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Research Article

Developing Madura local content and augmented reality-based digital textbook to improve scientific reasoning ability

Mochammad Yasir [a,1,*], Ana Yuniasti Retno Wulandari [a,2], Nur Qomaria [a,3], Binar Kurnia Prahani [b,4], D. Dwikoranto [b,5]

[a] Natural Science Education, Faculty of Education, University of Trunojoyo Madura, Telang Road, Bangkalan, East Java 69162, Indonesia
[b] Physic Education, Faculty of Mathematics and Natural Science Education, Surabaya State University, Ketintang Road, Surabaya, East Java 60231, Indonesia
[1] yasir@trunojoyo.ac.id*; [2] ana.wulandari@trunojoyo.ac.id; [3] n.qomaria@trunojoyo.ac.id, [4] binar.prahani@gmail.com, [5] dwi_bsc.saja@yahoo.co.id
* Corresponding author

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ABSTRACT

Textbooks currently circulating have not been adapted to online learning systems and their contents are less interactive, less communicative, and have not been based on local content potential. This research aimed to produce digital textbooks based on Madura local content and augmented reality to improve students' scientific reasoning ability. This research development was done based on ASSURE instructional design, between July and August 2020. This research involved 15 students of SMP Al-Hikam Burneh, Bangkalan-Madura. The assessments of the digital textbook were done to decide its validity, practicality, and effectiveness. Furthermore, the students' scientific reasoning abilities were measured using pretest and posttest. The validity data obtained were analyzed descriptively using percentages, while students' scientific reasoning skills were analyzed using gain scores. The results showed that the percentage values were 87.5% for content validity (valid), 91.10% for media (very valid), 87.41% for technical (very valid), and 88.9% for practicality (valid). In addition, the students' scientific reasoning skills were classified as effective based on the gain scores achieved in each indicator i.e., 0.49 (argumentation), 0.45 (existing knowledge), 0.38 (methodology), 0.43 (analysis), and 0.40 (concluding). Thus, the digital textbook developed is effective to improve students' scientific reasoning skills.

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INTRODUCTION

Nowadays, the rapid development of technology makes the world seem limitless, marked by changes in the life order of the global community. The concept of society is centered on technology-based human-centered as the era of Society 5.0 (Raharja, 2019; Wibawa & Agustina, 2019; Özdemir, 2018). However, at the beginning of 2020, this has changed since the arrival of Covid-19, which WHO later declared a global pandemic (Cakraborty, 2020).

The impact of Covid-19 has disrupted school activities around the world and threatened children's educational rights in the future. Social and physical distancing policies to break the chain of distribution by prohibiting crowds of people certainly implement learning, not face-to-face as in general. The current developing solution is the implementation of distance learning using online-based technology (Kristanto, 2020; Khasanah and Widuroyekti, 2020; Tauhidah et al., 2021).

Providing online distance education is a big opportunity and challenge oriented to 3 things, namely: a) Strengthening thinking skills, b) How knowledge works; and c) Digital lifestyle. Strengthening thinking skills requires scientific reasoning to build and provide evidence of interpretation of phenomena, and show the link between evidence and argumentation (Chang, Liu, & Tsai, 2016; Topcu, Sadler, Tuzun, 2010). How knowledge works is the ability to regulate thought processes that require self-awareness (Moradpour et al., 2013; Biwott, Limo, & Maru, 2019). The digital lifestyle is a strong character for a person to adapt to life in the digital era (Zubaedi, 2012; Pannen, 2018).

It has been reported that there has been an increase in the use of information technology, especially the internet in various fields during the Covid-19 pandemic (Nicola, et al., 2020; Djalante, et al., 2020). This affects the government's policy strategy in various sectors, particularly education. The implementation of Work and Study from Home aims to enable people to work and study at home. The government closed schools and replaced teaching and learning activities with an online system. With the online system, there are various problems faced by students and educators, such as the subject matter has not been delivered, many tasks, slow signals, are not accustomed to self-awareness and reasoning well (Yi et al., 2020; Viner, 2020).

