

# Interactive Math E-Book: An Alternative Learning Resources for 21<sup>st</sup> Century Learners

Heni Pujiastuti<sup>1</sup>, Rudi Haryadi<sup>2</sup>  
{henipujiastuti@untirta.ac.id<sup>1</sup>, rudiharyadi@untirta.ac.id<sup>2</sup>}

Universitas Sultan Ageng Tirtayasa, Indonesia<sup>1,2</sup>

**Abstract.** The objective of this research is to create an interactive math e-book that can be used as learning material for middle school students. The development procedure used is ADDIE(Analysis, Implementation, Development, Evaluation, and Design) model. The instruments used were expert validation questionnaires, student response questionnaires, and learning outcomes tests. This study involved three content experts, three media experts, and 60 students. The results showed that achievement scores obtained from content experts 87.50%, media experts 90%, student responses 88.57%, and student learning outcomes 84.33%. These achievement score shows that the math e-book is eligible and can be used in the learning process. Other findings are known that the achievement score of urban student learning outcomes is significantly better than other students. It can be concluded that the math e-book is more suitable as learning resource for urban students.

**Keywords:** Math e-book, interactive book, urban, rural-urban, rural.

## 1 Introduction

The electronic book is a very vital tool for learning because it can easily be accessed and it is portable enough to be carried about by the students thereby reducing the number of items to be conveyed by each child to school[1]. For example, an e-Interactive e-books have been developed to support children's and family education to understand diabetes and this is very helpful[2]. The electronic book also helps to facilitate interaction in the classroom, thus motivating school children to learn better and faster[3].

Technological advancements have made remarkable changes. Urban children have perfectly absorbed various technological changes, so that it has become a daily sight of how urban children cannot be separated from their gadgets. While children in the rural have high technology tools, most of them are still dreams. But the impact of negative technology has been perfectly absorbed in the city, while the rural does not seem to show its influence.

Digital information is one of the main features of information revolution, and it includes e-books, enhanced books, interactive books, and others[4]. In the world of education, recently, electronic books are increasingly becoming popular because of its usage. Publishers have the opinion that the use of these digitalized books is an excellent replacement to textbooks because they can be accessed wherever and whenever. They are also cheaper and portable; hence, they will successfully emerge as the future learning materials in mathematical education[5].

The consequences of the development of e-books were the reduction in the number of print media and books purchased by the public. The general statistic has shown that people have started to like e-books since they eliminate the high-cost printing and publishing. The electronic books are generally cheaper than printed books[6].

The progress of digital devices has changed peoples reading habit. With the emergence of smartphones and tablets, the development of newspapers, magazines, and digital books are increasing because everything can easily be accessed directly with these digital gadgets. The habit of reading print media is pretty much displaced by the presence of digital devices such as smartphones and tablets [7]. Many persons have applied the digital method in Learning mathematics nowadays. The e-book is a better medium to foster interaction mathematics education because it improves the effectiveness of studying complex calculations [8].

The 21st century is known as the era of vast knowledge, and it is a season that gives more attention to students ability to think critically and relate factual knowledge to the real world experience. To meet up with these standards, appropriate channels must be in place, and one of such is the electronic book[9]. Information technology is useful in our everyday life. Hence it is a great tool to solve the problems of the 21st century. One of its application is internet usage. In Indonesia, internet usage experiences a significant increase on a yearly basis. The aim of the Indonesian 21st-century education should be to teach the students necessary skills to ensure that they can stand the test of the global era[10].

To develop a product in the form of electronic books, sufficient skills and experience are needed so that product development goals are achieved. In the past five years, researchers and teams have succeeded in developing several products of electronic-based teaching materials and have obtained a Copyright certificate from the Indonesian Ministry of Law and Human Rights. Some of the results related to this study have also been disseminated in national [11] and international seminars[12]. In both studies, the teaching materials can only be used on computers or laptops, while the electronic books developed in this study can be used on gadget.

## **2 Method**

In this study, there were five stages involved including analysis, design, development, implementation, and evaluation. The five stages are adopted from the development model of ADDIE (Analysis-Design-Development-Implementation-Evaluation)[13]. This model was selected because it is used to describe a systematic development of learning media. Besides, ADDIE is a general model that is considered suitable for the development research [14]. The procedure of ADDIE is also sequential and the evaluation results of each stage promote learning of the next step. One of the roles of ADDIE is to serve as a guideline in building training equipment and infrastructure programs that are effective, dynamic and supportive of the performance of the training [15].

In analysisstage, we identify the problem, conducting a needs analysis and performs the task analysis. The researcher makes a blue print of the product to be developed in design stage. The development stage is the process of realizing blue print or product design. At this stage, a math e-book was developed for junior high school students. In the implementation phase is carried out by testing the product directly. The testing phase is carried out in two stages, expert validation and field test. Validation is done by content and media experts. Field tests were conducted on a number of respondents who were in accordance with the criteria and

objectives of product development. The evaluation is carried out for product revision needs and determining the feasibility of the final product. The results of expert validation and field test were analyzed by calculating the percentage (%) of achievement scores obtained from all experts and respondents. The formula can be seen in equation (1).

$$\text{Achievement Score} = \frac{\text{Total Score}}{\text{Ideal Score (100)}} \times 100\% \quad (1)$$

Eligibility criteria are determined based on achievement scores. Products are eligible if only if the achievement score is more than 70%. If the achievement score is less than 70%, the product is not eligible and it has to correction based on the research objectives.

