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Media scratch development on coordinated themes cartesius uses addie model

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A B S T RAK

Matematika merupakan mata pelajaran yang sangat penting di sekolah. Hal ini dikarenakan matematika berperan dalam menyelesaikan masalah sehari-hari. Salah satu mata pelajaran matematika adalah koordinat kartesius. Dalam pembelajaran matematika, pemanfaatan media pembelajaran masih rendah dan sebagian siswa masih kesulitan dalam mengerjakan soal koordinat kartesius. Solusi yang dapat digunakan untuk menyelesaikan permasalahan yang dihadapi siswa dan guru adalah dengan menggunakan aplikasi Scratch yang menampilkan gambar disertai penjelasannya. Penelitian ini bertujuan untuk mengetahui perancangan media pembelajaran Scratch dan juga mengetahui kemampuan siswa setelah menggunakan media Scratch tersebut. Model ADDIE memiliki lima tahapan yaitu Analyze, Design, Develop, Implement, dan Evaluate. Subjek dalam penelitian ini adalah tujuh siswa Kelas VII di salah satu SMP Negeri di Bandung. Hasil validasi oleh validator ahli materi, validator ahli media, guru, validasi User Acceptance Testing (UAT) dan juga pengguna menunjukkan bahwa media pembelajaran yang dibuat masuk dalam kategori layak untuk digunakan dalam proses pembelajaran. Setelah siswa melakukan pembelajaran menggunakan media Scratch, diperoleh nilai rata-rata output siswa sebesar 81,14. Berdasarkan skor tersebut, terdapat 6 dari 7 siswa yang dinyatakan memenuhi Kriteria Ketuntasan Minimal (KKM). Selain itu, pada perhitungan ketuntasan klasikal diperoleh sebesar 85,7%, sehingga dapat disimpulkan bahwa media pembelajaran ini sangat efektif.

A R T I C L E   I N F O

A B S T R A C T

Mathematics is a very important subject in school. It's because it plays a role in solving everyday problems. One of the topics of

mathematics is the cartesian coordinates. In mathematical learning, the use of learning media is still low and some students still have difficulty working on cartesian coordinates. The solution that can be used to solve the problems that students and teachers face is to use the Scratch application that displays images with explanations. The study aims to learn about Scratch learning media design and also learn about students' abilities after using the Scratch media. The ADDIE model has five stages: Analyze, Design, Develop, Implement, and Evaluate. Subjects in the study were seven students of Class VII in one of the secondary schools of Bandung. Validation results by material expert validators, media expert validators, teachers, User Acceptance Testing (UAT) validation, and also users show that the learning media created in the category deserves to be used in the learning process. After students perform learning using Scratch media, the average student output score is 81.14. Based on the score, there are 6 out of 7 students declared to be in favor of the Minimum Proficiency Criteria (KKM). Besides, the classical proficiency calculations were obtained at 85.7%, which can be concluded that the learning media is very effective

1. INTRODUCTION

Mathematics is a very important subject in school because of its role in solving everyday problems. One of the mathematical subjects is the cartesian coordinate (Yulianisa & Sudihartinih, 2022). The cartesian coordinate is one of the maths that attempts to represent points on the field of cartesian based on a problem that is transformed into a mathematical representation that corresponds to real life. (Setiyowati , et al.., 2023).

This material is simple compared to other mathematical subjects, but some students still have difficulty working on it. The difficulties of students in solving the topic of cartesian coordinates are caused by various consequences, such as student misunderstanding of the concept (Fitriyah, et al., 2020), student misinterpretation of the subject, and student error in drawing coordinate points and also drawing the coordinate symbols (Lango & Lede, 2022), as well as student error to determine the origin of coordinates or certain points. (Rahmawati, et al.., 2019).

During the learning process of mathematics, some teachers only use books as learning materials and are equipped with learning tools such as tablets and PowerPoints when teaching math. (Amir, 2016; Awalia, et al.., 2019). Due to the limited use of mathematical learning media, most students still do not understand the concept and are also prone to being too lazy to work on it. (Dewi & Septa, 2019; Maharani, et al.., 2018). One solution to this problem is the use of learning media. (Asnawati, 2019). In mathematics teaching, the media is needed as a means of communication between teachers and students to clarify abstract concepts. (Suseno, et al.., 2020). Learning media can also support the success of learning processes (Ulfah, et al., 2016). Teachers can use learning media to convey more meaningful learning as it is done through visualization. This is because students prefer the visual to the teacher's writing, and they don't need to explain the lesson orally or in a lecture, so it can help students better understand the material they are teaching. (Kustiati, 2022).