Online learning problems also arise from the content of science material. Science material is not associated with nature as it should be. Students must understand how nature works and its utilization to produce methods and tools, form certain laws/theories (Arisandi, 2019; Feibleman, 2010; Sulasih et al., 2017). Understanding of science content has not been developed through the stages of observing, asking, trying, reasoning, making conclusions, and communicating (Villagonzalo, 2014; Ardiansyah, Harlita, & Ramli, 2021). One way that can be taken is using local content as a learning resource, such as Madura.

Madura local content such as waterfalls in the sea to provide feedback on the increase in fishing yields of fishermen as a belief is not necessarily true (indigenous knowledge). Knowledge of belief can be studied as a science if it can be proven scientifically through experiments and literature studies (scientific knowledge). Students are encouraged to seek knowledge from various sources through the involvement of cognitive processes. The involvement of cognitive processes is carried out by scientific reasoning which stimulates self-awareness intellectual development. The illustration of the example above shows the relationship between Madura local content and science in the form of science (ecosystem), scientific method, and the nature of science (Yunin, et.al, 2019). This linkage has led to self-awareness that local Madura content is very important for science and technology.

With online learning, it is necessary to include science content in online learning. One way to do this is to create digital-based textbooks. Digital textbooks are a combination of illustration and animation in the form of audio, text, graphics, images, and videos (Hayati & Fitriyah, 2021; TMS & Sirait, 2016). The goal is to make it easier for students to learn independently and guidance (Daar, 2020; Seamolec, 2013; De Cock, 2021). The concept of Madura local content can be conveyed in detail through illustrations of text and images, as well as proving scientific knowledge of indigenous knowledge and then conveyed to the concept of science material through animated tutorials in the form of audio, text, graphics, images, videos. This indicates the characteristics of digital textbooks based on local Madura communication.

Communicative digital textbooks can be sharpened with the addition of 3D illustrations and animations. How to combine virtual objects/objects into the user's real environment and then project in real-time using Augmented Reality (AR). AR principles are interactive and real-time. The difference between AR and Virtual Reality (VR) is that VR combines real objects into a virtual environment (Villagomez, 2010). AR is easier and cheaper to develop so it is widely used in various fields (Chen, 2014; Martinez, 2013).

The contribution of this research is to help students develop science process skills in biological materials encountered in everyday life through good reasoning and representation, to integrate local wisdom with learning materials through media/digital learning resources, making it easier for students to understand concepts and preserve local wisdom in learning, and contribute to strengthening the literature on the effectiveness of using AR in learning.

Based on the background, analysis of the problems, and solutions offered, the development of digital textbooks is carried out using Madura-based local content as a context-based on student experiences and augmented reality that describes the original form of local Madurese content. The purpose of this research was to develop digital textbooks based on Madura local content and augmented reality to improve students' scientific reasoning abilities.

METHOD

This research is using research and development (R & D) method by adapting the instructive design ASSURE. The teaching material development model used is ASSURE with six steps namely Analyze Learner; state objectives; select instructional methods, media, and materials; utilize media and materials; require learner participation; evaluate and revise (Smaldino, 2014). In this research, all stages were carried out starting from the analyze learner stage to evaluate and revise stage. The analyze learner stage is carried out by identifying and analyzing student characteristics that are adjusted to learning outcomes. Things that are important in analyzing the characteristics of class VIII junior high school students include the general characteristics of students, the basic competencies that students must have (knowledge, abilities, and attitudes), and student learning styles. The next step is to state the standards and specific learning objectives possible, in this case, to improve students' scientific reasoning abilities at the state objectives stage. At the select instructional methods, media, and materials stage, namely choosing the methods, media, and teaching materials to be used. In this study, a new Madura-based digital textbook with local content and augmented reality was created. The next step, utilizing media and materials, is digital textbooks based on Madura local content and augmented reality that is tested on VIII grade junior high school students to ensure that the textbooks that have been developed function effectively in improving students' scientific reasoning abilities. Students are invited to actively participate in learning that has been designed at the required learner participation stage. In the last stage, evaluate and revise, an assessment of the effectiveness of digital textbooks based on Madura local content and augmented reality that has been developed in learning is carried out to determine the quality of the textbook. The meeting of these stages was carried out from July to August 2020. The ASSURE development model scheme is presented in Figure 1.

