Development of qr code-assisted learning materials to improve students 'numbers' abilities on spldv material in class x of ma nurul huda bercak asri cerme bondowoso

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ABSTRACT

This research aims to develop QR Code-assisted teaching materials to enhance students numeracy skills in the SPLDV (System of Linear Equations with Two Variables) topic for Class X students at MA Nurul Huda Bercak Asri Cerme Bondowoso. The research is an R & D (Research and Development) research or commonly known as development research, where development research is a different research from other research, because in this research we are required to develop a product that already exists so that it is suitable for use now or even in the future. The R & D research method used in this study uses the four-D or 4D model, namely: Define, Design, Develop, Disseminate. The teaching materials or modules developed in this study have been equipped with several videos that explain the material or examples of questions. In addition, the learning devices that have been developed have gone through validation tests, practicality tests and effectiveness tests. In this study, researchers used several samples of class X MA Nurul Huda Bercak Asri Cerme Bondowoso students, namely 10 people to carry out validation tests, practicality tests and effectiveness tests of learning devices. The results of the data analysis of QR code-based learning devices have met the criteria for quality and feasibility of developing learning devices that have been set, namely meeting the validity criteria with a result of 93.3%, effectiveness with a result of 86% and practicality with a result of 80%.
Keywords: Teaching Materials, QR Code, Numeracy Skills, SPLDV

A. INTRODUCTION

The rapid development of information and communication technology has made it impossible for humans to escape from technology in their daily lives (Widodo, 2019). The use of technology is also very common, starting from ordinary activities to being used as a tool to help us in our work (Suryadi, 2015). The very rapid advancement of technology has also forced the world of education to make innovations in order to keep up with the times (Nurillahwaty, 2021). Although technology is widely integrated into education, there remains a gap in the development and practical implementation of accessible, QR Code-assisted learning materials that effectively enhance students' numeracy skills (Aswita et al, 2022).

The advancement of technology in the world of education is not without reason (Pratikno, 2017). Because, technology has the ability to receive and send information very quickly (Triyono, 2018). This advantage is what makes the world of education really need technology in its application (Deliviana, 2017). In addition to these advantages, technology can also save energy, costs and time for teachers and students (Suminar, 2019). Learning technology is a complex and integrative process that includes humans, tools, and systems including ideas, procedures, and organizations (Akbar, 2023). Educational technology is the application of scientific knowledge to learning which results in learning objectives being achieved effectively and efficiently, which is not only limited to tools and goods or hardware but also software, and brainware (Lailan, 2024). One of the applications of technology in the world of education is the use of QR Code. QR Code is a two-dimensional image that has the ability to store large amounts of data (Prathivi, 2019). Another opinion also says that QR Code can be called a storage media that can store large amounts of data (Murtadho, 2016). QR Code was published in 1994 with the aim of quickly tracking vehicles in the manufacturing sector (Ani et al., 2011). QR Code itself is a development of Barcode, where QR Code has the advantage of being able

DOI : 10.26486/jm.v8i1.4270
W : http://ejurnal.mercubuana-yogya.ac.id/index.php/mercumatika
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to store larger data than barcode. This is because QR Code can store data vertically and horizontally, while Barcode only stores data horizontally (Sholeh, 2016). With its ability to store data horizontally and vertically, QR Codes have a much smaller size than Barcodes, namely only one-tenth of the size of Barcodes (Dedy Irawan & Adriantantri, 2019).

The use of technology such as QR Code in the world of education is also expected to help achieve learning goals, namely creating effective and efficient learning (Handayani, 2024). As the name implies, this is a QR code that can be displayed quickly even though the amount of data is large. This is in line with the opinion of (Dora, 2017) There are many ways we can do to achieve these learning goals. One of them is the development of learning media, or what we often call teaching materials. Moreover, as an educator, a teacher must be able to master technology, so that learning will run effectively and efficiently (Siswadi & Mada, 2023). Teaching materials are tools for students and teachers in conducting teaching and learning activities in the classroom. Teaching materials can basically also be interpreted as materials that can be used as learning aids, so that students can learn on their own. (Magdalena et al, 2020). There are characteristics of modules that can increase motivation, namely self-instruction, self-contained, stand alone, adaptive, and user friendly (Raden et al., 2019).