In the twenty-first century, teachers should provide teaching materials that are consistent with the development of the times. Teachers should also use ICT as an alternative to help students understand concepts (Muharni, et al., 2021), as well as deliver learning materials that are fun, interesting, and relevant to the materials they want to be taught. (Ghufron, et al.., 2022; Kustiati, 2022). Scratch is a programming language that beginners can use to display animations, sounds, and images (Sutikno, et al.., 2019). In the cartesian coordinate material, the Scratch application is the most appropriate solution to solve problems faced by students and teachers as the Scratch app displays images and descriptions compared to GeoGebra. The Geogetra app only shows images, and the GeoGebra application is also difficult to use on Android offline. Scratches can be easily accessed online and offline (Chasannudin, et al., 2022). Therefore, Scratch can be used on Android, students find it easier to use Scratch, and also more students are used than on iOS.

Some studies on the development of mathematical learning media using Scratch are on the topics of the greatest federative factor (FPB) (Sudihartinih, et al.., 2021), algebraic overlapping (Yulianisa & Sudihartnih, 2022), the size of the triangle area (Novita & Rachmatin, 2021) and flat

buildings. (Nuraeni, et al.., 2021). Scratch is also used in other lessons such as physics (Intana, et al.., 2018), and science literacy. (Latip, 2022; Poobalan, et al.., 2019). Based on the research report, there has been research on android-based learning media design on the topic of point position against point of origin (0,0), and certain points (a,b) using the Scratch application by the author himself (Emanuela & Sudihartinih, 2023) but need to express further the process of development of such media. Therefore, the researchers will study the design of Android-based learning media using the Scratch application on the topic of point position against point of origin (0,0) and specific point (a,b).

2. METHODS

Research and Development is a process or measures to develop a new product or to improve an existing product (Okpatrioka, 2023) and also to test the effectiveness of existing products as well as to develop and create new products. (Yuliani & Banjarnahor, 2021). The ADDIE model, pioneered by Branch, has five stages of this model: Analyze, Design, Development, Implement, and Evaluate. (Fitriyah, et al.., 2021). Analysis is a phase in analyzing several problems encountered during the learning process, including the lack of adequate learning material and media. Design is the stage of choosing materials and designing storyboards.

Development is the development stage, where learning materials are developed based on planned designs. In addition to developing Scratch-based material, the validator also performs validation of advice to improve the learning material produced. At this stage, validators include media experts, material experts, teachers, and UAT (User Acceptance Test). A user acceptance test is carried out to find out the user's response to a program test that has been designed by distributing a raft containing open questions through Google Forms and conducting interviews. Implementation is a phase of experimental learning media conducted by conducting experiments on a group of high school students. Implementation of learning media using a single-group pretest-posttest design. The research design begins with a pretest, then provides a Scratch development treatment, and ends with a final test. (posttest). Evaluation in this research is a process evaluation as it is associated with the research and development stages to improve the product developed during the production of learning materials from the analysis stage to the implementation stage.

The participants in the study were seven male students from one of the schools located in Bandung City, West Java Province. The instruments used in this research are test instruments and non-test instruments in the form of unstructured interviews and lifts. The test instrument consists of pretes and postes. The test consists of five question descriptions representing each indicator of

concept understanding. The Concept Understanding Indicator according to Mayasari & Habeahan (2021) mention indicators of concept understanding as follows: using images to help solve a problem, providing examples rather than examples for a concept, classifying examples into a concept; being able to apply similarities between concepts and procedures; understanding and using appropriate patterns for solving problems; applying similarities or differences to solve problems; able to explain solutions.

Research methodology contains the use of a research approach, time and place of research, targets/objectives, research subjects, procedures, instruments, and data analysis techniques as well as other matters related to the research method. Targets/objectives, research subjects, procedures, data, and instruments, are given with sub-headings.

Data obtained from the test results, and data analysis using the following formula.

$$Value = \frac{Total\ score\ Obtained}{Ideal\ score\ total}\ x\ 100\%$$

The final score will be compared to the Minimum Compliance Criteria (MCC) values that apply in the school where the test is conducted. The number of students declared to be successful has an influence on learning success. This learning success refers to classical accuracy. Classical accurateness can be obtained using the following formula.

$$Classical\ Intensity\ (KK) = \frac{Many\ strict\ students}{Many\ overall\ students}\ x\ 100$$

Classical intensity is the benchmark for the effectiveness of interactive learning media based on Scratch to develop the ability to understand concepts on the topic of cartesian coordinates. The classical accuracy is interpreted by Table 1.