The instruments used in this study consisted of expert validation questionnaires, student response questionnaires, and learning outcomes tests. Validation questionnaire was developed to assess the suitability of book content with learning objectives. Other validation questionnaires to assess the appearance and practicality of the media. Both questionnaires were given to content and media experts. While the student responses questionnaire used to find out the respondents' interest. The questionnaire has a score range of 10-100 for each aspect assessed, so the average total score is 100. This instrument can be accessed on <https://osf.io/t2cbr/>.

This study involved 60 junior high school students in Banten Province, Indonesia. Of the 60 students, 20 students from schools in urban areas (urban students), 20 students from schools in the rural-urban (rural-urban students), and 20 from schools in rural areas (rural students).

### 3 Result and Discuss

The result of study was obtained from the result of validation and field test to respondents. Validation stage to find out achievement scores from content and media experts. Meanwhile, the field test was conducted to find out the achievement score of student responses and learning outcomes. In this study, the data can be accessed on <https://osf.io/jaqr/>.

#### 3.1 Content expert validation

The results obtained from the validation of content experts can be seen in Table 1.

**Table 1.** Result of content expert validation.

No	Indicator	Achievement score (%)				Criteria
		Expert 1	Expert 2	Expert 3	Total	
1	Aspects of the truth of the concept	85	90	80	85	Eligible
2	Aspects of breadth and depth of concepts	90	95	85	90	Eligible
3	Aspects of language	90	95	85	90	Eligible
4	Aspects of appearance	85	90	80	85	Eligible
	Total				87.50	Eligible

These data indicate that the product in the aspect of learning material is categorized as very feasible since the learning material includes the elements of conceptual truth hence it was given a rating of 85%. While Breadth and depth of concepts were rated 90%. Linguistic aspects were given a 90% rating, and the display aspect had a percentage of 85%. Generally, the content experts assessed the math e-book with a very decent category at 87.50%.

### 3.2 Media expert validation

The achievement score of the media experts can be seen in Table 2.

**Table 2.** Result of media expert validation.

No	Indicator	Achievement score (%)				Criteria
		Expert 1	Expert 2	Expert 3	Total	
1	Aspects of appearance	85	90	80	85	Eligible
2	Aspects of implementation	95	95	95	95	Eligible
3	Aspects of language	90	95	85	90	Eligible
	Total				90	Eligible

According to Table 2, the average total evaluation of media expert validators is at a percentage of 90%. The average vividly displayed that math e-books are categorized as very feasible to use. This is in line with the achievement score on the appearance aspect with an average of 85%, the implementation aspect 95%, linguistic aspects 90%, all aspects in the category are very feasible.

The e-book developed as a learning media has several advantages, including: 1) a search column on the top right of the media that makes it easy for readers to search for words. 2) electronic book can be read in various gadgets provided that the Shockwave Flash Media is installed. 3) there are video and simulating questions in the media (multimedia), 4) small devices are also able to duplicate and store different information.

### 3.3 Student response

The results of student response can be seen in Table 3.

**Table 3.** Results of student response.

No	Indicator	Achievement score (%)				Criteria
		Urban	Rural-Urban	Rural	Total	
1	Aspects of Interest	90.50	85	79.50	85	Eligible
2	Aspects of Desire	97	95	93	95	Eligible
3	Aspects of Attention	95	91	84	90	Eligible
4	Aspects of Solving Problems	87	78	75	80	Eligible
5	Aspects of Maintaining Quality	90.50	85	79.50	85	Eligible
6	Accepting Challenges	95	93.50	81.50	90	Eligible
7	Satisfaction Aspect	98.50	95	91.50	95	Eligible
	Total				88.57	Eligible

According to the results of the table above, the achievement score was 88.57%. Its means, generally the response to the math e-book is in the good category. This result is also supported by the achievement score for each indicator of more than 80%. It can be said that students are interested and able to use the math e-book well in learning process.

### 3.4 Student learning outcomes

In this study, student learning outcomes were obtained after they learned using the math e-book for several meetings. The electronic book when appropriately applied to the learning process can enhance effectiveness in learning. The results can be seen in Figure 1.