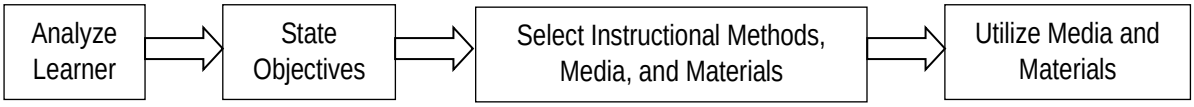


Figure 1. Schematic of the development ASSURE model

The development of the digital textbook based on Madura local content and augmented reality is reviewed based on theoretical and empirical feasibility. The target of this research is digital textbook-based Madura local content and augmented reality. The development stage was conducted in major of S-1 Natural Science Education in Education Faculty (FIP) and limited trial at SMP Al Hikam Burneh, Bangkalan with 15 students of class VIII. The limited trial design is using One Group Pretest-Posttest Design. The data obtained in this research is the result of the validation of Madura local content and augmented reality-based digital textbooks and the result of students' scientific reasoning skills.

The result of Madura local content and augmented reality-based digital textbook validation was analyzed by quantitative descriptive. The analysis method used in the study is using Formula 1.

$$P = \frac{f}{N} \text{ x } 100\% \quad (1)$$

By the description of 'P' is the percentage of eligibility digital textbook, N is the maximum number of scores and f is the number of scores obtained. The Madura local content and augmented reality-based digital textbook is considered to be deserved as a good category if the validation rating achieves ≥69% (Akbar, 2013). Meanwhile, a scientific reasoning test of the student is used to measure students' scientific reasoning skills. To calculate the scientific reasoning test scores of students using the Formula 2.

$$\text{Score} = \frac{\text{Total score of answers}}{\text{Maximum score}} \text{ x } 100\% \quad (2)$$

Then, the scores obtained are interpreted into scientific reasoning level scores according to PISA (Chang, 2016; Lawson, 2004). The improvement of students' scientific reasoning skills was analyzed by normalized N-gain, using Formula 3.

$$\text{N} - \text{gain} = \frac{\text{Posttest score} - \text{pretest score}}{\text{Maximum score} - \text{pretest score}} \quad (3)$$

With the criteria of the gain score, g ≥ 0.7 is a high category, 0.3 ≤ g <0.7 is a medium category, and g <0.3 is a low category.

RESULTS AND DISCUSSION

This research is a type of R & D (Research and Development) research using the ASSURE model. At the Analyze Learner stage, it was carried out at the initial stage of conducting research by conducting observations, unstructured interviews with subject teachers, and distributing questionnaires to students. From the results of interviews with subject teachers, it can be concluded that science learning rarely performs diverse and conventional learning methods, namely using textbooks and student worksheets, the skills of teachers using learning media aids in the form of computers/laptops are still limited, the use of computer-based learning media is still rarely used by the teacher because the teacher is less creative in innovating to develop science learning which has an impact on less effective learning so that students tend to be less interested in science learning even though they already have a learning resource center room, a multimedia room, and a computer laboratory. The information obtained from distributing questionnaires to students can conclude that: 1) the general characteristics of students in class VIII SMP Al Hikam Burneh are 13 and 14 years old, with an average distribution of female and male students; 2) students' basic competencies, specifically their initial (cognitive) knowledge of using computers, operating several programs/software such as Microsoft Word, Microsoft Excel, PowerPoint or the internet which then store and display them again; 3) the learning styles of grade VIII students when learning like learning styles that are not monotonous, such as learning while listening to music, walking and watching or learning through computers. Students are very enthusiastic when learning is done using computers because students experience the process directly in the learning and also it caused by the involvement of students.