Table 1. Classical intensity

Range Final Score	Criteria
KK > 80%	Very effective
60% < KK < 80%	Effective
40% < KK < 60%	Less Effective
\20% < KK < 40%	Ineffective
0% < KK < 20%	Very Ineffective

A Likert scale is a measurement used to measure attitudes, opinions, and perceptions of individuals or groups related to social events (Sugiyono, 2013). The Likert Scale in this study uses five options based on scale levels according to Sugiyono (2013). To obtain results in the form of structured information, the data analysis uses the following formula.

$$Percentage\ Value\ = \frac{sum\ of\ scores\ obtained}{sum\ of\ ideal\ scores}\ x\ 100\%$$

In determining the percentage to be calculated, the determination in table 3.5 is based on the interpretation of the scores according to Arikunto & Jabar (2018) as follows.

Table 2. Percentage of Achievement

Range Final Score	Criteria
KK > 80%	Qualified
60% < KK < 80%	Worth
40% < KK < 60%	Quite qualified
\20% < KK < 40%	Less qualified
0% < KK < 20%	Not qualified

3. RESULT AND DISCUSSION
Learning Media Design Process

The following is the Scratch-based learning media design process using the ADDIE procedure:

a. Analysis

The analysis is the first phase of the preparation phase in the development of the AD DIE model. The problem faced by students on cartesian coordinate material is that some students have not yet been able to draw cartesian coordinates some students are still confused about determining the point in the cartesian coordinate and also students are mistakenly writing the quadrant of cartesian coordinates. Students also have difficulty pointing the position of a point in a particular point.

b. Design

At the planning stage, material selection and initial planning of the learning media are carried out by creating a storyboard for the game layout to be created. Storyboards are made in Microsoft Word and consist of a total of five pages containing about opening view, introductory view, menu view, material view and material description, exercise view, and game view. Figure 1 shows some storyboard designs made.

VISUAL	SKETSA	AUDIO	VISUAL	SKETSA	AUDIO
Dalam frame ini terdapat background layer dengan resolusi 1024x768 dan 2 layer animasi	Animasi Judul Animasi Penjelasan Aplikasi dan Kalimat Pembuka	Slow music dan Voice Over	Dalam frame ini terdapat background layer dengan resolusi 1024x768, teks judul, dan 1 layer animasi	Judul Masukan Nama Icon-icon yang berhubungan dengan konsep posisi titik	slow music ditambah dengan *voice over*

Figure 1. Storyboard View

c. Development

At the stage of learning media creation, the learning media design corresponds to the storyboard design that has been created.
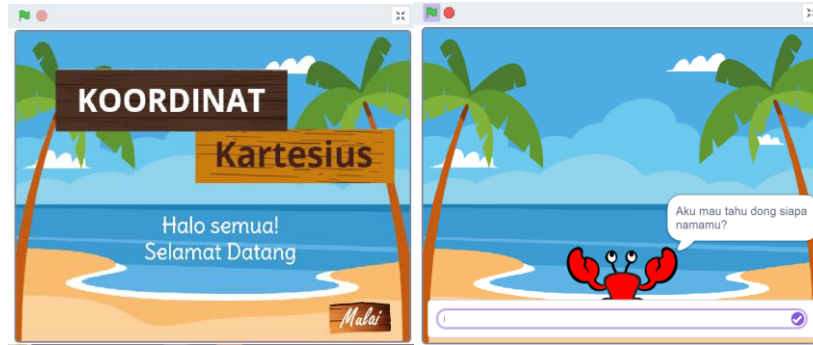
Figure 2. Scratch Media Appearance

The initial appearance of this game is shown in Fig. 2. Start the game by first pressing the Start Game button and the opening speech. At this stage, not only are Scratch learning media created, but validation tests are also carried out by validators. To ensure that the developed learning media design is valid, validity tests are carried out by providing a validation lift. There are four validation tracks: media expert validation carrier, material expert validating carrier, and UAT validation Carrier. The following conclusions of the validation response to the validating expert carrier can be seen in Table 3.

