

# Developing an Android-Based E-Textbook to Improve Learning Media Course Outcomes

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**Abstract**—This research aims to develop an Android-based e-textbook for a learning media course to enhance student learning outcomes. The learning media course was selected because students require an e-textbook to improve their comprehension of the criteria and creation techniques of learning media during online learning. This study utilized the research and development method with the 4D model created by Thiagarajan and Semmels. Six learning media expert validators tested the product's feasibility, and the product's effectiveness was tested on students through experiment research. Descriptive statistics and an eligibility criteria table were used to determine the product's feasibility and usability. In addition, an independent sample t-test was used to determine the product's effectiveness. According to the expert evaluation results, the product validity falls into the "very good" category (4.50 out of 5, or 90%) in aspects of language, presentation, appearance, and usefulness. The effectiveness test results indicated that the Android-based e-textbook significantly affects student learning outcomes. In addition, students' perceptions of the usefulness, ease of use, and satisfaction of the Android-based e-textbook are also in the "very good" category (4.27 out of 5, or 85%). According to a qualitative data survey, students mentioned that the most useful aspects of the product were the tutorial videos, quizzes, menus, and page markers. Nevertheless, a few students experienced difficulties with their internet connection and reading limitations.

**Keywords**—Android-based e-textbook, interactive e-book, ebook usabilities, e-book challenges, learning media course

## 1 Introduction

During the COVID-19 pandemic, online learning as an alternative learning method poses new challenges for teachers and students (Gumede & Badriparsad, 2022; Li & Che, 2022). Teachers and students must possess self-directed learning skills, technological pedagogical knowledge, digital literacy, and the ability to utilize online tools in order to support online learning (Elshami et al., 2022; Verawati et al., 2022). In addition, digital literacy, self-efficacy for online learning, student emotions (such as enjoyment and boredom), and the quality of interactions between students and content, students and teacher, and between students affect students' engagement and performance

in online learning (Gu & Huang, 2022; Wang et al., 2022). Therefore, online learning requires the use of appropriate electronic learning tools to help students comprehend online learning activities and complex materials (Mudjid et al., 2022).

According to preliminary research, students' lack of computer program proficiency prevented them from achieving a higher level of performance while adapting to distance education (Aristovnik et al., 2020). These issues arise as a result of the teachers' inability to use electronic learning tools and online learning media to design interactive and engaging online learning activities (Junus et al., 2021; Sujarwo et al., 2022). Moreover, self-study at home, a lack of access to appropriate learning resources, and a lack of access to e-learning platforms are the greatest obstacles students face during online learning (Hoque et al., 2021). Consequently, the implementation of online learning increases student anxiety and lowers student achievement during the COVID-19 pandemic (Kim & Park, 2021).

The Learning Media course is one of the compulsory subjects in the Department of Elementary Education. This course is needed to cultivate students' critical and creative abilities in the production and utilization of learning media (Smaldino et al., 2012). The results of a preliminary study revealed that many students had difficulty comprehending the criteria and steps for creating learning media, particularly those involving computer programs. The unstable internet connection and limited time for synchronous learning also prevented them from achieving superior learning outcomes (Li & Che, 2022). In addition, students reported that the available literature was insufficient and difficult to use to understand the criteria and procedures for producing learning media. Because of this, students need textbooks with multimedia to help them learn online (Masa'deh et al., 2022).

One of the technologies that can affect education is the e-textbook. The term "e-textbook" refers to any electronic book used as a textbook (Bozkurt & Bozkaya, 2015). Textbooks are guidebooks for learning activities that have complete, systematic, and straightforward content so that students can use them independently (Afnita et al., 2021). Furthermore, e-textbooks have several advantages over printed textbooks, such as being more durable, portable, accessible, and engaging (Almekhlafi, 2021; O'Bannon et al., 2017). Therefore, the use of the e-textbook can be one solution to improve students' reading skills and learning outcomes, especially during distance learning (Afnita et al., 2021; Almekhlafi, 2021; Masa'deh et al., 2022).

