Development of digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students STKIP PGRI Lubuklinggau

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Abstract. The problems that arise in the world of education today include the low competence of teachers and lecturers in the era of education 4.0, namely developing teaching materials or digital material therefore a teacher or lecturer must have various skills including skills in developing the right digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students. This study aims to develop digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students for elementary school mathematics, whiteboard animation for elementary school teacher education students of STKIP PGRI Lubuklinggau which has been tested valid and practical. This study uses a development research approach from the preliminary analysis stage, the design stage, and the assessment stage. The subjects of this study were students of the fifth semester of elementary school teacher education at STKIP PGRI Lubuklinggau. Data collection techniques using questionnaires, observation, or interviews. The data analysis technique used is a descriptive analysis that describes the validity and practicality. The research has a very valid teaching material product with a score of 95% and practical with an average score of 92.5%. Thus, the teaching materials in this study can be used because they have been declared valid and practical.

1. Introduction

Students majoring in primary education are expected to have high thinking ability. The improvement of the lecturer’s competence has not been successfully conducted by the training institute. According to a study by Manurung [1] shows that the teaching of primary education is still overly teacher-centered. University teachers tend to learn through lectures, questions, and answers. The development of technology, which is getting faster and faster, has a big influence in the field of education. Preparing graduates who are qualified and able to compete globally, and master technological developments are important for everyone and important for the future of a country [2]. Learning is the heart of the educational process in an educational institution. So that the development of science and technology has changed the mindset and progress in various fields. Currently, the process of improving education is inseparable from learning and the factors that play an important role in the learning process both internally and externally similar result was obtained by Islam [3] who stated that the use of multimedia animation as teaching media improved students’ thinking process. Technological developments in learning today allow students to access learning resources that are open and describe real-world
conditions that not only involve students with the environment but in learning activities can also use computers to create and combine text, graphics, audio, moving images by combining links and tools that allow users to navigate, interact, create, and communicate [4].

According to Sousa et al. [5] the utilization of multimedia in learning encourages students to the process of the invention and can solve ill-structured problems [6]. Kapi et al. [7] said that interactive multimedia as audio-visual media can show phenomena in physics in a more realistic manner. More real visualization strongly supports the learning process. According to Weaver [8] network-based, digital information technology devices have various functions that are very important for learning, especially with network technology. The development of digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students must be adjusted to the characteristics of students and the times, one of which is the whiteboard animation media. Furthermore, the classification of teaching materials according to Hamdani [9].

According to Munir [10], the use of multimedia is an important component in the learning process. The use of media is considered important because it helps achieve learning goals. Therefore, the preparation of instructional media is one of the responsibilities of educators. According to Manurung and Panggabean [11], learning media in the form of interactive multimedia tools is reasonably capable of providing learning experiences that correspond to the level of cognitive development of students. The problems that arise in the world of education today include the low competence of teachers and lecturers in the era of education 4.0, namely developing teaching materials or digital material Çelik and Aytin [12], Arkorful and Abaidoo [13], Ghavifekr and Rosdy [14], therefore a teacher or lecturer must have various skills including skills in developing digital teaching materials right.

The results of observations show that educators still use a lot of teaching materials such as books, modules, and student worksheets that are still in printed form, not yet using teaching materials in digital multimedia form. The development of digital teaching materials must be adapted to the characteristics of students and the times, one of which is digital whiteboard animation teaching materials. This is according to the results of research from Miftahul et al. [15] The results of this study have implications for the trend of developing competencies for elementary school teachers, in which teachers must have competence in terms of 1) digital skills, 2) creative thinking, and 3) communication skills Cakrawati [16], Mokhtar and Dzakiria [17]. Students in mathematics learning are required to prepare mentally at the time of receiving new information which is marked by real actions through solving mathematical problems Bahar et al. [18]. In learning mathematics, educators should be able to choose an appropriate approach and teaching materials so that student learning outcomes are getting better.

