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Development of Steam-Based E-Booklets to Improve IPA Learning Outcomes on Human Respiratory System Material in Class V Sdn 104208

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ABSTRACT

This study aims to determine the validity, practicality, and effectiveness of STEAM-based e-booklets in science lessons on human respiratory system material. This type of research is an ADDIE model of development research (analysis, design, development, implementation, and evaluation). Data collection techniques in this study were observation, interviews, validation, and tests. This research was conducted in class V, SDN 104208, Cinta Rakyat. The results of this study indicate that (1) the product is valid from media expert I by 90% and expert II by 84%. (2) The product is valid according to material expert I by 86% and material expert II by 93%. (3) The product is valid according to language experts by 90.7%. (4) The product received a positive response from users, namely 2 V-A class teachers by obtaining 93.4%, V-B class teachers obtained a percentage of 94.7%, and students as product practicality experts. (5) The effectiveness test with the percentage of learning completeness is shown using the t test results (2-tailed), which are obtained at 0.000 referring to the basis for decision-making means 0.000 <0.05 or Ho is rejected and H1 is accepted. Thus, it is concluded that there is an influence between STEAM-based e-booklets and student learning outcomes on the material of the respiratory system in humans in grade V students of SDN 104208 Cinta Rakyat and STEAM-based e-booklets are proven to be effective for the science learning process in grade V.

Keywords*: *E-Booklet, STEAM approach, learning outcomes

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INTRODUCTION

The digital age of education has brought about changes in the learning process. Learning is a teacher's effort to help students learn easily. In learning, there are several goals to be achieved. This learning is a combination of learning components that interact and integrate with each other. Therefore, if one of the components cannot interact, the learning process will face many obstacles that will frustrate the achievement of learning goals as well as learning outcomes. Learning outcomes are the abilities of students after gaining their learning experience. According to Sudjana (2004), there are three types of teaching and learning outcomes, namely skills and habits, knowledge and direction, behavior, and ideals or achievements. One of the things that affects learning outcomes is the model and approach to learning used. Optimal learning outcomes are a major requirement in 21st-century education.

According to Rinawati (2021) learning outcomes are the abilities that children acquire after learning. When students are unable to achieve a good understanding of the subject matter, they will have difficulty applying that knowledge in real-life situations or facing more complex tasks. In line with Amalia's opinion (2022) that low learning outcomes are a serious problem in today's education system, Education has a very important role in shaping a generation that is competent and ready to face the challenges of the times. However, many students still experience difficulties in achieving adequate learning outcomes.

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Low student learning outcomes caused by teachers who only use student books make learning less interesting for students when receiving information provided by the teacher. Therefore, it is necessary to use technology-based learning resources as a tool to clarify the information conveyed by the teacher. This is in accordance with what is stated by the Association of Education and Communication Technology (AECT), which defines media as a symptom of the forms and channels used to convey messages or information.

The results of observations on Monday, May 15, 2023, at SD Negeri 104208 Cinta Rakyat, Percut Sei Tuan Subdistrict showed that the learning methods at the school had not utilized technology such as projectors or the use of laptops. The fifth grade teacher explained that in the learning process, educators use passive learning media such as pictures on cardboard and government-printed books. Therefore, efforts are needed to introduce the use of technology to educators and learners. The teacher-centered learning method seems to dominate, which causes the low learning outcomes of students in class V of SD Negeri 102408 Cinta Rakyat after observation at the school. This can be seen from the analysis of daily science scores, where students must achieve a minimum score of completeness (KKM) of 70. Based on the pre-test data, the acquisition of class V-B students of SD Negeri 104208 Cinta Rakyat obtained a science test score on respiratory system material less than 70 by 57.69%, and the percentage of students who scored 70 was 11.53%, and the value above 70 was 30.76%.