At the state standards and objectives stage, the researcher conducted research on science curriculum class VIII SMP, especially on basic competencies in the concept of business and simple aircraft namely KD 3.3.; KD 4.3 Presenting the results of investigations or problem-solving about the benefits of using a simple aircraft in everyday life. Simple business and aircraft concept applications are found at 4 types of Madura local content, namely shredded baby tuna, karapan sapi, batu ampar, and forged keris. In the select strategies, technologies, media, and materials stage, the researcher chooses the strategy used in science learning, which is student-centered by involving students in science learning as a user of the media used in the form of a digital textbook with basic competencies to analyze the trend of using simple aircraft in life. Every day in science learning using computer or laptop technology. Furthermore, the researcher conducted a product design process that was developed using the Flipbook or Sigil Material Software which supported the development of products in the form of musical instruments; animation; pictures related to learning obtained from various sources on the internet; audio in the form of a researcher's voice recording for the voice actor for the product being developed; videos from various sources on the internet that are still related to science learning, and texts that are also obtained from various sources on the internet to support science learning materials. The equipment used is a computer/laptop, laser disk player, DVD.

The development of a digital science learning textbook in the form of a book in an electronic form consisting of pages. In digital view, textbooks are like books that can be opened with the help of the mouse cursor via a computer/laptop. This flowchart consists of a front page from a digital textbook accompanied by instructions for use, an introduction which is an introduction, and a table of contents. Then, on the next page, there are learning activities consisting of learning materials that describe each type of Madura local content. The four types of Madura local content are reviewed in terms of the form/appearance of the local content and the constituent materials, the tools/machines used in making the local content, the procedure for making local content complete with the size/dose/concentration of each material used and mixed in the local content manufacturing procedure, and the peculiarities of the local content differentiate it from other local content. At the design stage, the digital textbook was made on the effort and simple plane concept in the B5 size format. The display of digital textbooks that have been made is presented in Table 1.

At the utilizing technology, media, and materials stage, involves students using digital textbooks in actual classes, the researchers conduct validity and practicality tests which aim to see the validity, practicality, effectiveness of the product being developed, both material and media, namely digital textbooks that are suitable or not at the time involve students in actual classes. The developed digital textbook is validated by experts (2 validators). Experts assess the feasibility of digital textbooks on material aspects and media aspects. The experts also gave some criticisms and suggestions for the perfect digital textbook developed. Some criticisms and suggestions from experts, among others, related to writing still found several typos, the use of spaces that are too tight, and the need to add some terms in the glossary. The results of the recapitulation of expert evaluations of the feasibility of digital textbooks in the material aspects are presented in Table 2.

Table 1. Display of digital textbook

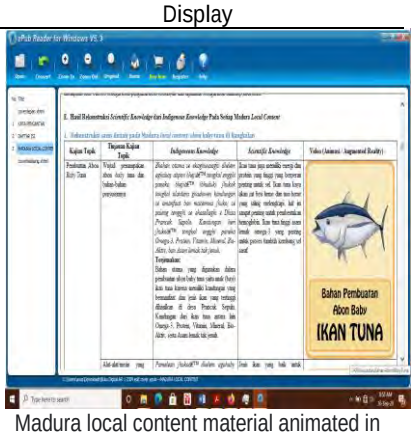
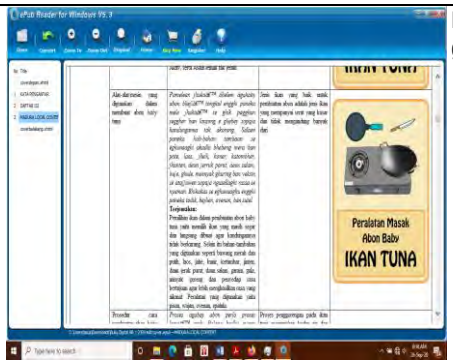
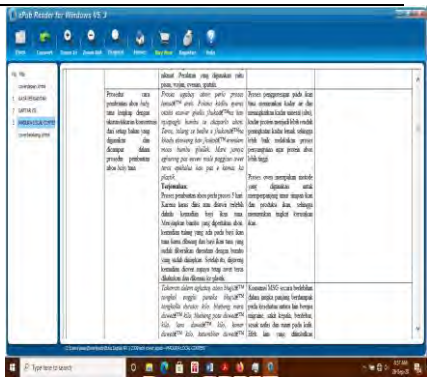
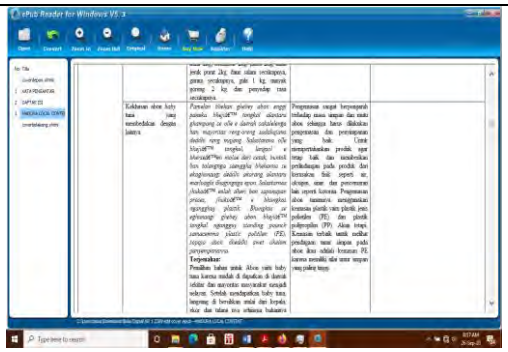
Note	Display	Note	Display
Cover	 Cover digital textbooks based on Madura local content and augmented reality that has been made	Form/ appearance	 Madura local content material animated in Augmented Reality (AR), cross-bordering indigenous knowledge each Madura local content to scientific knowledge based on ethnoscience
Tools/machines used	 The tools/machines used in making the local content	Manufacturing procedure	 The procedure for making local content complete with the size/dose/concentration of each material used and mixed in the local content manufacturing procedure
Peculiarity	 Peculiarities of the local content differentiate it from other local content		

