\% < kv \leq 70\%$	Not valid, it is recommended not to use it because it needs revision
$0\% < kv \leq 50\%$	Invalid, or should not be used

(Alvionita et al., 2019)

Furthermore, in the practicality analysis technique of the media by respondents, the formula used to calculate the percentage score at formula (2), with PS is score percentage, $\sum JSR$ is Total score the answer to each respondent, and $\sum JSTR$ is highest score total respondent (Purwatiningsih & Yundra, 2019).

$$PS = \frac{\sum JSR}{\sum JSTR} \times 100\% \qquad \text{... (2)}$$

The results of the respondents' practicality questionnaire obtained can be interpreted in terms of the practicality criteria of the respondents' practicality questionnaire shown in Table 2.

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Table 2. Respondent practicality questionnaire practicality criteria

Practical Criteria	Practicality Level
$85\% < kp \leq 100\%$	Very practical, or can be used without revision
$70\% < kp \leq 85\%$	Quite practical, or usable but needs minor revisions
$50\% < kp \leq 70\%$	Less practical, it is recommended not to use it because it needs revision
$0\% < kp \leq 50\%$	Impractical, or should not be used

(Alvionita et al., 2019)

Next, qualitative descriptive data analysis techniques were carried out on data collected from validation questionnaires and practicality questionnaires in the form of responses, criticism and suggestions and observation results during media trials. The steps used in qualitative descriptive data analysis techniques include: collecting data, reducing relevant data, presenting data in the form of descriptions and drawing conclusions.

RESULTS AND DISCUSSION

The results of the research based on the development procedure are described in the following stages.

Research and Information Collecting

The results of observations and interviews conducted by researchers during the Introduction to Schooling Field (PLP), from 08 September to 08 October 2022 at SMP Negeri 2 Bojonegoro, showed that students' interest in learning mathematics was decreasing. This is because the teaching media used only focuses on books such as worksheets or textbooks. Apart from that, it has been found that educators only use blackboards to deliver material because they have yet to be able to develop their media. So, educators' use of technology, facilities, and infrastructure in learning has yet to be maximized.

Field studies reviewed the Competency Standards and Basic Competencies obtained from one class VIII mathematics lesson material, namely Cartesian coordinates. Besides that, literature studies were conducted on several previous studies relevant to the existing problems, and one solution was obtained by developing game-based learning media. Based on the researchers' considerations and several relevant previous research results, Microsoft PowerPoint was chosen as the application used in developing game-based learning media.

Planning

The development of game-based learning media aims to create a fun and memorable learning atmosphere for students. It can attract interest in learning, make students more focused on learning, and convey the material properly so that students no longer find it difficult to understand the material. The concept of game-based learning media developed includes an explanation of Cartesian coordinates material and several interactive games that could be used to assist learning in class. The research instruments prepared include a media validity questionnaire for media experts and material experts and a media practicality questionnaire for educators and students adapted from previous research that has been validated.

Develop Preliminary Form a Product

Based on the results of preparing the game-based learning media concept that has been determined, materials are collected in the form of materials as

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well as practice questions on Cartesian coordinates, image design, animation, and background sound. Then, all the materials were combined to produce an initial form of game-based learning media called X-MATH. The X-MATH learning media developed by this researcher consists of 22 slides, including the home page slide, the developer slide, the Information slide, the main or home menu slide, the teacher's instructions slide, the interactive math game slide, the game slide finding a place on the map, the The game determines the position using the coordinate axes, the slide determines the destination and the game slide determines the position on the quadrants. Moreover, the media is equipped with a user manual, which contains the background of the development of the media, product specifications, and links to access the media.

The next step is that the media is validated by two validators, including material validation and media validation. The following results of material and media validation are presented in Table 3.

