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Research Article

Validation of a Mixed Reality-based Digital Book on the Topic of Algebra for Grade 7

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Abstract.
In the current era, learning has been touched by technology that develops very rapidly, one of which is the book metamorphosis from print to digital form. Therefore, we need a book in digital form which is called a digital book. Digital books will be more interesting if they can turn our environment into a digital space. One technology that can present digital objects in the real world and interact with them using touch is mixed reality. The purpose of the study is to produce a mixed reality-based digital book that is valid for improving students' numeracy literacy skills. This study used Borg and Gall's research and development pattern method. The data were collected through expert validation for product testing. In media validation, which includes general aspects such as aspects of learning presentation, aspects of language feasibility, and graphic aspects, the result meets the valid criteria with an average score of 5 validators of 92.8%. Material validation includes general aspects such as, aspects of material substance, learning aspects, and beneficial aspects, the result meets the valid criteria with an average score from 5 validators of 92.4%. Based on the results of media and material validation of the digital book, it can be concluded that it is suitable for use. The implication of this study is to make it easier for students to learn using digital books.

Keywords: digital book, mixed reality, literacy, numeracy

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1. Introduction

Education is one of the determinants of the nation's progress, and based on Law No. 20 of 2003, education is a conscious and planned effort to create a learning atmosphere and learning process so that the students actively develop their potential to have religious and spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, nation, and country. The presence of science and technology in the world of education makes humans more developed and not outdated in order to be able to think creatively and innovatively with the existence of technological knowledge that comes into the world of education.

The rapid growth of knowledge and technology in the 21st century will lead to consequences for the magnitude of the different challenges compared to those that

we have faced before. In this modern era, books have undergone a metamorphosis from print to digital form, so operationally, they are more practical, able to maintain their quality, and not outdated. This statement is in line with Nugroho who states that digital books are more practical and easier to carry everywhere [1]. Awang says that a digital book is an alternative technology that makes it easier for readers to access and read books anywhere, anytime, and quickly find relevant material without having to read the entire book [2]. Digital books are a form of presenting learning media in the form of virtual books [3]. According to Park et al., adopting digital technology through digital books can encourage students' motivation [4]. In consequence, teachers use digital books in learning to create an interesting and conducive learning atmosphere [5]. Hull and Chaparo explain that digital books allow users to read a three-dimensional interactive book [6].

Digital books will be more interesting if they can turn our environment into a virtual space, which later will be used as media to communicate with a combination of the real world and the virtual world within the same scope. One of the technologies that can present digital objects in the real world and interact with them by using touch is Mixed Reality. Mixed Reality refers to the real environment that allows interaction along with virtual experiences [7]. Mixed Reality is a combination of Augmented Reality and Virtual Reality that offers the ability to interact physically with virtual objects in the real world [8][9]. In Mixed Reality, users cannot only see the expanses or virtual objects, but they can also physically or mentally interact with and/or manipulate them. The ability to interact with the virtual expanses in the real world is what differentiates Augmented Reality and Virtual Reality [10].

Numeracy literacy is the knowledge and skill to use various types of numbers and symbols related to basic mathematics to solve practical problems in daily life, then analyze the information in many forms and interpret the results of the analysis to predict and make decisions [11]. Numeracy literacy is often said to be the same as mathematics, and for students, mathematics is a difficult subject [12]. Ekowati and friends claim that numeracy literacy is defined as a person's ability to use reasoning [13]. Improving students' numeracy literacy cannot only be done with audio and visual interactions; interesting media is also needed to make students happy while learning so they will not feel bored [14]. One of the media to improve numeracy literacy is a digital book that contains Mixed Reality and gives new experiences in the virtual world where it has mixed concepts between Augmented Reality and Virtual reality. This study aims to see the Validation of a Mixed Reality-Based Digital Book on the Topic of Algebra for Grade 7.

