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Validity of the Science E-Module Based on the 7E Learning Cycle Model Integrated Technological Knowledge

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ABSTRACT

Prospective elementary school teacher students need to understand one of the subjects, namely science, which is taught through the Elementary Science Learning course. In learning, it was found that lecturers dominated lecture activities. Besides, students did not maximize their ability to use technology to find the information. The purpose of the study was to determine the validity of science e-modules based on the 7E Learning Cycle model integrated with technological knowledge. This research is development research using the Plomp development model. The instrument used is an expert validation sheet assessed by 3 validators, namely material validators, language validators, and media validators. The validator's assessment obtained results, namely material experts with 81%, language experts with 88%, and media experts obtained 84%. The overall average of the assessment is 84.3% in the Very Valid category. The conclusion obtained is that the e-module based on the 7E learning cycle model integrated with technological knowledge is valid and feasible to continue for the practicality test.

Keywords*: *validity, e-module, 7E learning cycle, technological knowledge

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INTRODUCTION

Science is one of the subjects that must be taught at the elementary school level. Thus, PGSD students should master the concept of science subject matter by attending Pembelajaran IPA di SD courses. Pembelajaran IPA di SD course aims to equip prospective elementary school teacher students with elementary science material and be able to apply the learning material in the actual context. The objectives in this course are in accordance with the nature of science as a product and process. Science as a product should be able to produce facts, data, concepts, principles, and theories. Science as a process should be able to direct the way of thinking to solve environmental problems. So it is appropriate that science learning be carried out with learning activities that can arouse curiosity to explore and find various concepts.

Based on observations in Pembelajaran IPA di SD courses, problems have been found, such as the implementation of lecture activities, which are dominated by presentations, and the unavailability of teaching materials that are able to activate students during lectures. The results of the preliminary analysis that has been carried out by involving lecturers and students who take Pembelajaran IPA di SD courses also show that in lectures, lecturers play a more dominant role. In addition, most of the student assignments refer to sources that are less clear, which can cause misunderstandings of concepts. Although the lecturer has tried to summarize the material in a PowerPoint presentation, this has not provided an opportunity for students to be active during lectures. Preliminary analysis with students also found that students expect a clearer explanation of the material, especially for material concepts that are directly related to the scope of science in elementary school (Mustika et al., 2023). Lecturers and students agreed that it was necessary to develop teaching materials in the form of modules for Pembelajaran IPA di SD courses.

Teaching materials are learning resources that are systematically arranged with the aim of supporting successful learning. The use of teaching materials makes the subject matter more conceptualized so that

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learning objectives can be achieved properly (Nurbaeti, 2019). Teaching materials can be grouped into visual teaching materials, audio teaching materials, audio-visual teaching materials, interactive multimedia teaching materials, and digital teaching materials (Marisa et al., 2020). E-modules are part of digital teaching materials because they are created using certain applications and used by utilizing digital devices. Conceptually, e-modules are similar to modules because they are attractively packaged with the aim that they can be easily studied independently. In e-modules, learning activities are designed in a planned manner so that students can achieve learning objectives individually. (Violadini & Mustika, 2020). The components contained in the e-module consist of learning objectives, instructions for use, learning activities, material summaries, assignments, references, and answer keys. These components must be listed clearly (Aulia & Andromeda, 2019; Putri et al., 2020; Sugihartini & Jayanta, 2017).

In order to adapt to current learning demands, the module will be designed in the form of an e-module or electronic module display. The e-module is designed using the 7E learning cycle model and integrated with technological knowledge. The 7E learning cycle model consists of seven stages, namely elicit, engage, explore, explain, elaborate, evaluate, and extend. (Amini & Usmeldi, 2020; Balta & Sarac, 2016; Baybars & Kucukozer, 2018). The seven stages in the 7E learning cycle model include: (1) elicit, the stage of exploring initial knowledge, which can be done by asking questions; (2) engage, the stage of focusing, stimulating thinking, and encouraging interest in learning. This stage is done by reading, discussion, or other activities; (3) explore, the knowledge acquisition stage, which can be done by group discussion; (4) explain, the stage of explaining concepts, presenting facts, providing clarification, and listening critically; (5) elaborate, the stage of applying skills to related concepts; (6) evaluate, the stage of assessing the learning experience; and (7) extend, the stage of expanding the concepts that have been learned in different contexts (Adilah & Budiharti, 2015; Kustianingsih & Muchlis, 2021; Mustika et al., 2023). The selection of the 7E learning cycle model is in accordance with solving the problems found, where the application of the 7E learning cycle model can help students gain constructivist learning, deepen their understanding of the material, and be able to apply the concepts they have learned (Mustafa & Suyanta, 2019).

