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Development of Android-Based E-pocketbook on the Material of the Body Defense System to Increase Motivation and Cognitive Learning Outcomes of Senior High School Students

Arini Muyasaroh, Sigit Saptono[1] ✉

1Biology Department, FMIPA, Universitas Negeri Semarang, Indonesia

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Abstract

Technological advances in the 21st century are expected to be able to provide changes in the field of education so that the quality of Indonesian education can improve, for example through innovative development of learning media such as e-pocketbooks. Body Defense System material is a complex material filled with foreign terms, so it is considered difficult. In addition, the limited and unrepresentative learning media in the material makes students less motivated to learn and not optimal in participating in learning. This study aims to develop a valid, practical, and effective e-pocketbook media product to increase motivation and cognitive learning outcomes of high school students. The type of research carried out is development or Research and Development (RnD), with the data used includes validity, practicality, and effectiveness test data on increasing student motivation and cognitive learning outcomes. The data analysis technique includes validity analysis, practicality analysis, and effectiveness analysis on increasing student motivation and cognitive learning outcomes. Small and large scale tests were carried out in the same school, namely students of SMA Negeri 12 Semarang. Based on the research results, the e-pocketbook media was declared valid by media experts at 85%, while by material experts it was declared very valid with a percentage of 90%. Practicality test results obtained from teacher scores of 96% and students of 91% so that it is included in the very practical category. The effectiveness test of increasing motivation obtained a score of 31.3% in the highly motivated category, 63.3% in the motivated category, and the remaining 5.4% in the moderately motivated and unmotivated categories. The N-Gain result of 0.74 is included in the high criteria with 91% of students in the high and medium N-Gain categories, while the other 9% have low N-Gain. Based on the results of the study, it can be concluded that the e-pocketbook media of the Body Defense System material is classified as valid, practical, and effective media to increase motivation and improve cognitive learning outcomes of high school students.

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✉**Correspondence Address:**
D6 Building, Faculty of Mathematics and Natural Sciences (FMIPA), Sekaran, Gunungpati, Semarang, 50229

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E-mail: sigit_biounnes@gmail.com

INTRODUCTION

Advances in science and technology that are developing in the 21st century have provided rapid changes, especially in the field of education (Istiana et al., 2024) This technological advancement can provide additional knowledge needed in learning so that later it can have an impact on improving the quality of education (Hidayat & Khotimah, 2019). The way that can be done as an educator in responding to this situation is to develop a learning system that follows the times so that it becomes more interesting, innovative, and also fun (Menrisal et al., 2019) The utilization of increasingly sophisticated technology can be used as an effort to support a more advanced learning process, for example by developing various variations of media, methods, or learning models. The development of learning media will make it easier for students to understand the material and learn independently (Nurbani & Puspitasari, 2022)

The success of the learning process according to Suardi (2018) can be required by three main points, namely students (learners), teachers (educators), and learning resources. Learning resources can be anything that can help achieve learning objectives, including e-pocketbooks or electronic pocketbooks, not necessarily in printed form such as textbooks, but also in electronic or digital form. According to Mclsaac & Gunawardena (1996) in Supriadi (2015) mentions that the increasing variety of educators who develop learning resources in schools is done as an effort by educators to be able to increase interaction and feedback with students. This is also aligned with the current condition of students who are generation Z. Generation Z itself was born in the years 1995-2012 and is characterized by being heavily involved in technology.

Based on the definition from KBBI or the Big Indonesian Dictionary, a pocketbook is a small book that can be put in a pocket and carried everywhere. According to Adi Setyono & Wahyuningsih (2013) in their research also defines that pocket books are small, lightweight, and can be stored in pockets. This allows e-pocketbooks to be carried and read anytime anywhere. Hizair (2013) in his research also said the same thing, that pocketbooks are small and can be stored anywhere. E-pocketbook is a small electronic book that is easy to carry anywhere with material that has been arranged concisely so that it can facilitate the learning process of students (Saputri et al., 2022). E-pocketbook has an attractive design, easy to use, and informative, and can arouse students' interest in learning because it can be accessed anywhere and the material in it is interesting.