2. Method

This study is a research and development (R & D) study that refers to the model developed by Borg and Gall [15]. The purpose achieved in this study is to obtain a digital book by using valid mixed reality. Steps in this study included analysis of the products to be developed, analysis of media materials and instruments, product planning and preparation, and validation. The data were collected through the validation of material experts and media experts and then analyzed using quantitative descriptive analysis.

3. Result and Discussion

3.1. Results

3.1.1. Analysis of the Products that will be Developed

Analysis of teaching materials used by junior high school mathematics teachers, especially in grade 7, is performed by using teaching materials that are already available but have not yet been transformed into real things. Here is a visual representation of some of the teaching materials that have been used thus far:

2.1 Penjumlahan dan Pengurangan Bentuk Aljabar

Ilustrasi

Setiap hari Selasa Bella dan Zahra mengikuti pelajaran matematika di sekolahnya, minggu ini materi yang akan dipelajari adalah operasi hitung bentuk aljabar. Setelah pembelajaran dimulai pak Budi, guru Matematika mereka menunjukkan beberapa kantong berisi bola bekel, beberapa toples berisi kelereng, dan beberapa uang logam Rp 500,00.

Gambar 2.1 : Pembelajaran di kelas

Pak Budi meminta Bella dan Zahra untuk mempraktekkan operasi hitung bentuk aljabar dengan memanfaatkan ketiga macam benda tersebut dengan asumsi bahwa setipa kantong dan setiap kaleng masing-masing berisi bola bekel dan kelereng yang sama. Perhatikan tabel berikut.

Ilustrasi

Bu Ana memiliki kebun berbentuk persegi panjang dengan luas $x^2 - 16$. Sore itu Bu Ana sedang berkebun bersama putranya, Toni. Kemudian ia meminta Toni untuk menghitung panjang dan lebar dari kebun tersebut dalam x. Ayo bantu Toni melakukan tugas dari ibunya!

Permasalahan di atas adalah salah satu contoh masalah yang berkaitan dengan **Faktorisasi Suku Aljabar**. Agar kamu dapat membantu Toni mari pelajari dahulu uraian materi berikut!

Gambar 3.1 : Berkebun

Figure 1: Algebraic Addition and Subtraction and Factorization of Algebraic Form.

Various weaknesses identified from the analysis results of the teaching materials circulating in Semarang City are as follows:

1. The illustrations involved are very limited.
2. It still contains many elements of writing or text.
3. The illustrations used are not quite appropriate; they do not describe the conditions around the students.
4. Not yet accommodating activities of constructive students.
5. Not optimal yet in accommodating character cultivation in the students.

6. Not yet accommodating three-dimensional environmental illustrations.
7. There are no implicit guidelines for teachers to help provide ideas for activities after students explore open materials
8. E-books are not available yet.

3.1.2. Initial Product Development

There are various shortcomings in the teaching materials used, so some of the development focuses have been chosen as follows:

1. It is necessary to present an environment that describes the real situation as a medium so that the students are able to call on their experiences to learn certain competencies.
2. The environment presented needs to accommodate the materials that will be studied in the Merdeka curriculum for junior high schools.
3. The environment presented is an environment that is known in students' lives.
4. The need for activities that can be student activities.
5. Not only presenting mathematical skills, the teaching materials used also need to accommodate literacy and numeracy skills.

3.1.3. Expert Validation and Revision

The first draft of the development results of the digital book was validated by material specialists and media experts. The practitioners (potential users) are the mathematics teachers who are members of MGMP Matematika Kota Semarang. While the academicians are the lecturer colleagues at Universitas Muhammadiyah Surakarta and Universitas PGRI Ronggolawe. The indicators that are being validated are as follows:

1. **Media Expert Validation**
2. General Aspects
3. This digital book medium is an interesting media development.
4. This medium is designed attractively and is easy to understand.
5. This medium can improve students' critical thinking.