Although digital textbooks on mobile are useful for supporting the learning process, the use of digital books has not been widely adopted in the Indonesian education system (Ninghardjanti et al., 2020). Accessibility problems (Almekhlafi, 2021), the effect of screens on eye fatigue (Kang et al., 2009), and student digital device readiness have hindered teachers and students from using digital books in the learning process. Previous research has also shown that the use of PDF e-books as textbooks is less than satisfactory because they only have images, text, and static links (Asrowi et al., 2019). In addition, digital books created by previous researchers with iBooks are only compatible with Apple devices and not with Android devices (Daud et al., 2015). Therefore, it is necessary to develop a valid and appropriate e-textbook to enhance student satisfaction and knowledge (Aristovnik et al., 2020; Yorganci, 2022).

A comfortable online learning environment can be created by combining mobile technology, contextual learning strategies, and meaningful learning designs (Lisana & Suciadi, 2021; Papadakis & Kalogiannakis, 2019). For example, recent research indicates that the use of Android learning media on mobile devices can provide an effective means of establishing socially interactive and constructivist learning environments (Droliya et al., 2020; Nurhasanah et al., 2022; Papadakis et al., 2020). In addition, utilizing digital textbooks can boost student motivation (Gunnars, 2021), improve students' understanding (Harasim, 2017; Zakharova & Podvesovskii, 2021), keep students' attention (Wang, 2022), and foster social interaction and teamwork (Papachristos et al., 2010). Furthermore, the use of project-based learning (PjBL) can increase students' engagement in knowledge construction (Guo et al., 2020) and improve students' problem-solving skills, decision-making, working with others, and time management (Beneroso & Robinson, 2022; Gomez-del Rio & Rodriguez, 2022). Therefore, the use of project-based learning in the Android-based e-textbook will provide the most effective learning environment in an online learning context (Francese et al., 2015). Based on the problem's context, this study aims to develop an Android-based e-textbook for a learning media course and test its validity and effectiveness in improving student learning outcomes.

## 2 Methods

### 2.1 Research design

This study used Thiagarajan and Semmel's 4D model as a research and development method. The model was selected because it consists of sequential steps to minimize a product's weaknesses and can be implemented in various fields, including education (Verawati et al., 2022). The 4D model comprises four hierarchically organized steps: define, design, develop, and disseminate (Thiagarajan et al., 1974). In the first step, the researchers determined learning outcomes based on curriculum study, material study, and students' needs. The second step is designing an Android-based e-textbook using all the information gathered in the first stage. In the third step, the validity of the product was tested by six learning media expert validators, and the product's effectiveness was tested on students through an experimental study. Furthermore, researchers investigated the usability and disadvantages of the Android-based e-textbook through the students' responses to a questionnaire. Finally, the researchers distributed the Android-based e-textbook to public users in the last step. The stages of this research can be seen in Figure 1.

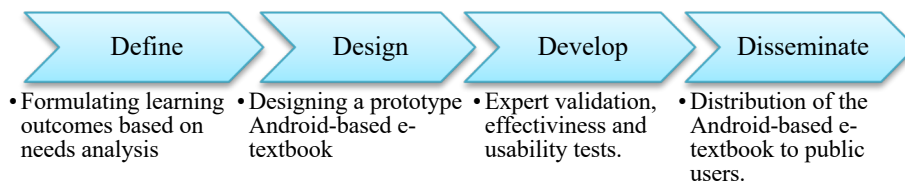


Fig. 1. Stages of research

The trial design utilizes a quasi-experimental design with a non-equivalent control group to determine the product’s effectiveness. The quasi-experimental design of the study is presented in Table 1.