E-modules will also be integrated with technological knowledge with the aim that students can utilize and develop skills in using technology that prospective elementary school teachers should have. (Mustika, Miaz, et al., 2022). Technological knowledge is part of the Technological Pedagogical Content Knowledge (TPACK) conceptual framework proposed by Shulman and refined by Koehlers and Mishra (Mustika, Jamaris, et al., 2022; Voogt & McKenney, 2017). Technological Knowledge is related to mastery of technology, which is currently one of the competencies that teachers and prospective teachers must have. Technological knowledge leads to knowledge about a variety of technologies, both simple and digital, following the development of 21st-century learning. Technological knowledge indicators include the ability to install additional devices on a computer, create documents, or save documents (Malichatin, 2019). The most important component of technological knowledge is the ability to adapt and learn existing technology. (Fuada et al., 2020). The designed e-module is adjusted to the results of the needs analysis and then proceeds to the prototyping phase with the design research method.

The gap in this research stems from the widespread discussion of the 7E learning cycle model in science education in schools, and its incorporation into teaching materials such as worksheets or assessment sheets (Istuningsih et al., 2018; Komikesari et al., 2020; Utami & Manurung, 2024). However, there is no research that discusses the development of the 7e learning cycle model in the form of e-modules. In addition, there is also no research that specifically integrates technological knowledge into the development of e-modules. This integration is important to optimize the use of technology in the learning process. Therefore, this research is important to do in order to develop and evaluate the validity of science e-modules based on the 7e learning cycle model integrated with technological knowledge and then assess their impact on learning outcomes.

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METHOD

Research Method

The development research conducted refers to the Plomp development model, which consists of three phases: preliminary research, prototyping phase and assessment phase. This research is a continuation of the previous research stage, namely the preliminary research stage, to then proceed to the prototyping phase. The design of the prototype uses the design research method, which has a function to design (to design) or develop (to develop) with the aim of solving complex problems in the field of education (Ilahi et al., 2021). The prototype design stage aims to design several prototypes, evaluate prototypes, and make iterative revisions.

Research Instrument

The research instrument used was an expert review validation questionnaire aimed at assessing the prototype design that had been produced. The alternative answer choices on the instrument are "strongly disagree (SD) = 1", "disagree (D) = 2", "agree (A) = 3", and "strongly agree (SA) = 4". Prototype evaluation begins with a self-evaluation conducted by the researcher himself and continues with an expert review. Experts involved in this study include material experts assessing the feasibility of content, linguists assessing language, and media experts assessing presentation and graphics. The determination of expert review is determined based on the field of expertise of each expert.

Data Analysis Technique

The data analysis technique of the expert validation questionnaire uses a percentage technique:

$$average = \frac{total\ value\ weight}{total\ value\ maximum}\ x\ 100\%$$

The interpretation of the results of the validation questionnaire analysis can be seen in Table 1.

Table 1. Interpretation of the results of the validation questionnaire analysis

No	Total Score	Category
1	0 – 20	Invalid
2	21 – 40	Not valid enough
3	41 – 60	Enough Valid
4	61 – 80	Valid
5	81 - 100	Highly valid

RESULTS AND DISCUSSION

In this section, the results and discussion of the research activities that have been carried out in the prototyping phase are presented. The science e-module based on the 7E learning cycle model integrates technological knowledge that has been designed (prototype 1) is continued at the validation stage, which is divided into two steps, namely self-evaluation and expert review. The validation test aims to determine the validity of the product developed before it is used in learning. (Lestari & Parmiti, 2020). The results of the validation and revision of the prototype are described as follows.

1. *Self Evaluation* Result

Self evaluation is intended to self-assess prototype 1 before it is assessed by experts. Self evaluation is done in order to detect errors that occur when designing prototype 1 so that they can be revised again (Putra et al., 2017). The results of the self evaluation analysis can be seen in Table 2.

