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Development of STEM-Oriented E-Modules to Improve Science Literacy Ability of Elementary School Students

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Abstract: The goal of this project is to create an electronic module, or E-Module, for third grade elementary school kids that is designed using the Book Creator application and integrated with a STEM learning strategy. Development research, also referred to as Research and Development (R&D) employing the ADDIE paradigm, is this kind of study. The subjects of this study are instrument validators, expert validators (material experts, linguists and media experts) and students in class III SDN 07 Kampung Jawa II, students in class III SDN 04 Rawang and students in class III SDN 17 Kampung Baru. The research instrument consisted of validation sheets, questionnaires and test instruments. The data analysis technique used is validity analysis and practicality analysis. The results of the validity by media experts are 91, 68% with very valid qualifications. The results of the validity of the linguists are equal to 88.95% with valid qualifications. The results of the validity of the media experts are equal to 90.41% with very valid qualifications. The percentage of the teacher's score for product feasibility is 92.06%, which is included in the very practical category. The practicality test percentage of students is 90.31%, which is included in the very practical category. Thus, this research succeeded in producing a STEM-based E-module to improve the scientific literacy skills of elementary school students.

Keywords: E-Modules; Science Literacy; STEM Approach

Introduction

Education has advanced into the 21st century, integrating technological mastery, knowledge, attitudes, and abilities (Pertiwi et al., 2018; Taufiqurrahman, 2023). 21st century learning sets diverse educational goals with the aim of feeling the needs of learners and reflecting a better and more relevant education is something that has developed throughout history. The educational sector was impacted by technological advancements made during the fourth industrial revolution. The development of the world of education can be seen from the learning process such as curriculum development, use of learning models, selection of learning methods, use of teaching materials and so on (Hanikah et al., 2022; Mulyani, 2019). The evolution of education must alter for the better in tandem with advancements in knowledge and technology. As a result, teachers must learn how to package their lessons in a more engaging way if they want to help pupils gain the abilities they need for the twenty-first century. The 21st century is a time of extremely rapid advancements in science, technology, and society. Indonesia's 2013 curriculum facilitates the development of 21st century abilities in the classroom (Kimianti & Prasetyo, 2019;Kuncahyono & Aini, 2020).

Observations that have been made in three elementary schools in grade III found that learning is still teacher-centered, where the teacher only uses the main book and companion book or student worksheets where every year there are no new innovations in providing textbooks so that students cannot explore all of them. his ability to study. Based on the development of the demands of the times in the 21st century, learning must be student-oriented with the aim of providing meaningful experiences in the learning process. The

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researcher has provided ten scientific literacy items in various question formats. The early findings of the class III students' initial scientific literacy ability at SDN 07 Kampung Jawa II demonstrate that the results of the class III students' initial scientific literacy ability are still low. Only three of the 25 students received ratings above the minimum completeness threshold, and the remaining 24 received scores below it. The researcher additionally requested the results of the students' daily assessments from the homeroom instructor in addition to the findings above. Based on the results of the daily assessment of class III students, the percentage of students' daily assessments for each subject was obtained, namely the daily assessment of Mathematics 44% of students who completed, Indonesian 40% of students who completed, PKN 48% of students who completed and Arts 20% of students who completed.

Furthermore, the researchers conducted interviews with teachers in the three schools and obtained data that these schools had been supported by the facilities and infrastructure provided by the schools in facilitating all the learning needs of their students in the form of approximately 7 laptops in each school interviewed. However, the use of facilities and infrastructure by teachers in the learning process is not maximized. This is in accordance with the results of interviews that teachers are less involved in maximally active students and focused on conventional learning methods. Giving material is more focused on enriching knowledge (cognitive) and minimal in forming attitudes (affective) and experiences (psychomotor). Explanation is more dominant through the lecture method. The issues identified lead to the conclusion that new innovations are required to facilitate students' scientific literacy and make lessons easier for them to understand. One of the innovations that can be developed is making additional teaching materials. Making e-modules in this study uses the Book Creator application because this application allows users to create interactive digital books that can include various types of media, such as images, videos, sounds, and text (Siti Rodi'ah, 2021). With this application, users can easily create e-modules and add interactive elements such as links, soundcards and videos. The process of creating e-modules with Book Creator is quite easy. In an educational context, making e-modules with Book Creator can help teachers create interesting and interactive learning materials. In addition to applications, the development of e-modules must also be linked to an approach that can make e-modules appear more systematic and clearly organized (Fikriana & Haryani, 2023; Sanjaya, 2022).