One of the subjects that uses teaching materials is mathematics. Mathematics is one of the subjects that has been taught since elementary school to college. Mathematics cannot be learned only with memorization skills, because mathematics also requires understanding, reasoning, and problem-solving skills. Mathematics is a subject that we will encounter at every level of education. This is because mathematics is a basic science in education. In addition, mathematics is also very important to learn because it is a science that is the source of all sciences (Apostle, 2022). When we study mathematics, we will find several materials that are interrelated with each other. Because, mathematics is a continuous subject (Muslina, 2017). This means that if we want to learn new material or sub-chapters, then we need to understand the basic concepts of the material. In addition to the basic concepts that we must master, we also need to master the ability to count in studying mathematics. Besides that, the concept of mathematics is something that is very close and we often encounter it in our daily lives (Siagian, 2017). That is why it is very important for us to study mathematics.

This problem is also experienced by students of class X at MA Nurul Huda Bercak Asri Cerme Bondowoso. Difficulties in solving problems are often faced by students, one of which is in the SPLDV material which is often out in every exam, both school exams and national exams. One of the things that causes this problem to occur is the lack of students' numeracy skills. That is why the researcher chose the title "Development of QR Code-Based Teaching Materials to Improve Students' Numeracy Skills in SPLDV Material in Class X MA Nurul Huda Bercak Asri Cerme Bondowoso".

B. METHOD

1. Types of research

The research method used in this study is R & D (Research and Development) which is called development research. Development research is different from other types of research because it involves further development of existing products (Rustamana et al, 2024). Another opinion also says that development research, namely research that can create new products or improve existing products, test whether the product is effective, and verify that the product is considered effective (Okpatrioka, 2023). In general, development research has the characteristics of designing and developing products, testing products, and validating products (Waruwu, 2024). Research and development (R & D) in education is the process used to develop and validate educational products (Fayrus & Slamet, 2022)

From the description it is clear that this research creates new products by further developing existing products. The R & D research method used in this study uses the four-D or 4D model

which consists of 4 stages of development, namely Define, Design, Develop, and Disseminate (Sindia Mutiara, 2021).

2. Time and Place

This research was conducted in the odd semester of the 2024-2025 academic year. The location or place of this research is at MA Nurul Huda Bercak Asri Cerme Bondowoso. The sample in this study was determined using purposive sampling, selecting 10 Class X students from MA Nurul Huda Bercak Asri Cermee Bondowoso based on their availability and relevance to the research objectives. The subjects of this study were grade X students. There are several reasons for conducting this research at MA Nurul Huda Bercak Asri Cerme Bondowoso as follows:

a. The researcher also acts as an educator at MA Nurul Huda Bercak Asri Cerme Bondowoso.
b. The existence of permission or availability from MA Nurul Huda Bercak Asri Cerme Bondowoso to conduct research.
c. Similar research has never been conducted at MA Nurul Huda Bercak Asri Cerme Bondowoso.

3. Research Procedures

The research procedure used in this study is using the 4D development model, in which there are 4 stages that must be passed. The four stages are defining, designing, developing and also disseminating. However, due to the limited funds available in this study, the fourth stage, disseminating, was not carried out. The following are the stages that must be passed in this study:

1) Definition (define)
   a) Analysis of teaching materials in the form of modules used at MA Nurul Huda Bercak Asri Cerme Bondowoso.
   b) Analysis of teacher and student needs in learning activities.
   c) Preparing the research instrument that will be used at the definition stage.
2) Planning Stage (design)
   a) Designing a QR Code-based module to improve students' numeracy skills according to the data obtained at the define stage.
   b) Create or prepare expert validation sheets for QR Code-based module designs to improve students' numeracy skills.
   c) Conduct expert validation of the module design that was carried out in the previous stage.
3) Development Stage (develop)
   a) Developing the initial product into a QR Code-based module to improve students' numeracy skills according to the design made in the previous stage.
   b) Create or prepare expert validation sheets for QR Code-based modules to improve students' numeracy skills that have been created.
   c) Conduct expert validation of the developed modules.
4) Dissemination Stage (disseminate)

   In this final stage, product packaging and distribution are carried out online, as well as writing research reports.