According to limited interviews with teachers at SMA 12 Semarang, it is known that learning resources for Body Defense System material are still limited in the form of LKS and material discussions cannot be delivered in depth. Less varied learning media is also one of the causes why the material is classified as difficult. In addition, Achmad, 2023 in his research stated that body defense material according to grade 12 is classified as difficult because there are many foreign terms and has complex concepts. Khairunnisa et al. (2023) research also stated that this body defense material is not only considered important but also has a high level of difficulty. The results of the interview motivated the author to compile an e-pocketbook learning media on the material of the Body Defense System so that students can learn more easily and teachers can also be assisted by additional learning resources on the material of the Body Defense System.

Based on the Big Indonesian Dictionary, the word motivation means encouragement or effort that arises consciously or unconsciously in a person to take an action for a certain purpose (Bagja et al., 2018). Hamzah (2016) in his research states that this motivation is a form of wants, needs, instincts, impulses, and drives, which is something that forces humans to act or do something. This student motivation will be able to influence student learning outcomes. In general, learning outcomes can be seen from changes in overall behavior which include cognitive, psychomotor, and affective aspects (Nurtanto & Sofyan, 2015) These changes occur from the simplest to the most complex. According to Bloom (1956) the "learning domain" is divided into three aspects or classifications, namely (1) cognitive aspects, (2) affective aspects, and (3) psychomotor aspects. Meanwhile, Bloom's cognitive domain is divided into 6 levels, namely knowledge, understanding, application, analysis, synthesis, and evaluation.

There are two learning outcomes in chapter 5 about Body Defense System, the first is that students are able to analyze the relationship between the roles of the constituent components of the Human Defense System and the second is that students are able to investigate disorders of the body's defense system in relation to the occurrence of a number of diseases. In the material section, it will be explained briefly and completely about what are the components of the Body Defense System, then the types of the Body Defense System which consists of two types, namely, specific body defense responses and nonspecific body defense responses. In addition to being presented with supporting images regarding the mechanism of each type of body defense system, students will also be given additional insights related to current issues that are still related to the Body Defense System.

Based on the description in the background, it is necessary to conduct research in order to develop learning resources in the form of an android-based e-pocketbook on the material of the Body Defense System in class XI SMA. The e-pocketbook developed is expected to be used to increase student motivation and cognitive learning outcomes on the material of the Body Defense System. The objectives in this study are to analyze the validity of the e-pocketbook media being developed, to analyze the practicality of the e-pocketbook media, and finally to analyze the effectiveness of the media being developed on increasing student motivation and cognitive learning outcomes.

RESEARCH METHOD

The research was conducted at SMA N 12 Semarang in the odd semester starting in October-November 2024. The type of research in this study is development research or Research and Development (RnD). The development research that will be carried out has the aim of developing and validating the product as stated by Sugiyono (2017)). While the research design uses 4D which is divided into four stages, namely define, design, development, and disseminate. The subjects of this study were students of class XI F4, 5, and 6 for the large-scale test, while for the large-scale test were students of class XII F3. The dependent variable in this study is the effectiveness of e-pocketbook on increasing students' motivation and cognitive learning outcomes. Meanwhile, the independent variable is the e-pocketbook media developed. Data collection techniques in epocketbook development research conducted are observation, interviews, and questionnaires for non-test instruments, while for test instruments using pre-test and post-test. In the validity test of the e-pocketbook product developed using a questionnaire instrument for validation of media experts and material experts. In the media practicality test, a questionnaire was also used which was aimed at teachers and students in class XII. In testing the effectiveness of e-pocketbook media on increasing student motivation using a questionnaire, while for testing the effectiveness of e-pocketbook media on improving cognitive learning outcomes using test instruments in the form of pre-test and post-test, where both values will be analyzed using N-gain.

RESULTS AND DISCUSSION

This section presents the results and discussions regarding the development of android-based e-pocketbook media on the material of the body defense system to increase motivation and cognitive learning outcomes of students in three grade xi classes. The following is the link to access the developed e-pocketbook of body defense system material: Link *E-pocketbook* materi Sistem Pertahanan Tubuh

Characteristics of E-pocketbook Media

The e-pocketbook that is being developed uses software in the form of Canva applications. The size of this product is 12 x 19 cm, with 24 pages. The first sheet is the front cover and the last page is the back cover. The typeface or font used in this product is Archivo Narrow for the title measuring 42.9, the subtitle uses the same font as the title, but the size is 31.1, for the dominant typeface Glacial Indifference measuring 27. The material presented in the product made is equipped with a summary of the material, mind map, video links, color representative images, article links containing information to add insight to the "Did You Know?" column, practice questions, and student activities. The following is an example of the front cover design and content of the e-pocketbook media being developed.