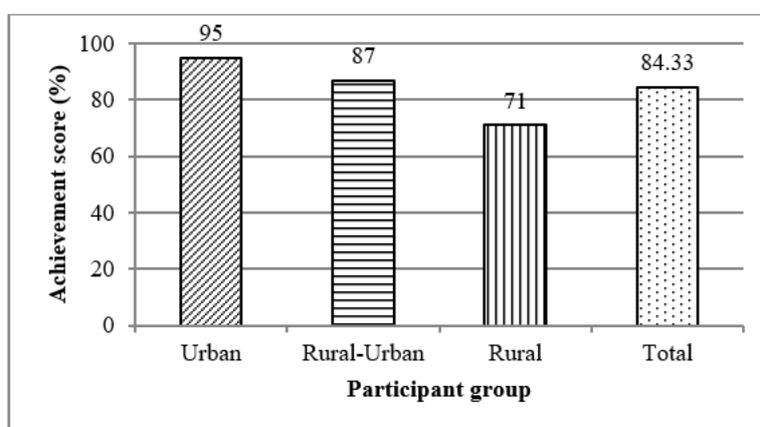


Fig. 1. Achievement score of student learning outcomes

The result shown in Figure 1 that the achievement score of student learning outcomes for each group including to the high category. This stated that generally students both urban, rural-urban, and rural, have been able to learn well using the math e-book. The statistical test results show that the differences in the three achievement scores are significant (sig. 0.00 less than 0.05). Its means that the achievement score for urban student learning outcomes is significantly better than rural-urban and rural students. In other words, as an alternative learning resources, the math e-book is more suitable for use by urban students than rural and rural-urban students.

## 4 Conclusion

The electronic book has been successfully developed, validated, and tested. According to the results of validation and field tests of the math e-book, the achievement score obtained is more than 70% for each stage. Its means that the math e-book is eligible and can be used as learning resource in the learning process for students. Another finding from this study that the math e-books are more suitable for urban students. This is possible because they are used to gadgets in their daily lives, while rural students still need to adapt to the use of gadgets. Through the math e-book, they can repeat learning as much as they want, while rural students,

the majority of whom do not have a gadget, cannot do it. Our results also have rather general implications for the analysis of educational policies, especially in mathematics learning in urban areas, which must take into account the use of gadgets in the learning process.

## References

- [1] J. Y. Chao, P. W. Tzeng, and H. Y. Po, "The study of problem solving process of e-book PBL course of atayal senior high school students in Taiwan," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 13, no. 3, pp. 1001–1012, 2017.
- [2] D. Tsvyatkovska and C. Storni, "Designing an educational interactive eBook for newly diagnosed children with type 1 diabetes: Mapping a new design space," *Int. J. Child-Computer Interact.*, 2018.
- [3] M. Hamada and M. Hassan, "conditions of Creative Commons Attribution 4.0 International (CC BY 4.0) apply. Correspondence: An Interactive Learning Environment for Information and Communication Theory," *OPEN ACCESS EURASIA J. Math. Sci. Technol. Educ.*, vol. 13, no. 1, pp. 35–59, 2017.
- [4] S. Liao, J. Hong, and M. Wen, "Applying Technology Acceptance Model ( TAM ) to explore Users ' Behavioral Intention to Adopt a Performance Assessment System for E-book Production," vol. 14, no. 10, 2018.
- [5] M. Bode, M. Khorami, and D. Visscher, "A Case Study of Student and Instructor Reactions to a Calculus E-Book," *Primus*, vol. 24, no. 2, pp. 160–174, 2014.
- [6] E. D. Cassidy, M. Martinez, and L. Shen, "Not in Love, or Not in the Know? Graduate Student and Faculty Use (and Non-Use) of E-Books," *J. Acad. Librariansh.*, vol. 38, no. 6, pp. 326–332, 2012.
- [7] K. L. Hsiao and C. C. Chen, "Value-based adoption of e-book subscription services: The roles of environmental concerns and reading habits," *Telemat. Informatics*, vol. 34, no. 5, pp. 434–448, 2017.
- [8] D. Kotsopoulos, "E-Learning with *visual math*: An E-book review," *Can. J. Sci. Math. Technol. Educ.*, vol. 5, no. 4, pp. 517–519, 2005.
- [9] Y. Wang, J. Lavonen, and K. Tirri, "Aims for learning 21st century competencies in national primary science Curricula in China and Finland," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 14, no. 6, pp. 2081–2095, 2018.
- [10] J. C. Sanabria and J. Arámburo-Lizárraga, "Enhancing 21st century skills with AR: Using the gradual immersion method to develop collaborative creativity," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 13, no. 2, pp. 487–501, 2017.
- [11] H. Pujiastuti, "Bahan Ajar Interaktif Berbasis Pendekatan Saintifik pada Materi Garis dan Sudut untuk Siswa SMP," pp. 195–202, 2016.
- [12] P. Heni, "Interactive teaching materials based on scientific approach : triangles and quadrilaterals," vol. 00097, pp. 0–4, 2018.
- [13] L. N. Lior, "Design and Development Models and Processes," *Writ. Interact.*, pp. 21–42, 2013.
- [14] Z. Ozdilek and E. Robeck, "Operational priorities of instructional designers analyzed within the steps of the Addie instructional design model," *Procedia - Soc. Behav. Sci.*, vol. 1, no. 1, pp. 2046–2050, 2009.
- [15] R. S. Nadiyah and S. Faaizah, "The Development of Online Project Based Collaborative Learning Using ADDIE Model," *Procedia - Soc. Behav. Sci.*, vol. 195, pp. 1803–1812, 2015.