4. Research Instruments

The research instrument used in this study is a questionnaire. The questionnaire used is a validation sheet and also a student questionnaire sheet. The use of the questionnaire is not done without reason, but with the aim of facilitating data processing when analyzing data in the next stage.

5. Data Analysis Techniques

The following are the stages of data analysis techniques in this research:

1) Data analysis of learning device validation results
2) Practicality data analysis of learning devices
   In the analysis of the practicality of learning devices, this can be known in the following ways:
   1.) Analysis of educator activity data
   2.) Student activity data analysis
3) Learning Device Effectiveness Data Analysis
   The effectiveness of learning devices can be determined by analyzing student learning outcomes against student worksheets and learning outcomes, namely as follows:
   a. Student Response Questionnaire Analysis
   b. Learning Outcome Test Data Analysis

C. RESULTS AND DISCUSSION

1. Results
   The following are the results of the research that has been conducted:
   1) Results of data analysis from validation of learning devices
   a. Subject matter expert validation
      The validation of the material expert was carried out by the mathematics subject teacher at MA Nurul Huda Bercak Asri Cerme Bondowoso. The following are the results of the validation carried out by the material expert:

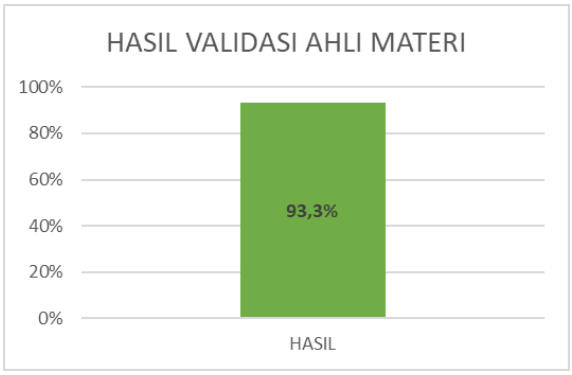

Figure 1. Validation by material experts

Based on the diagram, it can be seen that the results of the assessment carried out by the material experts show a percentage figure of 93.3%, if calculated through the percentage it is as follows:

Result $= \frac{28}{30} \; x \; 100\% = 93{,}3\%$

Based onFrom the results obtained, it can be seen that the module is very feasible in terms of material.

b. Media expert validation
   The following is the media expert validation with the following results:

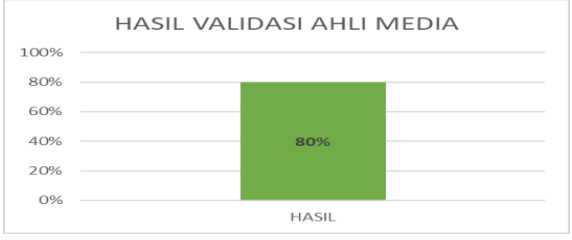

Figure 2. Media expert validation

Based on the diagram, it can be seen that the results of the assessment carried out by media experts show a percentage figure of 80%, if calculated through the percentage it is as follows:

Result $=\frac{24}{30}\ x\ 100\% = 80\%$

Based on the results obtained, it can be seen that the module is feasible in terms of media.

c. Linguist

The following is the validation of language experts with the following results:

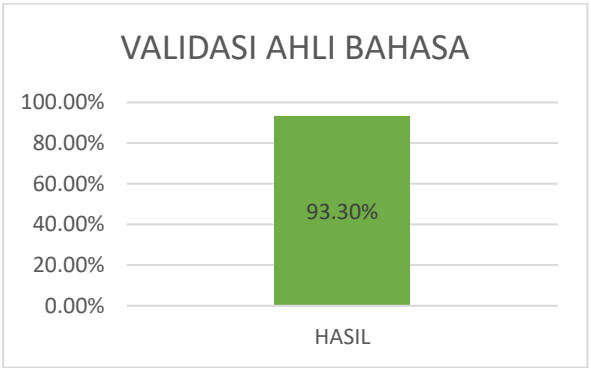

Figure 3. Linguist validation

Based on the diagram, it can be seen that the results of the assessment carried out by language experts show a percentage figure of 80%, if calculated through the percentage it is as follows:

Result $=\frac{28}{30}\ x\ 100\% = 93{,}3\%$

Based on the results obtained, it can be seen that the module is very feasible in terms of language.