Figure 1 Example of e-pocketbook media design developed

Based on Figure 1, it can be seen that the development of e-pocketbook media pays attention to the layout and color selection, and the attractiveness of each page. This is done so that users, especially students, can use the media comfortably and be able to arouse students' motivation to learn more.

Validation of E-pocketbook Media

The validation stage in the development of android-based e-pocketbook media material on the Body Defense System aims to determine the validity of the media that has been developed. The validity test consists of two stages, namely the validity test by media experts and material experts, with each stage validated by two validators. Media and material validators in this e-pocketbook media are lecturers of Biology Department, Faculty of Mathematics and Natural Sciences, State University of Semarang. The validity test of the e-pocketbook uses a questionnaire technique with an evaluation score in the form of a scale of one to four. The results of the evaluation score will be converted into a percentage and analyzed according to the category of validation results.

Validation of E-pocketbook Media by Media Experts

In the assessment conducted by media experts, two aspects were used which consisted of programming and display aspects. Validator 1 is Mr. Prof. Dr. Saiful Ridlo, M.Si. while validator 2 is Mrs. Dr. Sri Sukaesih, S.Pd. In the programming aspect there are 5 indicators, while for the display aspect there are 10 indicators. The results of the percentage of validation scores by media experts on e-pocketbook

products can be seen in Table 1.

Table 1 Percentage of Android-Based E-pocketbook Validation Score of Body Defense System Material by Media Experts

No	Validator code	Percentage (%)	Criteria
1	Validator 1	88%	Very valid
2	Validator 2	88%	Very valid
Average		88%	Very valid

Table 1 showed that the assessment conducted by two media validators in Table 1. show that the android-based e-pocketbook media on the material of the Body Defense System can be classified in very valid criteria with an average percentage of 88%. This shows that the validation of e-pocketbook media that is being developed according to two media experts is declared very valid.

Validation of E-pocketbook Media by Material Experts

Data from the validation of android-based e-pocketbook material on the material of the Body Defense System was obtained from two material expert validators who are active lecturers majoring in biology, Faculty of Mathematics and Sciences, Semarang State University. Validator 1 is Prof. Dr. Priyantini Widiyaningrum, M.Si., while validator 2 is Dr. Aditya Marianti, M.Si. The aspects used in the material validation test consisted of six aspects, namely, the suitability of the material with CP, indicators, and learning objectives; The correctness of the material concept; Material delivery; The suitability of images to clarify the material; Language; and The benefits of the developed media. The results of the percentage of validation scores by material experts on e-pocketbook products can be seen in Table 2.

Table 2 Percentage of Android-Based E-pocketbook Validation Score of Body Defense System Material by Material Experts

No	Validator code	Percentage (%)	Criteria
1	Validator 1	89%	Very valid
2	Validator 2	91%	Very valid
Average		90%	Very valid

The assessment results that have been carried out by two material validators in Table 2. show that the android-based e-pocketbook media on the material of the Body Defense System can be classified in very valid criteria with an average percentage of 90%. This shows that the validation of the e-pocketbook media that is being developed according to two material experts is declared very valid. The results of the android-based e-pocketbook media assessment of the Body Defense System material that has been validated by media and material experts, then averaged to determine the percentage of the overall assessment. The following recapitulation of the results of the e-pocketbook media assessment is presented in Figure 2.