**Table 1.** Quasi-experimental design

Class	Pretest	Treatment	Posttest
Experimental	O <sub>1</sub>	X <sub>1</sub>	O <sub>2</sub>
Control	O <sub>3</sub>	X <sub>2</sub>	O <sub>4</sub>

Information:

O<sub>1</sub> and O<sub>3</sub> = pretest

O<sub>2</sub> and O<sub>4</sub> = posttest

X<sub>1</sub> = treatment with project-based learning and an Android-based e-textbook

X<sub>2</sub> = treatment with project-based learning and Powerpoint slides

## 2.2 Participants

The feasibility test of the development product was carried out by six expert validators of learning media from different universities. The six experts were selected based on their expertise and willingness to review the products developed. The subjects in the trial of the effectiveness of the Android-based e-textbook model on student learning outcomes included 80 students taking the learning media course at the Islamic Elementary Education department, Walisongo State Islamic University, Semarang. The sex of the students consisted of 67 (84%) females and 13 (16%) males. Their ages ranged from 18 to 20 years, and they came from the same social and racial backgrounds. The experimental and control groups were determined using a purposive sampling technique based on academic ability. As a result, it was determined that there were to be 40 students in the experimental group and 40 students in the control group.

## 2.3 Data collection instrument

The questionnaire items for the Android-based e-textbook validity test were developed using the Suryani questionnaire (Suryani et al., 2018), which contains 22 statements about language, presentation, appearance, and utility. The results of the validators’ questionnaire validity test with the product moment were valid (mean = 0.866, minimum = 0.554). Furthermore, Cronbach’s alpha test results also indicated that the questionnaire for the validity test was reliable (alpha = 0.929).

The questionnaire items for the Android-based e-textbook usability test were adapted from Lund’s USE questionnaire (Lund, 2001), which was validated by Gao et al. (Gao et al., 2018). On a 5-point scale, participants in the experimental group were asked how strongly they agreed or disagreed with 15 statements regarding the usefulness, easiness, and satisfaction of the Android-based e-textbook. The results of the usability questionnaire validity test with product moment produced valid results (mean = 0.766, minimum = 0.550). In addition, the results of Cronbach’s alpha also showed that the questionnaire for the usability test was reliable (alpha = 0.767).

The pre-and post-test results provided quantitative data about the product’s effectiveness. Six chapters of the Android-based e-textbook were covered by the 60 pre-test/post-test questions, which were developed and validated. The validity test was conducted by analyzing the accuracy of each question in measuring indicators of learning achievement, asking a number of experts to examine the questions, rechecking the language multiple times, and analyzing validity with product moment. The results of the pretest and post-test validity tests for product moments were valid (pretest mean = 0.248; post-test mean = 0.274). Cronbach’s alpha test results also showed that the instruments used in the pretest and post-test were reliable (pretest alpha = 0.739 and post-test alpha = 0.799).

## 2.4 Data analysis

This study collected quantitative data using the validation questionnaire and the usability questionnaire, as well as the pretests and post-tests. In addition, expert validators’ responses to the validation questionnaire and experimental group students’ responses to the usability questionnaire were analyzed by descriptive statistics. Furthermore, the feasibility and usability of the product were determined using the criteria shown in Table 2.

**Table 2.** Eligibility criteria of development product (Asmianto et al., 2022)

Categorized mean score (X)	Eligibility Criteria	Category
$X \leq 1.79$	$X \leq 35\%$	Very Poor/ Invalid
$1.79 < X \leq 2.60$	36% - 53%	Poor/ Less Valid
$2.60 < X \leq 3.40$	53% - 68%	Moderately/ Acceptable
$3.40 < X \leq 4.21$	69% - 84%	Good/ Valid
$X > 4.21$	$X > 84\%$	Very good/ Very valid

The qualitative data collected from the questionnaire was used to revise the product and investigate the advantages and disadvantages of the Android-based e-textbook. In addition, the pretest and post-test results were analyzed using a normality test, a homogeneity test, and an independent sample t-test. The t-test analysis was conducted with SPSS 19 for Windows and a 5% significance level.

## 3 Results and discussion

### 3.1 Define

This study begins by defining or formulating the goals of developing an Android-based e-textbook. The purpose of developing an Android-based e-textbook can be formulated by considering student needs, convenience, cost, learning strategies, learning sources, and technologies (A. W. Bates, 2019). According to student feedback, the reduction in online meeting time made it difficult for them to comprehend the learning

media materials presented by the instructors. In addition, the lack of appropriate teaching materials as a companion for independent learning increases students' anxiety and cognitive load when completing lecturer-assigned tasks (Aristovnik et al., 2020). Regarding the lack of independent learning companion teaching materials, Asmianto et al. emphasized the need for android-based media that students could utilize as independent learning companions (Asmianto et al., 2022). In addition, the presence of textbooks in the learning process is expected to help students comprehend the subject matter studied (Masa'deh et al., 2022).