Table 2. Assessment of digital textbook aspects

Indicator	Validity (%)	Reliability (%)
Content Feasibility	87.50	88,78
Media Feasibility	91.10	90,71
Teknik Feasibility	87.41	86,10
Average	88.67	88.53
Criteria	Very Valid	Reliable

Based on table 2 it is known that in the digital textbook aspect, the validator gives an average validity rating of 88.67% with valid criteria and reliability of 88.53% with reliable criteria. This shows that the digital textbook developed is seen from the aspect of the digital textbook included in the valid category for use.

Indicators on the digital textbook aspects include the quality of the content feasibility, the media feasibility, and the technical feasibility. In the content feasibility indicator, the material presented in the digital textbook is considered to have led to scientific attitudes and cooperation. This can be seen in the activities of thinking, discussing, and experimenting contained in digital textbooks. The material in the digital textbook has also been linked to the application of the concept of work and simple plane, classification of living things, anatomy and physiology of living things found in the Madura local content and everyday life. This is suitable with the principle of the digital textbook that digital textbooks can contain problems in daily life, contain experimental activities, and present data (Sari, Sumantri, & Bachtiar, 2018; Hermawan, et al., 2022). The material presented in the digital textbook is also suitable with the basic competencies and learning objectives to be achieved. That is because digital textbooks are used to help teachers deliver material and achieve learning (Dewi, 2016; Sari, Sumantri, & Bachtiar, 2018; Wartono et al., 2018).

In the presentation feasibility indicator, the concept in teaching material has been presented logically and coherently, has included examples of questions that are packaged systematically with MEAs step, and the presentation of material has been student-centered. The teaching material developed is in accordance with the principles of developing a digital textbook. The principle of developing a digital textbook namely a digital textbook must be simple and easy to understand and reflect situations in everyday life (Aydin & Aytekin, 2018). Teaching material is made systematically so that students more easily understand its contents (Kurniawati, Anitah, & Suharno, 2017).

In the indicator of language feasibility, the language used in the digital textbook is in accordance with the development of student thinking and if there are foreign terms an explanation of the terms has been given in the glossary. Students need their thinking skills to understand the contents of the digital textbook (Onosanya & Omosewo, 2011). Therefore the use of language and terms must be adjusted to students' thinking abilities. The use of communicative and simple language makes it easy for students to understand the contents of the digital textbook (Sari, Sumantri, & Bachtiar, 2018).

The results of the recapitulation of expert judgment on the feasibility of digital textbooks in the media aspect are presented in Table 3.

Table 3. Assessment of media aspects

Indicator	Validity (%)	Reliability (%)
Size of digital textbook	93	90,71
Design cover of digital textbook	89	87,84
Design content of digital textbook	91	89,90
Average	91.10	89,48
Criteria	Very valid	Reliable