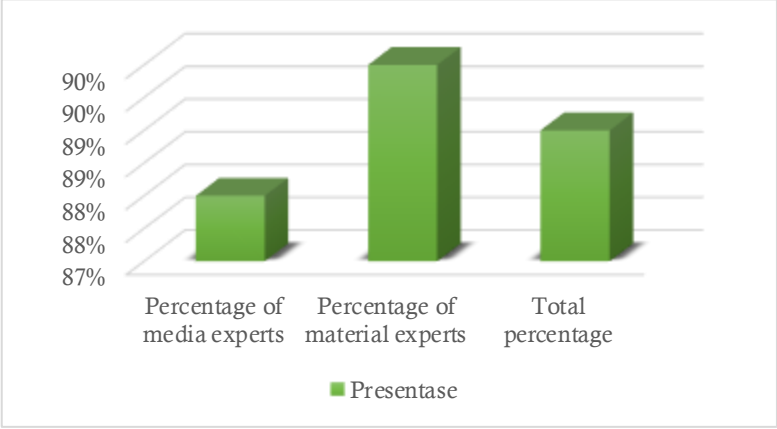


Figure 2 Results of the Android-Based E-pocketbook Media Assessment of Body Defense System Materials

by Material Experts and Materials

Practicality of E-pocketbook Media

Based on the questionnaire of the practicality of android-based e-pocketbook media on the material of the Body Defense System that has been carried out during the small-scale test stage. The small-scale test was conducted to determine the practicality of the e-pocketbook media developed from student and teacher assessments to increase student motivation and cognitive learning outcomes. The results of the questionnaire data on the practicality of e-pocketbook media by teachers in Table 3.

Table 3 Percentage of Android-Based E-pocketbook Validation Score of Body Defense System Material by Material Experts

No	Assessed Aspect	Percentage (%)	Criteria
1	Suitability of material with CP, indicators, and learning objectives	100%	Very practical
2	Quality	88%	Very practical
3	Effectiveness	100%	Very practical
4	Presentation	94%	Very practical
Average		96%	Very practical

Based on Table 3, each aspect obtained very practical criteria with aspects of the suitability of the material with CP, indicators, and learning objectives of 100%, in the quality aspect of 88%, in the effectiveness aspect of 100%, and in the presentation aspect of 94%. The average obtained was 96% and included in the very practical category. In addition, in the column of recommendations and suggestions the teacher wrote that the e-pocketbook media was good and suitable for use as media and learning resources, simple, and also practical. Mrs. Sri Nuryani, M.Pd. as a biology teacher at SMA Negeri 12 Semarang also concluded that the e-pocketbook media that is being developed in the category is feasible to be tested.

The results of the small-scale trial were carried out in a class that had received the previous Body Defense System material, namely class XII. In this study, the small-scale test was conducted on XII grade students of SMA Negeri 12 Semarang, totaling 17 children. The results of the practicality questionnaire are presented in Table 4.

Table 4 Percentage of Android-Based E-pocketbook Validation Score of Body Defense System Material by Material Experts

No	Assessed Aspect	Percentage (%)	Criteria
1	Use	87%	Very practical
2	Effectiveness	85%	Very practical
3	Display	87%	Very practical
Average		86%	Very practical

Based on Table 4, the average assessment percentage is 86% and is included in the very practical category. These results indicate that the developed media, namely e-pocketbooks, are very practical to use as learning media. After that, the average results of the practicality questionnaire assessment from teachers and students are presented in Table 5.

Table 5 Data on the Practicality of Android-Based E-Pocketbook Media on the Material of the Body Defense System by Students and Teachers

Respondents	Percentage Score
Biology teacher	96%
Students	86%
Total percentage	91%
Criteria	Very practical

The total percentage for the results of the practicality questionnaire by teachers and students is 91%

with a practicality value from teachers of 96% and students of 86%, the percentage is categorized as very practical. Based on these data, it can be concluded that the e-pocketbook media is included in the very practical category so that it can be used in learning on a large scale test. Based on these results, it can be concluded that the media being developed, namely the e-pocketbook, in the practicality test is categorized as very practical and gets a positive response from both teachers and students due to the attractiveness of the e-pocketbook media in terms of ease of use so that it can be used anywhere-anytime, the effectiveness of the material that is arranged systematically and completely, and an attractive appearance that attracts students to want to learn more. This is in accordance with research conducted by Agil Salihun (2024) which states that the practicality of a medium is one of the important factors for a learning medium to be declared effective to use.