All students (100%) of the learning media course agreed with the development of interactive digital textbooks in the learning media course. In their view, video tutorials are extremely helpful for describing the steps involved in creating learning media. Furthermore, most students (82%) recommended using online quizzes for exercise and evaluation. Concerning the subject matter of the learning media course, students proposed several different ideas, including strategies for using and developing visual media, learning videos, web blogs, and interactive learning media. In addition, students suggested the implementation of simulation, project-based learning, and problem-based learning in the learning media courses. The findings of this needs analysis are supported by prior research demonstrating that teachers can enhance the online learning process by combining synchronous learning with video recording, interactive quizzes, and learning management systems (Safitri et al., 2022; Tóth, 2021; Wang et al., 2022). Moreover, Android learning media with engaging content and tools can increase students' interest, motivation, and critical thinking skills (Asmianto et al., 2022; Moundy et al., 2021; Penrod et al., 2022). Based on these findings, developing an Android-based e-textbook is essential to facilitate online learning environments and assist students in achieving better learning outcomes (Nurhasanah et al., 2022; Verawati et al., 2022).

### **3.2 Design**

The design phase aims to create a digital textbook prototype based on the information gathered in the previous stage. The Android-based e-textbook for this study was created using multiple software applications, including Ispring Suite, Website to APK Builder, Filmora, and Quizizz. The authors chose these programs because they have the features required to create an Android-based e-textbook quickly and easily. For example, Ispring Suite can easily create HTML5 flipbooks (Dmitrieva, 2019), Website to APK Builder can quickly convert HTML5 files into Android apps (Verawati et al., 2022), Filmora can easily record and edit videos (Yuniari & Juliari, 2021), and Quizizz can create entertaining online quizzes (A'yun & Irwansyah, 2022).

The components contained in the Android-based e-textbook consist of the cover page, table of contents, introduction, usage guidelines, lesson plan, discussion of material topics, a glossary, references, and author biography. The discussion of material topics was organized logically, clearly, and concisely and was illustrated with images, diagrams, and videos to make it easy to understand independently (Afnita et al., 2021; Faham & Asghari, 2019). In addition, the Android-based e-textbook has menus, page markers, chapter summaries, worksheets, and QR codes to make it more affordable,

engaging, and interactive (Ambra et al., 2022; Suryani et al., 2018). The QR codes of the Android-based e-textbook can be scanned and clicked to view files, video tutorials, and interactive quizzes on web pages. The goal of putting parts of an e-textbook on a web page is to take advantage of web application features and reduce the file size of Android-based e-textbooks (Embong et al., 2012).

The Android-based e-textbook for the learning media course covers seven topics. The first topic discusses learning media definitions, classifications, selections, development, and utilization strategies. Then, the second and third topics discuss definitions, components, evaluation criteria, and creation techniques of educational infographics and comics. The fourth topic discusses learning video definitions, benefits, evaluation criteria, and production steps. The fifth topic discusses the fundamental concepts, components, evaluation criteria, and procedures for creating interactive learning media. The sixth topic discusses web-based learning media and blog creation procedures. Finally, the seventh topic discusses Google Classroom, Edmodo, and Moodle. These topics were selected based on an analysis of the curriculum, student needs, and learning conditions (A. W. Bates, 2019). In addition, these topics cover the common types of instructional media utilized by educators (Smaldino et al., 2012). Examples of the Android-based e-textbook pages can be seen in Figure 2.