Based on Table 3 it is known that in the media aspect, the validator gives an average validity rating of 91.10% with very valid criteria and reliability of 89.48% with reliable criteria. This shows that the developed digital textbook viewed from the aspect of the media included in the category is suitable for use. Indicators on the media aspects include the size of a digital textbook, the design of the cover of the digital textbook, and the design of the content of the digital textbook. The size of digital textbook using size B5. The cover design illustrates the contents of the material and uses a combination of colors and letters accordingly. The use of color combinations must be attractive, clear, and easily seen (Shabiralyani, Hasan, Hamad & Iqbal, 2015). The design of the content of the digital textbook has used letters, colors, and images that support the illustration of the material. The proper use of images helps visualize and clarify the material. The pictures make learning fun and motivate students to learn (Bozdogan, 2011; Pertamawati, Retnowati, 2019). When visual images are accompanied by verbal explanations will make it easier for students to understand the material and remember the material longer (Çímer, 2007). Augmented reality makes digital textbooks more communicative and makes their use more effective. This is also in line with Martinez's (2013) statement that the advantages of AR include: 1) Wide range of implementation in various media, 2) simplicity of object models, 3) inexpensive to manufacture, 4) easy to operate and communicative. The shortcomings of AR are: 1) sensitive to changes in perspective, 2) few makers, 3) requires large memory (Martinez, 2013; Fadilah et al., 2017). This digital textbook, this textbook combines virtual objects/objects into the user's real environment then projects in real-time so that it is interactive and real-time (Chen, 2014).

The developed has been appropriate to be used based on expert judgment and can be used as a learning resource for students. Learning resources are all things that teachers use in learning that support teacher explanation and can make students focus and understand what is learned (Akram & Malik, 2012; Syah & Yustina, 2021). Digital textbooks developed can be used as a source of visual media in learning. The use of visual media as a learning resource affects student understanding and makes it easy to remember new concepts (Jager, 2012). The use of digital textbooks facilitates interaction between teachers and students (Onosanya & Omosewo, 2011). A good digital textbook can improve student learning outcomes.

Teaching material that has been developed is then tested on students to find out the students' scientific reasoning ability after using digital textbooks. The results of students' scientific reasoning ability from the test are presented in Table 4.

Table 4. The results of students' scientific reasoning ability

Representation	Score
Argumentation of conservational of matter and volume	0.49
Existing knowledge of proportional reasoning	0.45
Methodology of the control variable	0.38
Analysis of proportional and correlational reasoning	0.43
Drawing conclusions to Hypothetical-deductive reasoning	0.40
Average	0.43

From Table 4 it is known that the average value of students' scientific reasoning ability is 0.43 included in the good category. Argumentation of students gets the highest score than methodology. Based on table 5, the highest scientific reasoning ability of junior high students is the argumentation that is only owned by 0.49 of all students, it states that this capability only has 15 samples, and the most scientific reasoning ability of low is the methodology of the control variable that is owned only 0.38 of all students.

The ability of reasoning can bring about important educational implications. Very high reasoning skills are needed not only in making decisions and solving problems (Lawson, 2004). Previous research has shown that there is a positive correlation between students on scientific reasoning ability and action of learning outcomes in science content (Lawson, 2000; Kohl, 2005; Dewi, et al., 2021). The increased scientific reasoning ability significantly positively impacts the practice of learning. Instructions are not just enough to lead students to develop/improve abilities (Lawson, 2004 ; Meltzer, 2005; Lestiana et al., 2018). Instruction should be able to influence students to grow to the highest level. Therefore, teachers should be able to teach science as a critical inquiry process.

The advantages of digital textbook development are first, overall digital textbooks developed are included in both categories based on indicators of the quality of content feasibility, presentation feasibility, language feasibility, book size, book cover design, and book content design. Second, the digital textbook contains examples of questions based on the Madura local content and augmented reality step which can train students' scientific reasoning abilities in solving problems. Third, introduce Madura local content to students so that students are more familiar with the surrounding environment. Fourth, digital textbooks contain examples of the application of the concept of work and simple plane, classification of living things, anatomy and physiology of living things in the Madura local content or everyday life so that it makes it easier for students to understand the material of work and simple plane, classification of living things, anatomy and physiology of living things. Fifth, the digital textbook also contains simple experimental activities that when done in learning can help students find and understand the concept of the material.

CONCLUSION

From these results, it can be concluded that the digital textbook based on Madura local content and augmented reality developed is effective to improve students' scientific reasoning skills. Suggestions for follow-up from this research are the need to use digital textbooks using various local wisdom that can be studied through ethnoscience/ethnobiology learning and also become the basis for developing learning models and local content curricula.

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