Table 3. Validation results

No	Validation	Percentage	Validity Level
1	Material	95%	Very valid, or usable without correction
2	Media	91,6%	Very valid, or usable without correction

Table 3 shows that the results of material validation and media validation are entered at the validity level, which is very valid or can be used without improvement, with respective percentages of 95% and 91.6% with a record of revising according to the advice given by the expert validator. The suggestions from the material and media expert validator include changing the writing on the educator's guide button to the material; the material needs to be corrected, adding the sub-chapters discussed, not yet interactive, and the sound does not support the contents of the game display on the media. Then the design was revised according to the suggestions and input provided by the material expert validator and media expert validator, including: improving the material, adding a material explanation sound that automatically plays when the material slide is open, adding moving illustrations to the material explanation and changing the sound to better support the game display. So that the media is more interactive and can be tested.

Preliminary Field Testing

The initial trial was conducted with a limited sample of 5 students in class VIII F of SMP Negeri 2 Bojonegoro to determine how students responded to the X-MATH learning media in learning Cartesian coordinates. After the practicality questionnaire was distributed to 5 students, the questionnaire results were analyzed. The results of the initial trial of this limited sample show that the game-based X-MATH learning media developed by researchers is very practical and can be used to help learn Cartesian coordinates in the classroom by improving the points written by respondents, among others, improving the appearance of the media, improving on background sound and sound quality and improvements to the presentation of material to make it more systematic.

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Main Product Revision

The product revision stage was carried out after obtaining the results of initial sample trials limited to students in class VIII F of SMP Negeri 2 Bojonegoro. Based on the data analysis carried out, several media deficiencies were obtained. Furthermore, researchers tried to minimize media deficiencies according to suggestions and input as well as the results of the practicality questionnaire. The improvements made include: adding several animations, changing the background color to better support the media and create attractiveness, replacing some of the less attractive background sound as well as adjusting the sound quality and improving the presentation of the material to be more systematic.

Main Field Testing

At this stage, game-based learning media was tested in conventional classes to determine how practical the media was in learning with respondents, one mathematics educator, and 27 students taken from classes VIII G and H at SMP Negeri 2 Bojonegoro. In carrying out field trials, researchers displayed game-based learning media to students in front of the class with the help of an LCD projector. Students enthusiastically pay attention to the learning media displayed in front of them. Next, students queue up to the front in turn to work on practice questions in the game. In conditions like this, apart from training students' self-confidence, they also create learning with peer tutors (peer teaching) by utilizing school facilities and infrastructure as well as developments in science and technology.

Table 4 shows the questionnaire results on the practicality of respondents to the game-based X-MATH learning media in field trials, which mathematics educators filled in, and students.

Table 4. Field Trial Results

Respondent	Score Percentage	Level of Practicality
Educator	98,3%	Very Practical
Students	82,7% (an average of 27 students)	Quite Practical

Table 4 shows that the results of the practicality questionnaire by educators are entered at the practicality level, which is very practical, or can be used without improvement with a score percentage of 98.3% which meets the practical criteria, namely $85\% < kp \leq 100\%$, then the results of the practicality questionnaire by students with the practicality level is quite practical, or it can be used but needs minor revision with a score percentage of 82.7% which meets the practical criteria of $70\% < kp \leq 85\%$. As for some suggestions and input from students, including adding more interesting images and backsounds to the media, the backsound volume is too loud and the game material is a little complicated.

Operational Product Revision

The product revision stage was carried out after obtaining the results of field trials in the classroom with respondents, namely one mathematics educator and more students than the initial limited sample trial, namely class VIII G and H, totaling 27 children. Based on the results of data analysis

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from the media practicality questionnaire, which was distributed to mathematics students and educators, several suggestions and input were obtained regarding the media being tested. Next, the researcher improved the media according to suggestions and input from respondents in order to maximize the media developed. These improvements include: adding images and changing the background sound to be more attractive, reducing the volume of the media background sound so it is not too loud, and improving the material so that it is easier for respondents to understand.

The following are the final results of the game-based X-MATH learning media with Cartesian coordinate material shown in Figure 2.