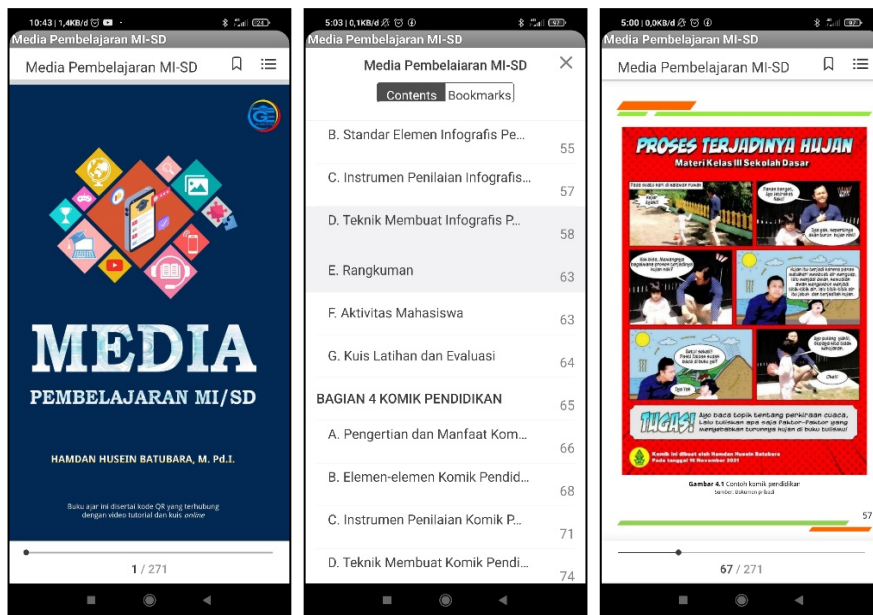


Fig. 2. The e-textbook app of the learning media course that has been designed

### 3.3 Develop

The objective of the development phase is to validate and test the product created in the previous step. The expert validators consisted of six people, namely: three validators were professors and lecturers of the learning media course; two were learning

media lecturers in the elementary education department, and the other was a lecturer on linguistics. Researchers communicated with the expert validators via Zoom meetings, WhatsApp, and emails during the validation process. The result obtained from the validity test stage is the Android-based e-textbook, which has been improved qualitatively with the guidance of the validator panel of learning media experts. The following suggestions from the validators have been taken into account: (1) fixing misspellings and unclear sentences; (2) making usage instructions clearer; (3) adding relevant images to some abstract material; (4) rearranging topics and images in a more effective way; and (5) making instructions and criteria of assignments clearer.

The expert validators’ assessment results in Table 3 showed that the Android-based e-textbook designed for the learning media course obtained an average score of 4.50 out of 5. Furthermore, according to Table 2, the Android-based e-textbook has a validity of the ‘very good’ category. As a result, we can conclude that the Android-based e-textbook met the product feasibility requirements in terms of language, presentation, appearance, and usefulness (Suryani et al., 2018). Furthermore, the validity test results show that the Android-based e-textbook meets the rules and principles of multimedia design (A. W. (Tony) Bates, 2019; Bozkurt & Bozkaya, 2015; Mayer, 2009) and can be used by the intended users.

**Table 3.** Validation scores

Indicators	Mean Scores of every expert						Mean scores	Eligibility
	V1	V2	V3	V4	V5	V6		
Language	3.83	4.50	4.17	4.50	4.83	4.83	4.44	89%
Presentation	3.88	4.88	4.38	4.50	5.00	4.63	4.54	91%
Appearance	3.88	4.88	4.38	4.50	5.00	4.63	4.54	91%
Usefulness	4.00	4.80	4.00	4.80	4.60	4.60	4.47	89%
<i>Average</i>	<i>3.90</i>	<i>4.76</i>	<i>4.23</i>	<i>4.58</i>	<i>4.86</i>	<i>4.67</i>	<i>4.50</i>	<i>90%</i>

After the validators agreed to the usage of the Android-based e-textbook model, the effectiveness test was carried out on students to determine its effect on learning outcomes. The trial implementation in this study involved two groups of students, each of which amounted to 40 people. Students in the experimental group were taught using project-based learning with an Android-based textbook (PjBL+ABET). In contrast, students in the control group were taught using project-based learning with PowerPoint slides (PjBL+PS). The syntax for Project-Based Learning with ABET is as follows: (1) In an online meeting, the teacher discusses learning plans and assigns pretests; (2) The teacher then discusses materials and assigns students to read materials through LMS Edmodo and mobile apps, do homework, participate in an online forum, and take quizzes; (3) Students use Edmodo and the mobile app to practice creating learning media; (4) Students post their project assignment files in Edmodo, invite their classmates to view them, and provide feedback; (5) Students review three classmates’ assignments and provide feedback on them; and (6) Before studying a new topic, students must revise their assignments, submit them via Edmodo Assignments, and complete quizzes.