Table 3. Media Validation Response

Name	Media Validation		
	Content	Technical	Instructions
Validator A	80%	80%	80%
Validator B	95%	80%	85%
Validator C	80%	80%	90%

Based on Table 3, it can be concluded that the learning media in content quality, instruction, and technical are categorized as highly qualified. Here is the conclusion of the validation response to the lifting of validation experts can be seen in Table 4.

Table 4. Materials Validation Responses

Name	Materials Validation		
	Content	Learning	Language
Validator A	80%	80%	80%
Validator B	95%	80%	90%
Validator C	90%	85%	95%

Based on Table 4, it can be concluded that the learning media in the quality of content, instruction, and technical categorized as very decent.

Table 5. UAT Response to Scratch Media

Name	Understanding the concept	Visual of the Game	Button Functionality	Interest	Benefit	Language
L1	+	+	-	+	+	+
L2	-	+	-	+	+	+
P1	-	+	+	+	+	+
P2	+	-	+	+	+	+
L3	+	+	-	+	+	+
L4	+	+	+	+	+	+
L5	+	+	+	+	+	+
P3	+	+	-	+	+	+
P4	+	+	+	+	+	+
P5	+	+	+	+	+	+
P6	+	+	+	+	+	+
P7	+	+	+	+	+	+
Total	10	11	8	12	12	12
Percentage	86,6%	91,6%	66,6%	100%	100%	100%
Category	Very good	Very good	Good	Very good	Very good	Very good

Based on table 5 shows that each element in the media in the category is excellent or highly qualified and also the student's response to the learning media is positive.

d. Implementation

In the implementation phase, the researchers conduct a pre-test evaluation. After that, researchers learn using the created Scratch learning media. The researchers evaluate the posts. Students' pre-test scores can be seen in Table 6.

Table 6. Student pre-response

Name	Student Answer Score on Each Question					Total Score	Value
	1	2	3	4	5		
Student 1	5	0	5	0	0	10	40
Student 2	5	0	0	0	0	5	20
Student 3	1	0	5	0	0	6	24
Student 4	0	0	3	0	0	3	12
Student 5	5	0	0	5	0	10	40
Student 6	5	0	3	0	0	8	32
Student 7	5	0	0	5	0	10	40

Based on the results of Table 6, most students know the cartesian coordinate point and can determine examples based on different quadrants, but many also do not know the quadrants and drawn points before using the learning media.

e. Evaluation

At the evaluation stage, researchers ask research subjects to respond to responsive lifts and complete posts related to coordinate material in everyday life. Student post-score results can be viewed in Table 7

Table 7. Student Post Value

Name	Student Answer Score on Each Question					Total score	Value
	1	2	3	4	5		
Student 1	5	0	5	5	5	20	80
Student 2	5	5	5	5	3	23	92
Student 3	5	0	3	0	0	8	32
Student 4	5	5	3	5	5	23	92
Student 5	5	5	5	5	5	25	100
Student 6	5	5	5	5	0	20	80
Student 7	5	5	5	4	4	23	92

The Minimum Testing Criterion (MCC) value that applies to the school where the research test is conducted, namely a score of 70, will be compared with the post-test results. Students are deemed to be qualified if their final score reaches the score of 70. Based on the results of Table 7 of the total students, the number of students who expressed commitment to learning success was 6 of all students that is 7. Considering the classical accuracy table, which can be found in Table 3.6, it can be concluded that the learning method is highly effective at 85.7% in improving the understanding of cartesian coordinate material.

Elevate student response

Table 8. Student response to Scratch media

Name	Aspect			
	Content	Language	Design	Interesting
Student 1	100 %	40 %	93 %	60 %
Student 2	80 %	100 %	86 %	73 %
Student 3	40 %	50 %	53 %	40 %
Student 4	60 %	100 %	93 %	93 %
Student 5	80 %	80 %	93 %	53 %
Student 6	80 %	60 %	60 %	73 %
Student 7	90 %	90 %	66 %	93 %

Based on table 8 shows that each element in the media in the category is qualified and also the student's response to the learning media is positive.

The following is the student's response based on the interview results:

1. Student 1 is already able to follow learning using self-developed media. When interviewed for student response purposes, the researchers had difficulty communicating with student 1 because the student is a student with special needs and has language difficulties, which causes students difficulty understanding the material in the learning media.

2. Student 2 is already capable of following learning using the media developed independently. Because student 2 is shy, researchers find it difficult to communicate with them during interviews for responses. The second student said that the learning media created was already appealing, the illustration was very helpful in understanding the material, the letter was very readable the language was understandable and Scratch media was able to understand the teacher's explanation.