6. This medium can have advantages over conventional media.
7. Aspects of Learning Presentation
8. The front title (cover) has already used the material to be learned.
9. The use of the medium is easy to understand.
10. This digital book contains activities to recognize numeracy literacy.
11. This digital book contains activities to recognize various types of emotions.
12. This digital book contains activities for character habituation.
13. This digital book makes it easier for teachers to plan lessons.
14. This digital book makes it easier for teachers to implement the learning.
15. This digital book makes it easier for teachers to develop learning content/materials.
16. The systematics of learning presentations in the media are presented sequentially.
17. **Material Expert Validation**
18. General Aspects
19. This medium is in accordance with the existing syllabus.
20. This medium is designed attractively, briefly, and clearly.
21. This medium can be useful for all who get the materials.
22. This medium is a new innovation in learning media.
23. Aspects of Material Substance
24. This digital book is in accordance with the introduction to numeracy literacy.
25. The use of terms is in accordance with the scientific level of the students.
26. The topic of the material is clearly conveyed.
27. The order of the material is systematically arranged.
28. Learning Aspects
29. The use of this digital book makes the learning process easier
30. The use of this digital book makes it easier for teachers to convey materials.
31. The material presented is in accordance with the learning objectives.

32. This digital book can facilitate students learning independently.
33. Example questions are in accordance with the learning objectives and stimulate students to think critically.
34. This digital book can help students in learning.
35. By hearing the teacher's explanation, students understand the materials being presented better.
36. Beneficial Aspects
37. It can be used as an alternative learning.
38. It can help make things easier for the students.
39. Provide an interesting learning atmosphere to eliminate learning boredom.
40. This learning media can facilitate students learning independently.
41. This media can be reused or used to develop other learning media.

The results of the validation generally state that the developed digital book has fulfilled standard teaching materials from general aspects, aspects of learning presentation, aspects of material substance, learning aspects, and beneficial aspects. In particular, the researchers highlight some indicators that have high relevance to the title of the study. They are as follows:

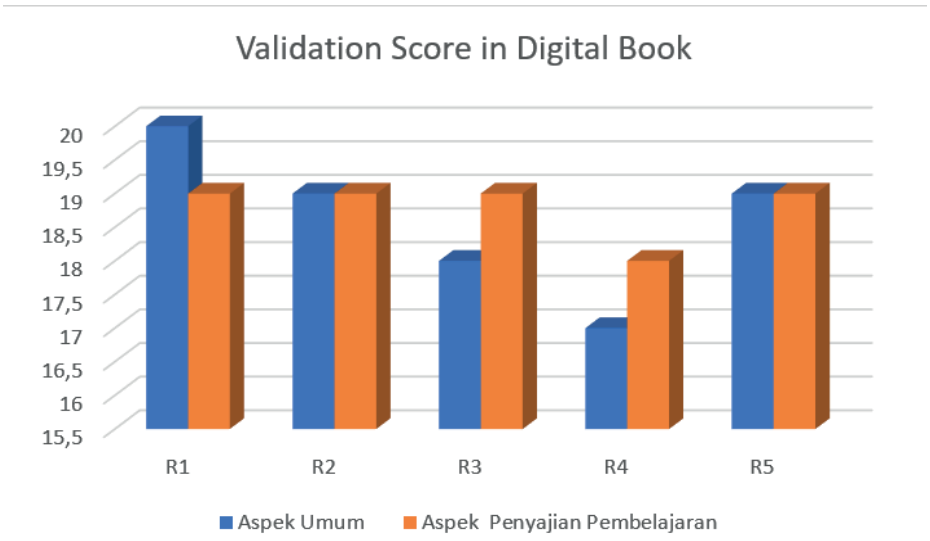

Figure 2: Validation Score in Digital Book Figure ??. Material Validation Score.