As prerequisites for the independent sample t-test, SPSS version 19 was used to conduct the Kolmogorov-Smirnov and the homogeneity of variance test. The significance value (Sig.) on the Kolmogorov-Smirnov test results for each group’s pretest and post-test data was greater than 0.05, indicating that the experimental and control groups’ pretest and post-test data were normally distributed. Furthermore, Table 5 shows that the significance value (Sig.) of the pretest and post-test on the homogeneity of variance test results was greater than 0.05, indicating that the pretest and post-test data of the experimental and control groups are homogenous.

**Table 4.** Tests of normality

	Group	Kolmogorov-Smirnov <sup>a</sup>		
		Statistic	Df	Sig.
Pretest	Experiment	.131	40	.082
	Control	.110	40	.200*
Posttest	Experiment	.112	40	.200*
	Control	.121	40	.142

**Table 5.** Test of homogeneity of variance

		Levene Statistic	df1	df2	Sig.
Pretest	Based on Mean	.344	1	78	.559
Posttest	Based on Mean	.094	1	78	.760

According to the effectiveness test, the average student scores of the experimental and control groups in the pretest were 48.38 and 48.58. According to the results of the independent sample t-test (Table 6), the significance value is greater than 0.05 ( $F = 0.344$ ,  $df = 78$ , sig. (2-tailed) = 0.932), so there was no significant difference in the pretest scores. This indicates that the initial conditions of the experimental group and the control groups’ initial conditions were identical. Furthermore, the average student scores of the experimental and control groups in the post-test were 73.37 and 65.58. The independent sample t-test indicates a statistically significant difference in the post-test scores of the students ( $F = 0.094$ ,  $df = 78$ , sig (2-tailed) = 0.002). This calculation demonstrates that the Android-based e-textbook significantly impacts student learning outcomes.

**Table 6.** The independent samples test results for the pretest and post-test data

		Levene’s Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	Df	Sig. (2-tailed)
Pretest	Equal variances assumed	.344	.559	-.086	78	.932
	Equal variances not assumed			-.086	76.494	.932
Posttest	Equal variances assumed	.094	.760	3.213	78	.002
	Equal variances not assumed			3.213	77.361	.002

These findings indicate that research and development guided by the 4-D model can produce appropriate and effective learning media. The findings of this study support previous findings indicating the superiority of interactive e-books over non-interactive e-books (Almekhlafi, 2021; Wahyuni et al., 2020). Furthermore, these findings indicate that students can achieve better learning outcomes by using affordable, user-friendly, engaging, and interactive learning media (Asmianto et al., 2022; Asrowi et al., 2019; O’Bannon et al., 2017). In addition, this study confirms the findings of prior research that demonstrated the benefits of mobile technology, video tutorials, and learning management systems for enhancing student engagement and motivation in online learning processes (Ayun & Irwansyah, 2022; Penrod et al., 2022; Wahyuni et al., 2020; Yuda Handaya et al., 2021). Unlike the previous study (O’Bannon et al., 2017), all study participants were able to access the Android-based e-textbook anywhere and at any time because they all owned Android smartphones.

Table 7 displays the experimental group students’ perceptions of the Android-based e-textbook. According to survey scale data, students have very good perceptions (4.27 or 85%) of the usefulness, ease of use, and satisfaction of using an Android-based e-textbook. Furthermore, the survey’s qualitative data shows that most students (38, or 95%) appreciated the portability, accessibility, and convenience of the Android-based e-textbook. In addition, all students reported that the interactivity features of the Android-based e-textbook, such as learning videos, step-by-step instructions, quizzes, and page markers, were extremely beneficial during the learning process.