2) Validation Results and Results of Data Analysis of Practicality of Learning Devices

a. Validation results and analysis results of educator activity data

The following are the validation results and analysis results of educator activity data:

a) Results of validation of educator (teacher) activities

The following are the results of teacher activity validation.

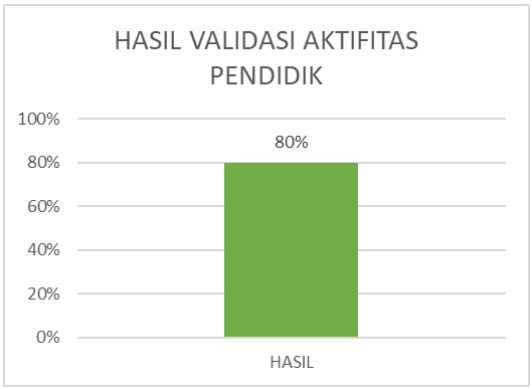

Figure 4. Results of validation of educator activities

Based on these data, we can see that the validation results of the teacher activity observation sheet are declared valid with a percentage value of 80% using the following formula:

Result $=\frac{24}{30}\ x\ 100\% = 80\%$

b) Results of the analysis of the observation sheet of educator (teacher) activities
The following are the results of the analysis of educator activity data carried out at MTs Nurul Huda:

Figure 5. Results of observations of educator activities

Based on the diagram, it can be seen that the assessment results carried out by the teacher show a percentage figure of 80%. If calculated through the percentage, it is as follows:

Result $=\frac{24}{30}\ x\ 100\% = 80\%$

Based on the results obtained, it can be seen that the module is practical.

b. Validation Results and Analysis Results of Student Activity Data
Followingis the result of validation and analysis of student activity data:
a. Student activity validation results
The following are the results of student activity validation.

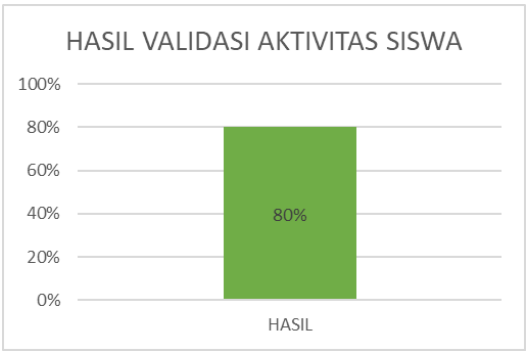

Figure 6. Results of student activity validation

Based onWe can see from the data that the validation results of the student activity observation sheet (OAS) were declared valid with a percentage value of 80% using the following formula:

Result $=\frac{24}{30}\ x\ 100\% = 80\%$

b. Results of student activity data analysis
Followingis the result of analyzing student activity data

Figure 7. Results of student activity observations

Based on these data, we can see that the results of the analysis of the student activity observation sheet (OAS) data are stated to be practical with a percentage value of 87.3% using the following formula:

Result $=\frac{131}{150}\ x\ 100\% = 87{,}3\%$

3) Results of Validation and Data Analysis of Learning Device Effectiveness

In this study, researchers used student response questionnaires and practice questions to determine the effectiveness value of the module that had been created. The following are the results of the validation and data analysis that have been carried out

a. Results of Validation and Analysis of Student Response Questionnaire Data

The following are the results of validation and analysis of learning device data using student response questionnaire sheets:

a) Student response questionnaire validation results

The following are the results of the validation of the student response questionnaire.