In order to fully accomplish the learning objectives, the use of E-Modules with the Book Creator program will be more comprehensive if it is combined with an engaging learning approach. The STEM (Science, Technology, Engineering, and Mathematics) method is one that can be employed in the creation of e-modules that are in line with the needs of 21st century competence and the features of student growth. Research conducted by Irman Artobatama et al., 2020 states that in order to produce student learning activities that are useful to help bring out students' thinking skills, which are characterized by problem-solving abilities, making decisions, analyzing assumptions, evaluating, and conducting investigations, STEM integrates four fields of disciplines: science, technology, engineering, and mathematics. In addition, in this article it can be seen that STEM learning is in line with the characteristics of the 2013 curriculum which designs thematic, scientific and contextual learning which is expected to improve student learning competence (Ilmi et al., 2021; Rizki Putri Wardani, 2021). Research conducted by Suci Annisa Ilmi, et al can be concluded that the achievement of student learning activities increased by 85.18% after using the STEM learning approach in elementary schools (Ilmi et al., 2021). The STEM approach is very suitable for use in learning to improve student learning outcomes, because STEM can foster creativity and interest in student learning through the process of solving problems in everyday life (Khairiyah, 2019).

Based on the description above, this study aims to develop an electronic module or known as E-Module which is designed using the Book Creator application and combined with the STEM learning approach to improve scientific literacy in third grade elementary school students. The benefits of research to produce STEM approach-oriented e-modules in integrated thematic learning in elementary schools.

Method

Development research, also referred to as research and development (R&D), is this kind of study. The word "development research" is a condensed version of research and development which strives to create a useful product (Desyandri et al., 2019; Restu, et al., 2021). The ADDIE model, which consists of five processes (analysis, design, development, implementation, and evaluation), is used in this study. (Setyosari, 2010). The following is the flow of implementing the ADDIE model in this study:

The goal of a needs analysis is to identify the fundamental issues that must be solved before developing e-modules and to determine the benefits and drawbacks of the teaching resources that have been used by teachers up to this point. Examine whether the e-module satisfies the requirements of the educational process. Examining a curriculum include examining the syllabus, core competencies, fundamental competencies, and learning indicators. The purpose of this curriculum

analysis is to evaluate the adequacy of the instructional materials that teachers in schools employ. The goal of a material analysis is to identify any fundamental issues and determine whether the developed e-module is compatible with the content. Students' talents and interests in using e-modules are to be ascertained through student analysis. The findings of this analysis might be utilized as an example when creating thematic integrated e-modules.

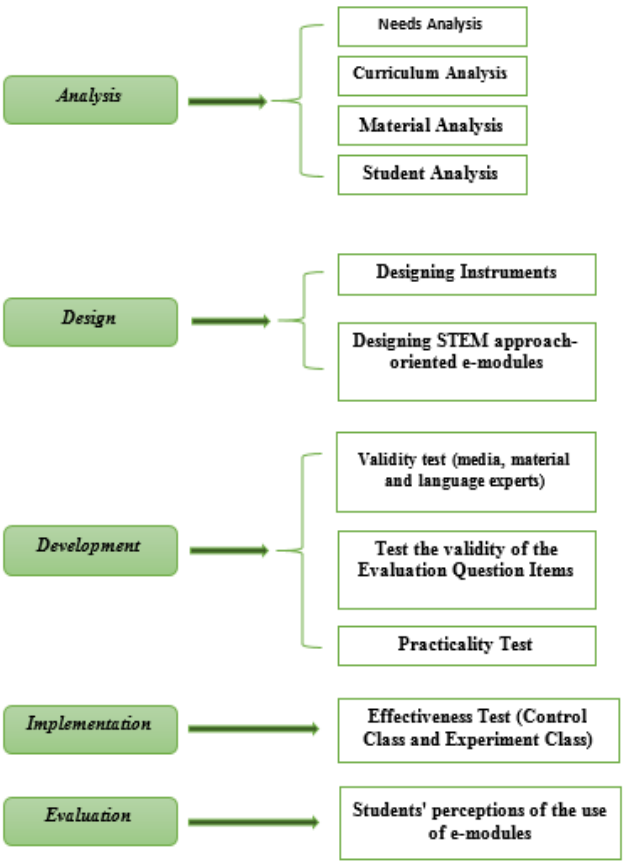

Figure 1. The ADDIE Model Implementation Flow

The subject of development research is as follows: 1) instrument validator; 2) expert validators (material experts, linguists and media experts); 3) students in class III SDN 07 Kampung Jawa II, students in class III SDN 04 Rawang and students in class III SDN 17 Kampung Baru. Instruments consist of various forms, such as validation sheets, questionnaire sheets, to test instruments. The AKM questions, which include matchmaking, multiple choice, complex multiple choice, and brief entries, make up the scientific literacy ability test instrument. The purpose of this test is to gauge pupils' scientific literacy levels. Validity analysis and practicality analysis were used as data analysis methodologies in development research. The table below shows how the validity analysis and practicality analysis were represented.