Mathematics has an important role in various scientific disciplines and advances human thinking. Mathematics can improve the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to work together is very important accordingly Chikasha et al. [19] find in Johannesburg that not all the teachers have felt comfortable when integrating ICT as a learning source at school. Teachers’ competence in using learning resources has an impact on the better achievement of the students, as has been found by Hendarwati [20], Setiyan [21], Warsita [22] in their studies. Related to the research that Purwanti [23] has done, the results obtained from the development of instructional video media with the ASSURE model in mathematics can make learning effective, but there are still some video elements that need to be perfected to facilitate the continuity of learning. Based on the background of the problem above, the researchers are interested in researching on the development of digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students STKIP PGRI lubuklinggau. The special objectives through this research scheme for novice lecturers are expected to develop digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education STKIP PGRI lubuklinggau students which have been tested valid and practical.

2. Methods
This research is research and development (R & D). This research adopts the steps proposed by Plomp, which are adopted from the Mckenney development model. This model consists of two stages, namely:
(1) preliminary research or preliminary analysis and (2) prototyping phase or design stage. The research data were obtained from validity and practicality. The validity test data is obtained through the learning device validation sheet completed by 3 selected experts based on the relevant expertise. Practicality data were obtained from student response questionnaires, and interviews from the one to one evaluation stage there were two students, a small group of seven students, and a field test of thirty-three students. The subjects in the study were students of the fifth semester of Elementary School Teacher Education at STKIP PGRI Lubuklinggau. Instruments and data collection methods in this study were interviews, questionnaires, and observations with product validation questionnaires, practicality questionnaires, and practicality interview sheets. The data analysis technique used is a descriptive analysis which describes the Likert scale based on the validation and practicality sheets according to the category, while the data from interviews and observations were analyzed qualitatively.

3. Results and discussions

The results of the preliminary research and prototyping phase of digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students for elementary school mathematics, whiteboard animation for PGSD STKIP PGRI Lubuklinggau students, the results of the research and discussion are presented as follows.

3.1. Results

At the preliminary research stage, an analysis of the Semester Learning Plan was carried out which was used to identify subject competencies to master various abilities and skills in teaching mathematics subject matter in elementary schools related to numbers, namely the concept of numbers and various kinds of numbers. The content of the is considered appropriate to achieve learning objectives based on the material to be made on digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students so that no revision is needed. The next stage is the prototyping phase, which is designing and developing digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students prototype for elementary mathematics using whiteboard animation.

The prototype digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students that have been made is self-assessed by the researcher using the self-evaluation instrument sheet. After the repair, this product was given the name prototype 2 elementary schools digital mathematics media using whiteboard animation. Product validation was assessed by validators from lecturers with different expertise, namely mathematics for product material aspects, learning technology for product media aspects, and Indonesian language for product language aspects. Based on all the aspects assessed, it can be seen that the average score given by the elementary school mathematics digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students validator uses a whiteboard animation with an accumulation of 95%. After the prototype product is repaired according to the validator's suggestion, then prototype 2 is declared very valid, the results can be seen in Table 1.

Table 1. The results of the validation of mathematics digital mathematics teaching materials in elementary schools using whiteboard animation.

| Number | Validator                  | Average (Percentage) | Category  |
|--------|----------------------------|----------------------|-----------|
| 1.     | Material aspect validator  | 96                   | Very valid|
| 2.     | Language aspect validator  | 94                   | Very valid|
| 3.     | Validator for media aspects| 94                   | Very valid|
| Average|                            | 95                   | Very Valid|

The practicality test of elementary school digital mathematics media was carried out using whiteboard animation to see its practicality. The prototype was conducted one to one trials, small group trials, and large group trials on PGSD fifth-semester students. The overall recapitulation score of the practicality
test from the one on one trial, small groups, and large groups obtained an average score of 95.83% and very practical. So it can be said that elementary school mathematics digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students using whiteboard animation has been declared very practical to use. The overall results of media practicality can be seen in Table 2 below.