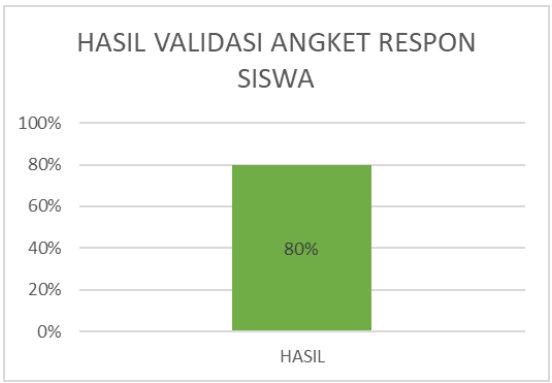

Figure 8. Results of validation of student response questionnaire

Based on these data, we can see that the validation results of the student response questionnaire sheet are declared valid with a percentage value of 80% using the following formula:

Result $=\frac{24}{30}\ x\ 100\% = 80\%$

b) Results of student response questionnaire data analysis

Followingis the result of the analysis of student response questionnaire data that has been carried out:

Figure 9. Results of observations of student response questionnaires

Based onFrom the diagram we can see that the results of the data analysis that has been done show a percentage value of 83.3% which means it is included in the effective criteria. The following is the percentage formula used:

Result $=\frac{250}{300}\ x\ 100\% = 83{,}3\%$

b. Results of learning outcome test data analysis

This data is obtained from the value of the practice questions in the module by determining the completion of the KKM value. The following are the results of the analysis of learning outcome test data based on the completion of the KKM:

Figure 10. Results of student learning tests

Based on the diagram, it can be seen that the results of the analysis of learning outcome test data based on KKM completeness show a percentage figure of 86%, if calculated through the percentage it is as follows:

Result $=\frac{860}{1000}\ x\ 100\% = 86\%$

Based on the results obtained, it can be seen that the module is very effective.

2. Discussion

The process of developing learning devices in the form of QR code-based modules to improve students' numeracy skills in the SPLDV material for class X MA Nurul Huda Bercak Asri Cerme Bondowoso has gone through four stages, namely defining development planning and distribution. In addition, the learning devices that have been developed have gone through validation, practicality and effectiveness tests. The teaching materials or modules developed in this study have been equipped with several videos that explain the material or examples of questions. The use of videos aims to increase interest and make it easier for students to understand a material. This is because videos are able to combine visuals (pictures) with audio (sound)(Yudianto, 2017). The video can be accessed

by students by using the requirements, namely each student uses a cellphone to scan the code. By using the QR Code, the book will be easily accessible by students because of its practical nature.(harizki et al., 2022). In this study, the researcher used several simple students, namely 10 people, to conduct validation tests, practicality and effectiveness of learning devices.

D. CONCLUSION

Based on the process and results of developing a QR Code-Based Module to Improve Students' Numeracy Skills in SPLDV Material for Class X MA Nurul Huda Bercak Asri Cerme Bondowoso, it can be concluded as follows:

a. The development process carried out in this study uses the 4D model. Namely through the stages carried out in the study including defining (Define), planning (design), developing (development) and disseminating (disseminate).
b. The results of the data analysis of QR code-based learning devices to improve students' numeracy skills in the SPLDV material for Class X MA Nurul Huda Bercak Asri Cerme Bondowoso, meet the criteria for the feasibility of developing learning devices and meet the quality that has been set, namely meeting the criteria for effectiveness, practicality and validity.
    1. The validity of the learning device was carried out by three experts, namely from material experts, media experts and also language experts. With the percentage value obtained from material experts, namely 93.3% with very valid criteria, the percentage value of media experts was 80% with valid criteria and the percentage obtained from language experts was 93.3% with very valid criteria. And for the learning outcome test, it was not only tested through a validator but also tested for validity and showed valid and reliable data.
    2. The practicality of the learning device was obtained based on the results of the analysis of the educator activity observation sheet, namely 80% with practical criteria and based on the results of the analysis of student activities, namely 87.3 percent with very practical criteria.
    3. The effectiveness of the learning device was obtained based on the results of the student response questionnaire, namely a percentage value of 83.3% with very effective criteria and the percentage of student completion was 86% with very effective criteria.

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