Table 1. Representation of Validity Analysis

Interval length	Percentage score	category
0-1.00	0%-54%	Invalid
1.01-1.75	55%-64%	Less valid
1.76-2.50	65%-79%	Enough
2.56-3.25	80%-89%	Valid
3.26-4.00	90%-100%	Very valid

Table 2. Representative validity analysis

Percentage	Criteria
90% - 100%	Very Practical
80% - 89%	Practical
65% - 79%	Pretty Practical
55% - 64%	Less Practical
0% - 54%	Impractical

Result and Discussion

The design of the E-module media and the description of the outcomes of the validity and applicability of the E-module are the foundations of the data that have been gathered in this development research. Five stages of development, including analysis, design, development, implementation, and assessment, are used to create E-module products. In order to identify the challenges faced in the learning process, the first step is to conduct a needs analysis. This is done through unstructured observation and interviews with the class teacher. The analysis's findings reveal some information, including the fact that students only use one teaching tool provided by the school during the learning process, that some students have trouble understanding the tools their teachers provide, that the learning process is less engaging, and that some students have trouble telling one learning tool from another. Additionally, pupils lack focus, are easily bored, and participate passively in their education.

The second stage is to design the E-module to be developed. This stage begins with determining the basic competencies and indicators of the learning material contained in the developed E-module. After determining the basic competencies and indicators, it will be followed by compiling learning materials that will be included in the E-module. In addition, at this stage an outline draft of the E-module was also prepared, including the cover, materials and E-module assessment instruments. and less active role in the learning process. The second stage is to design the E-module to be developed. This stage begins with determining the basic competencies and indicators of the learning material contained in the developed E-module. After determining the basic competencies and indicators, it will be followed by compiling learning materials that will be included in the E-module. In addition, at this stage an outline draft of the E-module

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The third stage entails creating instructional materials in the form of a finished E-module from the previously generated draft of the E-module. Making media designs beginning with the E-module display design, uploading E-module files to teaching materials in the form of E-modules, and creating a teaching material product that is prepared for implementation are all activities that take place at this stage. The designed e-module has a feature that sets it apart from other instructional resources. E-modules contain educational content, assessment tools, quizzes, and music that sets the stage for the learning process. These components can assist students combat the sensations of boredom and sleepiness they frequently encounter during the learning process. In addition, this can also help motivate and increase student enthusiasm and interest in learning in each learning process. The fourth stage is implementing the E-module product that has been developed. Before it can be implemented directly on students, interactive teaching materials that have been prepared beforehand will be tested for product validity by experts.

The purpose of the validity test is to determine the feasibility of the product that has been developed through the assessment of experts which include subject content experts, linguists and learning media experts. After carrying out validity tests by experts and the product that has been developed is declared feasible to be tested, it will proceed with the trial phase. The percentage results from the validity test and interactive teaching materials trials can be seen in the Table 3.

Table 3. Product Validity Test

Trial Subjects	Indicator	Validity Results	Percentage Qualification
Material Expert	Content eligibility Presentation eligibility Characteristics of e-modules	91.68 %	Very Valid
Linguist	Using language that is easy to understand Does not contain a double meaning	88.95 %	Valid
Media Expert	Informative graphics innovative	90.41 %	Very Valid

Based on the information from the aforementioned e-module validity test results, media experts were able to get validity findings of 91.68% with very valid qualifications. The authenticity of the linguists' results is equal to 88.95% with legitimate credentials. The results of the media experts' validity equal 90.41% with extremely valid credentials. These findings support the notion that STEM-based e-modules are appropriate for use in studies aimed at enhancing elementary school pupils' scientific literacy abilities. This e-module was revised and tested on practitioners, such as teachers and students, after the validators had been used to gauge its viability as a teaching tool. The results of the e-module feasibility or practicality test can be seen in the Table 4.

Table 4. Product practicality test

Subject	Percentage	Information
Teacher	92.06	Very Practical
Student	90.31	Very Practical
Average	91.18	Very Practical

Based on the assessment criteria table, which shows that STEM-based e-modules are in the extremely Practical category, the teacher received a percentage score of 92.06%. Similar to the student subjects' scores, the practicality test percentage was 90.31, falling into the very practical group. This demonstrates that the researcher's e-module meets the requirements for being a Very Eligible or Very Practical tool for use in teaching and learning activities in elementary schools. The findings of this study are corroborated by research by Ida Irmawati, whose findings on learning media and the production of E-Modules received incredibly exciting student responses in addition to being appropriate for use as teaching materials (Irmawati et al., 2021). In addition, this study is the same as the results of research by Kuncahyono that learning with E-Modules gets more favorable responses from students compared to learning with textbooks and conventional methods

(Kuncahyono, 2018). Furthermore, this e-module teaching material can be used as a learning resource for students and teachers in grade III elementary schools.

Conclusion

With the aid of the STEM-focused Book Creator program, valid and useful e-books can be created. This e-book is meant to help pupils become more literate in science. 91.68% of the validity results from media experts have extremely valid qualifications. The authenticity of the linguists' results is equal to 88.95% with legitimate credentials. The results of the media experts' validity equal 90.41% with extremely valid credentials. 92.06% of the teacher's points were given for product viability, placing it in the very practical category. Students scored 90.31 out of 100 on the practicality test, placing them in the very practical category. As a result, our research was successful in creating a STEM-based E-module to enhance primary school pupils' scientific literacy skills.

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The author declares no conflict of interest

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