Figure 2. Final results of game-based X-MATH learning media

Decreasing interest in studying mathematics for class VIII junior high school students in Cartesian coordinates material. The decline in interest in learning mathematics is caused by the use of learning media which only consists of books and the presentation of material by educators only using a whiteboard, thus creating a boring learning atmosphere for students. Beside that, students also have difficulty thinking abstractly in understanding and visualizing images or material concepts. This is supported by Dwiranata et al. (2019) that the use of media which are only textbooks and whiteboards in learning will be less than optimal because apart from taking up a lot of

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time because educators have to draw first before presenting the material, learning will also become less interesting.

Based on these problems, media is needed that can help the process of learning Cartesian coordinate material and attract students' interest in learning mathematics, namely by using game-based learning media in the Microsoft PowerPoint application. This is in accordance with Nurdiana & Asmah (2022) that the use of game-based media in learning Cartesian coordinates can be a method for educators to convey material and can attract interest and make it easier for students to learn mathematics. The choice of application for media development is Microsoft PowerPoint, which is familiar so there are no difficulties in operating it. This is in line with Batubara (2020) that selecting the right media must be in accordance with the interests, needs, conditions of students and must be in accordance with the skills of the user who operates it.

Next, design a media concept according to the needs of the learning process and the characteristics of students. Game-based media developed in Microsoft PowerPoint consists of material explanations in the form of writing, moving illustrations and sound explanations of the material as well as several interactive games that can support various student learning styles. In this way, the media developed can attract students' interest in learning mathematics, both from students with visual, audio and kinesthetic learning styles. This is in accordance with Muthoharoh (2019) in his research that the use of Microsoft PowerPoint assisted by LCD can cover a large transmission range so that it can support a large audience and can support all student learning styles ranging from visual, audio and kinesthetic learning styles.

Next, game-based X-MATH media was developed in accordance with the concept design that had been created. After the media is created, it's then continued with the validation process. The material validation results obtained a percentage of 95%, while the media validation results obtained a percentage of 91.6%. Both validation results have met the level of validity, namely very valid and can be used provided that the media is improved according to suggestions and input from each expert validator. Next, a limited scale trial of the X-MATH media was carried out on five students to find out the practicality of the media. After knowing the results of this limited scale trial, improvements were made based on input from students to practical media and a field trial could be carried out on a mathematics educator and 27 students to find out the practicality of the X-MATH media. The results of the field trials obtained an average percentage of 83.3%, which has met the practicality level, namely it is quite practical and can be used with minor revisions.

The weakness in this research is that the field trials were carried out close to school holidays and events, so the trials were carried out in a limited time and students were in a hurry because they coincided with other events so the results were less than optimal and only produced an average percentage of 83.3%. On the other hand, there are also several advantages of this research, namely that the game-based X-MATH learning media has succeeded in attracting students' interest in learning mathematics, can reach all students' learning styles so that students no longer have difficulty understanding

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and concluding the material and concepts provided. This is in line with research by Warmansyah (2019), Asmal & Taufik (2021), Eveline Siregar & Frista D. Ramadhani (2022) and Hartutik et al. (2022) that game-based media in the PowerPoint application has proven to be practical, attracts students' interest in learning and active participation in learning and makes it easier for students to remember learning. Apart from that, the results of this development research can add to mathematics learning media, especially in learning Cartesian coordinates for schools or other mathematics educators.

CONCLUSIONS AND SUGGESTION

The conclusion of this research resulted in the development of the X-MATH learning media which is the application of game-based learning to class VIII Cartesian coordinate material in order to increase students' interest in learning using the Borg and Gall model. The results of the questionnaire assessment showed that the validity of material experts obtained a score percentage of 95% and the validity of media experts obtained a score percentage of 91.6%. Then, based on the results of field trials conducted with mathematics educator respondents and students, an average score percentage of 83.3% was obtained. This shows that the learning media developed is quite appropriate with needs and characteristics of students so that the average percentage is 83.3%.

The learning media developed still has limitations, namely that it can only be accessed via a laptop or PC. It is hoped that future researchers can further develop PowerPoint game-based learning media so that it can be accessed on all devices, both mobile phones and laptops. Next, the media can be continued with an effectiveness test to see how effective the media that has been developed is.

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