3.1.4. Readability Test

The readability test was conducted on Mathematics Teachers and lecturers as the respondents with indicators tested as follows:

1. **Aspects of Language Feasibility**
2. The use of language in this medium is in accordance with the student's intellectual development.
3. The use of language in this medium is in accordance with the student's emotional levels.
4. The language used in this medium is easy for the students to understand.
5. **Aspects of Graphics Feasibility**
6. The display of digital book media is interesting.
7. The display of digital book media is suitable for introducing numeracy literacy.
8. Not using too many types and letter combinations.
9. Colors, elements, and layouts are harmonious and clarify their function.

The readability test results are as follows:

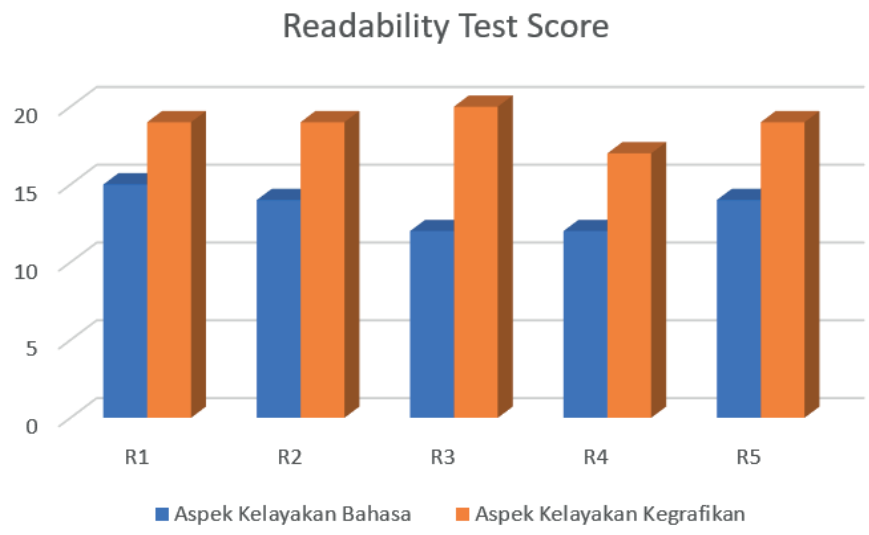

Figure 3: Readability Test Score.

Based on the results of the readability test, it is concluded that, from the aspects of language and graphic display, the developed digital book is suitable for use.

3.2. Discussion

Based on the results of the study, it shows that the validation of the digital book that has been developed has met the valid criteria. It is in accordance with input from validators who say that book digital media is an interesting medium and easy to understand. Apart from that, the digital book is able to improve the critical thinking of the students [16]. It is in line with Suarsana who conveys that e-modules can improve critical thinking skills if they are designed according to students' needs [17]. The presentation of the digital book is in accordance with the characters of the seventh-grade students. The media also contains activities for numeracy literacy and recognizing types of emotion and character. Ernia explains that Problem-Based Learning-based e-modules can be used for training students' numeracy literacy [18]. The validators also say that the media makes it easier for teachers to plan and implement learning. In teaching-learning activities, e-books can improve students' mathematical communication skills and help teachers in learning [19].

The validators assess that the sequence of the materials in the digital book media has been arranged systemically and the topics of the materials are presented clearly. The terms used are in accordance with the student's knowledge. In addition, this digital book is suitable for introducing numeracy literacy to the students. E-books can also strengthen numeracy literacy in students [20]. This media is innovative and interesting, so it can be used for learning easily. Interesting learning media can improve students' learning achievements [21]. The use of digital book media makes the learning process easier because it can facilitate students to learn independently. E-books can also facilitate students in improving problem-solving skills [22].

4. Conclusion

This study was developed based on Borg and Gall's models. The development of the digital book shows that the validation results of the mixed reality-based digital book on the topic of algebra for grade 7 have fulfilled and been valid according to the assessment of the validators. Input from the validators has been taken into consideration by the researchers to improve the digital book. This digital book presents an environment close to the students which is realized in the form of mixed reality.

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