The cause of low learning outcomes in students can be attributed to several factors, including (1) the use of traditional learning methods by teachers in class. SDN 104208 Cinta Rakyat, which makes learning one-way. This is in line with the findings of Firmansyah & Jiwandana (2022), which show that there are still teachers who tend to use a teacher-centered learning approach; (2) teachers' limitations in accessing varied learning resources. Teachers should have the creativity to explore various relevant learning resources. According to Suyanto (2006), most teachers in schools tend to be less creative and innovative in using various learning methods because they prefer traditional methods; and (3) limited learning resources that are only limited to theme books.

From the evaluation conducted, the book has several shortcomings, including: (1) the number of tasks and practice questions is far greater than the discussion of the material; (2) the types of questions presented have not stimulated students to think systematically; and (3) the material presented only follows the 2013 curriculum without further development and has not been integrated with learning strategies such as STEAM. According to Haderiah et al. (2022: 166), the STEAM approach teaches technology and engineering integrated with science and mathematics to solve problems in everyday life and develop the creative power of students. (4) Existing books in softcopy form are only available in PDF format. As revealed by Divayana et al (2018), most digital books use PDF format due to its ease of use and ability to be manipulated for security. However, unfortunately, this format does not support interactive learning.

Digital-based learning books are recognized as one of the success factors in learning. With e-booklets, students are expected to be motivated, actively involved physically and psychologically, maximize all their senses in learning, make learning more meaningful, and get direct experience. In learning science, using technology greatly affects student learning outcomes; therefore, with the STEAM learning approach, students are expected to combine scientific concepts and principles with technology, engineering, art, and mathematics in a practical and integrated learning context. In STEAM learning, students are encouraged to use creative thinking, critical thinking skills, and teamwork to solve problems.

Based on the problems found and several factors indicated to be the cause, there are efforts that can be made, namely developing digital booklets or e-booklets that are more up-to-date and in accordance with student learning needs so that learning is of higher quality. A textbook is a reference work that contains a comprehensive collection of materials from a particular field of knowledge. Textbooks are compiled for the needs of educators and are usually used in educational institutions. Textbooks can be presented in soft and paper versions.

Softcopy books are commonly referred to as electronic books (e-booklets). Simply put, an e-booklet is defined as a book with a digital version of a book, usually consisting of a series of articles containing

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material (Martha et al., 2018). Some of the advantages of e-booklets include: (1) it can make it easier for students to access material in.jpg,.mv3, and.mv4 formats, where these formats are not found in the printed books used by students in class; (2) it can be accessed on smartphones, making it easier for students to study independently at home; and (3) it can be used online, reducing data storage on smartphones.

Ruddamayanti (2019) adds that the benefits of e-booklets include: (1) small book size according to smartphone size; (2) not weathered like printed books; (3) digital format that does not change; 4) making learning more interactive; (5) reducing the teacher's task in delivering information; (6) facilitating individualized learning; and (7) providing access to more in-depth information for students.

In the context of science learning, e-booklets have an important role with their ability to reduce the level of abstraction of science concepts, thus making science learning more interactive. E-booklets are not only a learning resource but also help students control their thinking process by presenting materials based on the STEAM approach. It is important to find an e-booklet that fits the STEAM approach, which is not only academically valid but also practical and effective in supporting learning. STEAM-based e-booklets allow the integration of multimedia elements such as images, audio, video, and materials. This can help increase students' interest and facilitate their understanding of complex concepts. Through the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach, students can also learn the material in a holistic and integrated manner (Widatul, 2021).

The STEAM approach has advantages in the learning process, including: (1) actively engaging students through practical activities that are relevant to real situations (Nurwulan, 2020); (2) presenting interesting and fun teaching so that learning has deeper meaning for students (Yakman & Lee, 2012); and (3) honing and developing students' skills to generate more critical and creative ideas (Hadinugrahaningsih et al., 2017).