Effectiveness of E-pocketbook Media

Based on the research that has been carried out, there are data collection activities to find out whether the e-pocketbook media that is being developed is able to increase student motivation through filling out questionnaires and see how the improvement of student cognitive learning outcomes in large-scale tests using pre-test and post-test scores. The student learning outcomes obtained will later be used to strengthen the use of the media developed in the learning process so that later it can increase student motivation and cognitive outcomes. The instruments used are test instruments (pre-test and post-test) and non-test instruments (questionnaire sheet). The use of pre-test questions to determine the initial ability of students before learning using the e-pocketbook media that has been developed. While the post-test question is used to determine the final ability of students after learning using android-based e-pocketbook material on the Body Defense System. The questionnaire sheet for increasing motivation is used to find out how to increase student motivation.

Effectiveness of E-pocketbook Media on Increasing Student Motivation

The questionnaires were filled out in 3 classes, namely XI F4, F5, and F6, each of which amounted to 36 students with a total of 108 students. The assessment results were obtained from student assessments through questionnaires. The following Figure 3 presents the frequency distribution of the results of increasing student learning motivation.

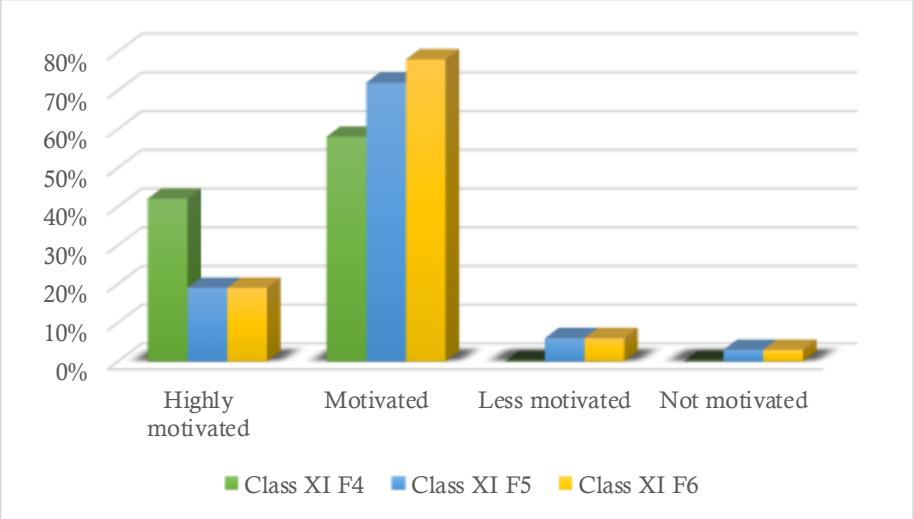


Figure 3 Frequency Distribution of Learning Motivation Improvement Results

Based on Figure 3, it can be seen that the android-based e-pocketbook media on the Material of the Body Defense System effectively increases student learning motivation. This is in accordance with research conducted by Triyanti (2015) in Rahayu & Saptono (2021) which states that the use of multimedia in learning is not only able to improve student learning outcomes and student activeness, but also able to increase student learning motivation.

Effectiveness of E-pocketbook Media on Students' Cognitive Learning Outcomes

The subjects in the research conducted were students of class XI F4, F5, and F6, each class containing 36 students. Based on these results, treatment was given in the form of implementing learning activities using e-pocketbook media in each class. The post-test results in the three classes after learning using e-pocketbook media averaged 82, so it can be concluded that the value between the pre-test and post-test has increased by 50 points. The increase in students' cognitive learning outcomes can be seen in Table 6.

Table 6 N-Gain of Student Cognitive Learning Outcomes

Average	Cognitive Learning Outcomes (Test Score)	N-Gain	Criteria
Pre-test	32	0,74	High
Post-test	82		

Based on Table 6, it is known that the initial cognitive abilities of students are still quite low, namely 32. After knowing the initial cognitive abilities of students using android-based e-pocketbook media on the material of the Body Defense System. The improvement in students' cognitive learning outcomes can be seen through the post-test results. This is because the post-test is used to measure the extent of students' abilities after being given treatment. The post-test results of students get an average of 82. It is known that there was an increase of 50 after students did learning using e-pocketbook based on android material on the Body Defense System with an N-Gain value of 0.74 and included in the high criteria.