Table 2. Practical results of elementary mathematics digital mathematics teaching materials in elementary schools using whiteboard animation.

| Number | Stage                | Average (Percentage) | Category      |
|--------|----------------------|----------------------|---------------|
| 1.     | One to one evaluation| 99                   | Very practical|
| 2.     | Small group          | 96                   | Very practical|
| 3.     | Field test           | 92.5                 | Very practical|
| Average|                      | 95.83                | Very Practical|

Based on the results of questionnaires and interviews, it was also seen that students were very motivated, more enthusiastic, and more enthusiastic in participating in the learning process. Students also stated that they enjoyed learning with elementary digital mathematics media using the whiteboard animation because its use was easy, practical, and easy to understand. They better understand the material in digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students so that they are motivated to learn in lectures. Students are also interested in making similar products so that later they can have the skills needed in the current digital era, especially in elementary school education pieces.

3.2. Discussions
The method used in this research is a type of research and development with a design research model to develop a product. The development model used in this study was adapted from the Plomp model. This model consists of three stages, namely (1) preliminary research, (2) prototyping phase, and (3) assessment phase. The product was tested in the fifth semester of class C with thirty-three students. A description of the process of designing development research that has been carried out relating to the validity and practicality of the product being developed will be explained as follows.

3.2.1. Validity. Elementary school mathematics digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students using whiteboard animation that has been developed is said to be valid if it meets certain criteria. According to Sugiyono [24], the characteristics of a product are said to be valid if they reflect the soul of knowledge (state of the art knowledge). This is what is said by content validation. Furthermore, the product components must be consistent with each other (construct validity). Therefore, the validation carried out on digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students in this study emphasizes the validity of the content (content validity) and the validity of construction (construct validity). Also, validity is a measure that shows the level of reliability and validity of a measuring instrument Akker and J. V. Den [25], Arikunto [26]. Thus, validity is a measure that shows the level of validity of something that is measured accurately and carefully.

The validity of the content has been declared valid by the validator because the digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students developed is by the actual material in learning numbers. The validity of the construct has also been declared valid by the validator. Based on the data analysis of the validation assessment by the validator, the digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students developed is classified as very valid. The results of the validation from these experts were collected and then analyzed to find the average of each indicator and each aspect. Based on the findings in a research journal Suherman et al. [27] developed traditional early
childhood games to develop basic motor skills because the movement elements match the need for developing children's basic motor skills, and took into account the requirements for kindergarten children, learning characteristics, and the need for fundamental motor skills characteristics.

Based on the validity analysis of the validation sheet questionnaire instrument, it was obtained the average score of the percentage of elementary school digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students assessment using whiteboard animation which was obtained from three aspects, namely material aspects, language aspects, and media aspects with very valid categories. Thus it can be concluded that the digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students developed have been declared valid and can be used in the learning process.

3.2.2. Practicality. The level of practicality sees the extent to which students can use elementary mathematics digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students using whiteboard animation well. According to Plomp [28], digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students is said to be practical if the media can be used easily by lecturers and students in learning. The practicality observed was a questionnaire on student participant responses and interview results regarding the practicality of digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students. For more details, see the following description. Elementary school mathematics digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students using whiteboard animation was carried out one-off trials, small group tests, and large group tests on the fifth-semester students of PGSD.

So it can be said that elementary school mathematics digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students using whiteboard animation has been declared very practical to use. This is following the results of research conducted by Wijayanti [29] analyzed the design of comic math based on whiteboard animation, which is a tool that has the function of delivering subject matter by combining stories with moving animated illustrations. Students are also interested in making similar products so that later they can have the skills needed in the current digital era, especially in elementary school education pieces. This is following the opinion Adeyemo [30] said that students spend more time on computers for recreational and other purposes than for academic purposes Çakıroğlu and Yılmaz [31], Kainz et al. [32], Adlim et al. [33]. Thus it can be concluded that the digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students were developed practically for use by students.

4. Conclusions
Based on the development and testing of digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students, the following conclusions are obtained digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students has been developed using whiteboard animation with a very valid average category. This can be seen based on the results of the validation of digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students by expert validators that have been implemented. These results illustrate that digital mathematics teaching materials developed are valid and can be used in the learning process. The practicality of digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students as a whole in the very practical category. This can be seen from the results of student responses and interviews that have been conducted. These results illustrate that the use of digital mathematics teaching materials in elementary schools using whiteboard animation for primary teacher education students is very practical and can help in carrying out the learning process.
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