Through the STEAM learning approach, students are given the opportunity to apply scientific principles in exploration and experimentation involving technology, engineering, art, and mathematics. In line with the opinion (Wandraini et al., 2022), the STEAM learning approach also enriches students' learning experiences and increases the attractiveness of science learning in elementary schools. By integrating STEAM elements, science learning becomes more interesting, meaningful, and relevant to students' daily lives. This helps students understand science concepts better and develop critical thinking skills, creativity, and teamwork so as to improve learning outcomes. The research conducted aims to determine the validity, practicality, and effectiveness of STEAM-based e-booklets in science lessons on the material of the respiratory system in humans.

METHOD

This development research model is Analysis, Design, Development, Implementation, and Evaluation (ADDIE). Dick and Carry developed the ADDIE design in 1996 with the aim of creating a learning system. Basically, ADDIE planning has similarities with other development plans, but the ADDIE planning stages are simpler, easier to understand, and include all the basic stages of development research, making it more effective and efficient to use as a basis for research development. The ADDIE design serves as a guide for e-booklet development and book quality testing in this study. The quality of the development product is measured from three aspects, namely validity, practicality, and effectiveness.

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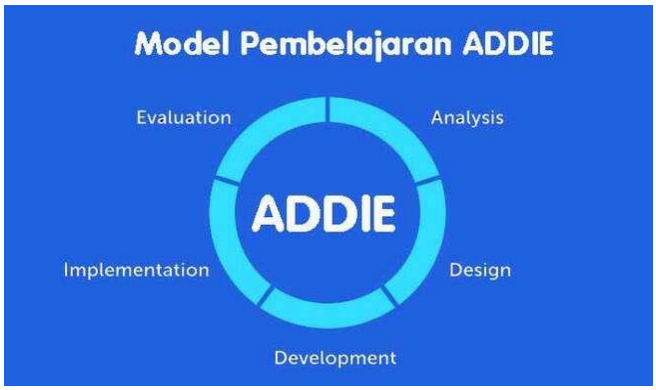

Figure 1. Design of ADDIE Development Model

The following is a description of the ADDIE research steps: (1) Analysis, as the first step is to analyze the need to develop a product. The development of a product can be initiated by a problem. The problem can arise because the available products are not relevant to user needs. Analysis is carried out on three aspects, namely needs, curriculum, and students. (2) Design activities in the ADDIE development research model are part of the product design process. Product design starts with designing the concept, then designing the content that will be included in the developed product, so that the product design is conceptual and can be used as a reference for the development stage; (3) Development. This stage is the realization of the product design that has been made. The goal at this stage is to produce STEAM-based e-books for science lessons. (4) Implementation. This implementation stage is intended to get feedback on the STEAM-based e-booklet developed and determine the effectiveness of the e-booklet. (5) Evaluation. Through this stage, the final revision of the developed product is carried out. Revisions are made according to the results of the evaluation or needs that cannot be met by the product. The final goal of the evaluation is the achievement of the development objectives.

This research and development was conducted at SDN 104208 Cinta Rakyat. The subjects in this study were VA class students in the experimental class and VB class students in the control class. Data collection techniques are steps taken to obtain data in the field. The data collection techniques used are observation, interviews, validity, and tests. The data collection process uses instruments such as questionnaires and test instruments. Analysis of instrument validity tests such as questionnaires and test instruments. The analysis of instrument validation test data is carried out by the product moment correlation formula, and then product validation data is analyzed by the formula:

$$P = \frac{\Sigma x}{\Sigma xi} \times 100\%$$

(Sugiyono, 2019)

Description:
P: Percentage of feasibility
Σx: Number of scores obtained (real value)
Σxi: Total score

The effectiveness of the product can be seen from the results of student learning. Data on student learning outcomes were analyzed using the t test with the help of SPSS.