Based on the N-Gain value of 0.74 (high category), it can be concluded that the media being developed is proven to be effective in improving students' cognitive learning outcomes. In accordance with research conducted by Sunarti (2021) which states that with motivation students are able to get better learning results so that there is an increase in learning outcomes. This is also in line with research conducted by Paul et al. (2022) in their research who also developed pocket books and could increase student interest or motivation and learning outcomes.

The results of the N-gain are known through the pre-test and post-test scores that students have done. The recapitulation of students' cognitive learning outcomes is presented in Figure 4.

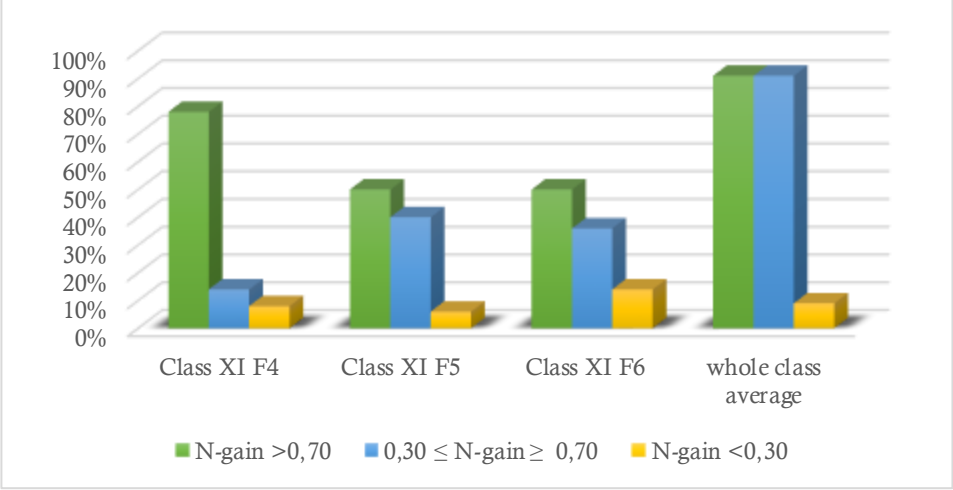


Figure 4 Recapitulation of Students' Cognitive Learning Outcomes

Based on Figure 4, it can be concluded that the e-pocketbook media used by students in learning effectively improve students' cognitive learning outcomes in the medium and high categories. This is supported by the use of this e-pocketbook media which can be used anywhere and anytime, so that students are facilitated when going to use. In addition, the material is concise, but still complete, accompanied by color images that support the explanation of the material making it easier for students to understand the material seen from the post-test scores that have increased.

Students who fall into the low N-gain group can be caused by different student interests and learning characteristics. Indeed, the characteristics of students in learning are classified into three major groups, namely sudio, visual, and kinetic groups (Thaariq et al. 2020). This is in accordance with Niwisruti et al. (2024) research which states that one of the things that affects student learning success is the character of the students themselves in learning. In addition, it could also be due to the limited duration of using e-pocketbook media during learning, so that students who have responsibilities in other subjects there are some who have not been able to immediately absorb e-pocketbook knowledge in a fast time. Not all students' learning interests are the same, so that in using e-pocketbook media can improve cognitive learning outcomes in 98 students and 10 other students have not been able to improve.

CONCLUSION

Based on the results of research and discussion, the conclusions regarding the development of android-based e-pocketbook media on the material of the Body Defense System to increase motivation and cognitive learning outcomes are explained as follows:

1. The results of the e-pocketbook media validation test by media experts were declared very valid with a percentage of 88%, while by material experts at 90% and included in the very valid category.

2. The results of the practicality test of android-based e-pocketbook media were declared very practical with an average percentage of 91% from teachers and students.

3. The results of the effectiveness test on the android-based e-pocketbook product trial of Body Defense System material to increase student motivation and cognitive learning outcomes resulted in a percentage increase in motivation of 31.3% in the highly motivated category and 63.3% in the motivated category so that e-pocketbook media is effective in increasing student learning motivation. The N-gain result of 0.74 is included in the high criteria with 91% of students in the high-medium N-gain category, while the other 9% have low N-gain, so it can be concluded that e-pocketbook media is effective in improving students' cognitive learning outcomes.

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