**Table 7.** Recapitulation of student response data to usability questionnaires

Aspect	Item	MIN	MAX	Mean	Eligibility	Category
Usefulness	1	2	5	4.28	86%	Very good
	2	2	5	4.13	83%	Good
	3	3	5	4.30	86%	Very good
	4	3	5	4.13	83%	Good
	5	3	5	4.13	83%	Very good
Easiness	1	3	5	4.28	86%	Very good
	2	3	5	4.58	92%	Very good
	3	3	5	4.50	90%	Very good
	4	2	5	4.15	83%	Good
	5	3	5	4.25	85%	Very good
Satisfaction	1	3	5	4.38	88%	Very good
	2	2	5	4.18	84%	Good
	3	2	5	4.28	86%	Very good
	4	3	5	4.15	83%	Good
	5	2	5	4.30	86%	Very good
Mean				4.27	85%	Very good

This study reveals several advantages and disadvantages of the Android-based e-textbook that support previous research and should be considered in the future. Accessibility, portability, and convenience are additional benefits mentioned in previous e-textbook studies (Ambra et al., 2022; Tarmizi & Al-odeh, 2021). In this study, students indicated that the most beneficial aspects of the learning process were finding a topic, marking pages, tutorial videos, and quizzes with immediate feedback (Sharma et al.,

2021; Wu & Chang, 2021). On the other hand, two students (5%) were concerned about the Internet network, and two others (5%) experienced discomfort when reading on their mobile devices. These findings confirm previous research that indicated that students' attitudes toward digital textbooks were influenced by their affordability, practicality, and usefulness (Almekhlafi, 2021; Faham & Asghari, 2019).

This study supports the constructivist learning theory because the Android-based e-textbook provides student-centered learning and numerous opportunities to personalize the learning experience (Wang, 2022). In addition, the benefits of interactive elements such as videos and quizzes in assisting students in improving their performance demonstrate that these findings support the cognitivist learning theory (Zakharova & Podvesovskii, 2021) and the media richness theory (Harasim, 2017). These findings should inspire schools, teachers, and publishers to develop interactive textbooks to help students reach higher levels of achievement.

### **3.4 Disseminate**

The final step in this research process is dissemination. A blog (<https://www.hamdanbatubara.my.id>) was used to distribute the Android-based e-textbook. Therefore, anyone, particularly college students and teachers in Indonesia, can download it from a website page and utilize it anywhere and at any time. Based on the Google Analytics report from 1st March 2022 until 31st May 2022, the blog ([www.hamdanbatubara.my.id](http://www.hamdanbatubara.my.id)) received more than 5 thousand page views and served more than one thousand users, mainly from Indonesia. Given that the book is in Indonesian, it is not surprising that most site visitors originate from Indonesia.

## **4 Conclusion**

The purpose of this research is to develop an Android-based e-textbook for a learning media course and to evaluate its validity and effectiveness in improving student learning outcomes. Based on the research results, it can be concluded that this research has produced a valid and effective Android-based e-textbook model for the learning media course. The expert validators' assessment results found that the Android-based e-textbook prototype obtained validity in the 'very good' category. These results indicate that, theoretically, the e-textbook developed has good conditions for language, presentation, appearance, and usefulness. Furthermore, the effectiveness test results indicate that the Android-based e-textbook significantly affects student learning outcomes. In addition, students' perceptions regarding the level of usefulness, easiness, and satisfaction of the Android-based e-textbook were in the 'very good' category (mean 4.27 and eligibility of 85%).

The findings of this study have implications for the development of digital textbooks that are more comfortable to use in the learning process and for future research. In addition, this study contributes to understanding the benefits and challenges of the Android-based e-textbook. Finally, this study is also important for schools and companies that may want to create engaging interactive e-textbooks.

Researchers may consider addressing the limitations of this study in the future. The participants of this study were 80 students, most of whom were women. The study findings are limited to higher education and do not account for the context of elementary and secondary education.

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