RESULTS AND DISCUSSION

Results

Research and development were carried out in accordance with the stages of research and development of the ADDIE model, as follows:

a. Analysis stage

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Analysis is the first step to developing a product until it is finally declared qualified. Analysis includes activities to observe an object and describe it in detail. In this study, some of the objects analyzed were the needs of students and teachers, the curriculum used, and the character of students. The results of curriculum analysis and student characteristics show that learning resources are needed to support the material of the human respiratory system. The learning resources needed by students are e-booklets that are able to help students improve learning outcomes and are able to attract interest in learning in a digital format and integrated with learning videos.

b. Design stage

The planning stage in this study is divided into three, namely: (1) planning the material to be presented; (2) planning product design; and (3) planning instruments to assess product feasibility. Referring to the indicators developed according to the learning outcomes and learning objectives, the material planned to be discussed in the e-booklet is the material on the human respiratory system. Referring to the results of the analysis of the character of students or research subjects, the product developed is a textbook with a digital format. The digital textbook developed is in the form of a flipbook, so students can still feel the sensation of opening a book via a smartphone. In the flipbook, there are several learning videos and links connected to interactive quizzes. The design was made with the aim that students can learn independently at school or at home with more fun and more easily understand the concept of the material being studied.

Currently, there are various digital book formats; one format that has the potential to support academic activities is EPUB (Electronic Publication). According to Eikebrokk (2014), the EPUB format is widely used by publishers and application developers. Since version 2 in 2007, EPUB has been widely used, including in academic journals. That is, the EPUB format has been widely used by publishers, including for academic journals, since 2007. However, Prasetya et al (2018) stated that despite its potential, EPUB is still not widely used globally in Indonesia. Therefore, in this study, a digital textbook in EPUB format was designed. The design of STEAM-based e-booklets in this study can be seen in Figure 2.

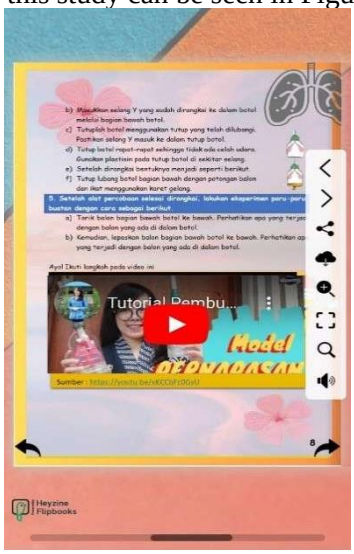

Figure 2. STEAM-based e-booklet

c. Planning Stage

The initial step in this development stage is product production. The manufacture of products in the form of e-booklets in the form of flipbooks is adjusted to the material design and product design design at the previous design stage, and then validation of the digital pocket book that has been produced is carried out. The e-booklet in this study was produced by utilizing the website heyzine.com. The Heyzine application can be accessed for free on Google without having to download it in the form of software, and it is easy to use even

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for amateurs (Rahmawati et al., 2022). Two science experts who served as material validators in this study assessed the material contained in the product, especially in the aspects of content, science language, and the implementation of material in learning. The results of material validation by the two validators showed an increase in the validity or feasibility of the material in the STEAM-based e-booklet developed. The average percentage of results from material expert I is %, while material expert II is 93.8%. These results are obtained from the table.

Table 1. Material validation

Aspect	Material Expert I		Materials Expert II
	Phase 1 Validation	Phase 2 Validation	Phase 1 Validation
Contents	4	4	4
	4	4	5
	4	4	5
	4	4	4
	4	5	5
	4	5	5
Language	4	4	5
	4	4	5
	4	4	5
	4	4	5
Learning	4	5	4
	4	4	5
	4	5	4
Total Score	52	56	61
Maximum Score	65	65	65
Percentage	80%	86%	93%
Criteria	Eligible	Very Eligible	Very Eligible

IT experts, as media validators in this study, assessed the media from various aspects, including appearance, media elements, and grammar. The results of the first validation showed that the product was declared feasible with an average percentage of 81%; the second validation resulted in a percentage of 88%, or the product was declared very feasible. Criticisms and suggestions given on media aspects include: (1) make the booklet description design in accordance with the basis of the learning model; (2) make the coloring and font size in the type section more adjusted so that the writing looks clear; and (3) make the layout, especially in the respiratory function, a summary scheme. Media validation scores are shown in the table.