3. Student 3 already could use learning media independently. In an interview for the responsive lift, student 3 stated that the Scratch medium was very good and interesting. The language used is easily understood by the user.

4. Students 6 are already able to use the learning media independently. In an interview for responsive raising, student 6 said that the Scratch media is very interesting with its easy-to-understand language. The illustrations can help to understand the material.

5. Students 7 say that learning in class uses the Scratch medium so that students do not get bored while learning and only use printed books and PowerPoints. In an interview for the response lift, 7 students said that the Scratch media was already good, with a language that was easy to understand by the user. However, he stated that the font size of the animated characters when

speaking was too small, so users could not read clearly. 7 students also learned to use the Scratch media because there were animations, games, and exercises that didn't get the students bored when they were learning.

Student 8 already can use the learning media independently. In an interview for the response lift, student number 8 said that the Scratch media was very interesting the language was easy to understand, and the illustration helped them understand the material. However, this student said that letters that appeared when the character animation spoke too fast, so they could not read the whole. Student number 8 also said that learning in the classroom uses media.

Research and Development is a process or measures to develop a new product or to improve an existing product (Okpatrioka, 2023) and also to test the effectiveness of existing products as well as to develop and create new products. (Yuliani & Banjarnahor, 2021). In this study, the ADDIE procedure is used to develop learning media. The ADDIE model consists of five stages: Analysis, Design, Development, Implementation, and Evaluation.

At the stage of analysis it was found that there were media constraints when conducting mathematical learning for students and the problem that students had with cartesian coordinate material was that some students could not draw cartesian coordinates and some students were still confused to determine the point in the cartesian coordinate and also the student mistakenly wrote the quadrant of cartesian coordinates students also had difficulty to pinpoint the position of points in a particular point. It's in line with Julius's research. (2018). It's also based on observations and interviews conducted by researchers at one of the schools in Bandung City. According to Talizaro (2020), learning media can make students better understand lessons and improve students' demands. One that the researchers used was the Scratch media as a learning medium.

The second stage after the analysis is to design the learning media to be planned. Storyboarding is an alternative to describing complete sentences as a planning tool (Khulsum, 2018). Storyboarding is intended to explain the design of learning materials to be developed. Like Muslich and Maryeni (2009), product specification determination is expected to be part of development activities. As for the product developed, the learning media is Scratch. The media is designed on cartesian coordinate material in the middle class. The media was designed with video, animation, audio, as well as games.

At the development stage, the researchers validated the Scratch learning media on the cartesian coordinate material. Based on the results of the discussion of the research, obtained results of validation by the media expert validator and also a material expert that the media used is worthy in various aspects of the assessed. The evaluation given by the teacher on the learning media developed obtained a positive response and media worthy of use. Thus, learning media can

help teachers in implementing the learning process, help learners understand the material as said by Miftah (2013), and also cultivate interest (daughter,2022) After students do learning using learning media Scratch, learners are given five questions. Based on the results of the post-test, out of the total number of students 7, there are 6 numbers of students who are declared to be successful in learning. The success of this learning refers to classical accuracy calculations. Considering the classic accurate calculations, it can be concluded that the learning method is very effective at 85.7% in improving the ability to understand cartesian coordinate matter just as Wardani (2022) and Mulyasari did. (2022).

In the discussion section, the important point that must be discussed is to fulfill the minimum five discussions. First, it appears that there is a connection between the results obtained and the basic concept. It needs to be emphasized whether there is conformity or contradiction with the results of previous research, better or otherwise. Second, describe the findings from the research results. Third, sharp analysis of research data. Third, an explanation of its relationship to previous concepts or theories. Fourth, there is a critical comparison with other relevant research. Fifth, use constructive arguments. Sixth, some statements confirm or correct previous findings. Discussion can be presented in sub-chapters.

4. CONCLUSION

Scratch learning media on the topic of cartesian coordinates can be well designed through ADDIE stages. Using the ADDIE model succeeded in creating a good game with stages namely analysis (analysis of problems experienced by students and teachers), design (selection of material and making storyboards), Development (developing Scratch media and performing validation), Implementation (testing trials to students), Evaluation (evaluation on media with questionnaire and post-test). Based on the results of the pretests and posts, each student has progressed towards understanding the concept after using the Scratch media. Therefore, further research is needed on various topics in other learning media planning and research on the effectiveness of the use of learning media in the classroom.

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