Table 2. Media validation

Aspect	Material Expert I		Materials Expert II
	Phase 1 Validation	Phase 2 Validation	Phase 1 Validation
Appearance	4	4	5
	4	3	4
	4	3	5
	4	4	5
	4	4	4
	4	4	4
Media Elements	4	4	5
	4	3	4
	4	3	5
Grammar	4	3	4
Total Score	40	35	44

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Maximum Score	50	50	50
Percentage	80%	70%	90%
Criteria	Very Eligible	Eligible	Very Eligible

The product validation stage lasted for approximately one month. The validation process is carried out starting with product assessment by validators, product revision, and product assessment again until the product is declared usable by all validators. The following is a summary of the results of digital textbook validation by all validators.

Above is a recapitulation of the validation results by all experts or validators, including material experts, media experts, and linguists. It can be seen that the validation of the material by the two experts was carried out twice and both experienced an increase, as well as the validation by linguists was carried out twice and experienced an increase. Meanwhile, validation by media experts was only done once by expert I and twice by expert II.

d. Implementation Stage

This analysis was conducted to test the research hypothesis. Before testing the hypothesis, it is necessary to test the normality and homogeneity of the research data as a prerequisite.

1) **Normality Test of Learning Outcomes**

The normality test of this study was carried out with the Lilieforst normality test model because the data owned was single data, not group data, and the data owned was > 50. The test was carried out with the help of IBM SPSS statistical software. The significance level in this normality test is $\alpha = 0.05$; if the test result > α, then the data is normally distributed, and if the test result < α, then the data is not normally distributed. The following is the normality test for pre-test data on learning outcomes:

Table 4. Normality Test Results of Pre-Test Data - Post Test Learning Results

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistic	df	Sig.	Statistic	Df	Sig.
Student learning outcomes	Experimental Pre-Test	.159	26	.089	.938	26	.121
	PostTest Experiment	.160	27	.075	.935	27	.092
	Control pretest	.123	25	.200*	.962	25	.449
	Posttest control	.126	26	.200*	.972	26	.678

The table above shows that the sig. value is greater than 0.05, or (0.089>0.05) and (0.200>0.05), and it is concluded that the research data is normally distributed. The normality test was carried out on all learning outcome data, including the student post-test.

2) **Homogeneity Test of Learning Outcomes**

If the results of this homogeneity test are homogeneous, it means that the pre-test and post-test data measured do come from the same population (homogeneous). The homogeneity test in this study was carried out with the help of IBM SPSS statistical software. The distribution homogeneity test data can be seen in the following table:

Table 5. Results of the Homogeneity Test of Learning Results

		Levene Statistic	df1	df2	Sig.
Post test scores on learning outcomes	Based on Mean	.658	1	50	.421
	Based on Median	.502	1	50	.482
	Based on Median and with adjusted df	.502	1	47.288	.482
	Based on trimmed mean	.655	1	50	.422

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The table above shows the significance value in the homogeneity test: 0.421> 0.05. Thus, it can be concluded that the data owned by the distribution is homogeneous.

3) **Hypothesis Test**

The purpose of hypothesis testing in this study is to decide whether the hypotheses (H1 and Ho) tested are rejected or accepted. If H1 or the alternative hypothesis is accepted, it means that there is an influence between digital books based on the metacognitive approach to understanding mathematical concepts of fraction material, but if Ho or the null hypothesis is accepted, then there is no influence between STEAM-based e-booklets on student learning outcomes on human respiratory system material for grade V students of SDN 104208 Cinta Rakyat. The following is the basis for decision-making in hypothesis testing:1. If the significance value (2-tailed) is <0.05, then Ho is rejected and H1 is accepted.2. If the significance value (2-tailed) > 0.05, then Ho is accepted and H1 is rejected. Hypothesis testing is done using the t test with a significance level of α = 0.05. This study uses a paired sample t-test or dependent t-test because in this study there are two samples, namely the experimental class and the control class, which are paired, or the number of students in both classes is the same. The t test in this study was carried out with the help of IBM SPSS statistical software. The results of the hypothesis test are as follows:

Table 6. Hypothesis Test Results for learning outcomes

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PRE TEST - POST TEST	-25.38462	10.19049	1.99852	-29.50064	-21.26859	-12.702	25	.000

The table above shows the t test results (2-tailed) obtained at 0.000. Referring to the basis for decision-making means 0.000 <0.05, or Ho is rejected and H1 is accepted. Thus, it is concluded that there is an influence between STEAM-based e-booklets and student learning outcomes on the material of the respiratory system in humans in grade V students of SDN 104208 Cinta Rakyat.

e. Evaluation Stage

At this stage, researchers reconsidered suggestions or input related to the textbooks developed for students and fifth grade teachers of SDN 104208 Cinta Rakyat as product users. Evaluation is carried out to provide feedback on the input received for product and user improvement.

Discusion

Based on the results of the validation of data collection instruments, both questionnaires and test instruments, as well as the validation of learning devices and development products, STEAM-based e-books are declared to meet the validity criteria. Validity refers to the extent to which the design of STEAM-based e-booklets is in accordance with the current state and technology (content validation) and the extent to which the components in digital textbooks are consistently related to each other (construct validation).

Another criterion for the quality of STEAM-based e-booklets is the practicality of the digital book itself. In the Big Indonesian Dictionary (KBBI), the word "practical" means easy and happy to use it, so the practicality of the product in this study was measured using teacher response questionnaires and student response questionnaires as product users. The results of the teacher response analysis show that V-B class teachers are interested and happy to use STEAM-based e-booklet products for science lessons because the illustrations and scientific content in the book can meet students' learning needs. The average value of the VB

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teacher's response is 3.12. In addition to paying attention to the teacher's response, the purpose of this STEAM-based e-booklet is to analyze the results of the student response questionnaire. The practicality test was conducted on 26 VB class students as product users. The results of the practicality test showed that 24 out of 26 students felt interested in STEAM-based e-books, and only 2 out of 26 students felt less interested.

STEAM-based e-books have met the effective criteria. This statement can be reviewed based on the effectiveness test results. Things that are done in the effectiveness test, namely showing the results of the t test (2-tailed) obtained of 0.000 Referring to the basis for decision-making means 0.000 <0.05, or Ho is rejected and H1 is accepted. Thus, it is concluded that there is an influence between STEAM-based e-booklets and student learning outcomes on human respiratory system material in grade V students of SDN 104208 Cinta Rakyat. So that e-booklets are declared effective for use in the science learning process in grade V elementary schools.

In the learning process, it can be seen that the teacher takes a long time to teach the material to students, and it can be seen that students have difficulty understanding the teacher's abstract explanation. For this reason, additional learning resources are needed for students as a solution so that they understand human respiratory system material. Another finding in the process of using STEAM-based e-booklet products is that there are two students who do not have a device or smartphone to access the e-booklet, and the data package has been facilitated by the school with wifi. While other students who have smartphones and data packages do not experience problems when accessing e-books,. In anticipation, researchers have provided a download feature in the e-booklet so that students can download the book and read it offline.

CONCLUSIONS AND RECOMMENDATION

Referring to the results of the study, a valid, practical, and effective e-booklet product was obtained. Learning devices in the form of digital textbooks meet the product validity criteria of all experts or validators, where (1) the final results of material validation obtained an average percentage of 89.5; and (2) the final results of media validation obtained an average percentage of 85%. Thus, it is concluded that the product is very feasible to be used by teachers and students in learning science material on the human respiratory system. The e-booklet meets the criteria of practicality. This can be seen from the responses of teachers and students to the development product, which show ease, pleasure, and interest in the e-booklet. Based on the results of the study, the developed e-booklet has met the product effectiveness criteria. It can be seen from student learning outcomes that there is an effect of e-booklets on the science learning process. The results of this study help students improve learning outcomes and make e-books an additional learning resource that supports teaching and learning activities

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