Table 2. Prototype 1 Self Evaluation Results

No	Aspect Evaluation	Description
1	Material in accordance with learning outcomes	Already
2	The substance of the material presented is good	Already

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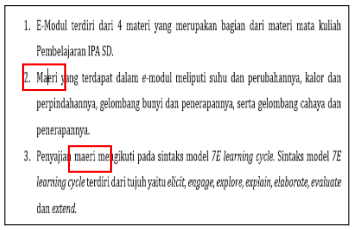
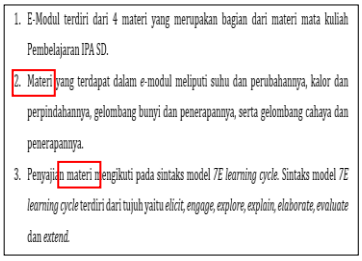
No	Aspect Evaluation	Description
3	Phenomena that are shared on Google classroom in the form of reading in accordance with the objectives of the elicit stage	Already
4	The learning videos observed for the problem identification process are in line with the objectives of the engage stage.	Already
5	Group discussion by utilizing a variety of online and offline learning resources according to the objectives of the explore stage.	Already
6	Presentation of the results of the group discussion report according to the objectives of the explain stage	Already
7	Proving concepts with simple experiments according to the objectives of the elaborate stage	Already
8	Self-assessment of the material learned according to the objectives of the evaluate stage	Already
9	Follow-up assignments that are collected on google classroom according to the objectives of the extend stage	Already
10	The language used is in accordance with the rules of good and correct Indonesian.	No, there are still mistakes in writing words
11	E-modules have a clear identity	No, the cover does not include the name of the course.
12	E-modules are presented systematically in accordance with the material	Already
13	E-modules are presented with complete information and instructions for use.	Already
14	The images and illustrations used are in accordance with the concept	Already
15	The design of the e-module display is attractive and in accordance with the concept.	Already

The results of the self-evaluation were used as input for the revision of prototype 1 which can be seen in Table 3.

Tabel 3. *Self-Evaluation Revision*

No	Findings	Before Revision	After Revision
1	Writing errors	 1. E-Modul terdiri dari 4 materi yang merupakan bagian dari materi mata kuliah Pembelajaran IPA SD. 2. Maeri yang terdapat dalam *e*-modul meliputi suhu dan perubahannya, kalor dan perpindahannya, gelombang bunyi dan penerapannya, serta gelombang cahaya dan penerapannya. 3. Penyajian maeri mengikuti pada sintaks model *7E learning cycle*. Sintaks model *7E learning cycle* terdiri dari tujuh yaitu *elicit, engage, explore, explain, elaborate, evaluate* dan *extend*.	 1. E-Modul terdiri dari 4 materi yang merupakan bagian dari materi mata kuliah Pembelajaran IPA SD. 2. Materi yang terdapat dalam *e*-modul meliputi suhu dan perubahannya, kalor dan perpindahannya, gelombang bunyi dan penerapannya, serta gelombang cahaya dan penerapannya. 3. Penyajian materi mengikuti pada sintaks model *7E learning cycle*. Sintaks model *7E learning cycle* terdiri dari tujuh yaitu *elicit, engage, explore, explain, elaborate, evaluate* dan *extend*.
2	The identity on the cover is not clear		

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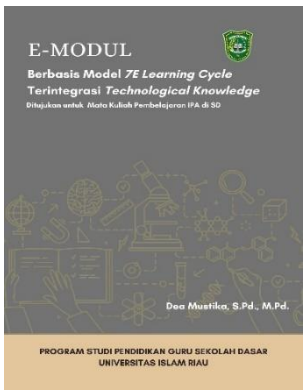
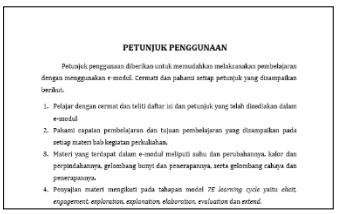
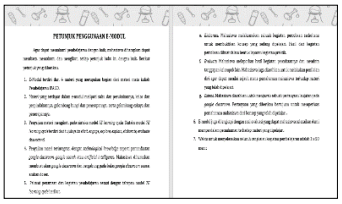
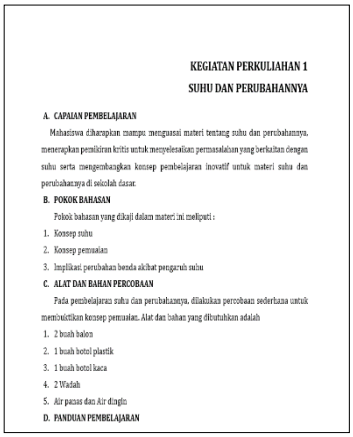
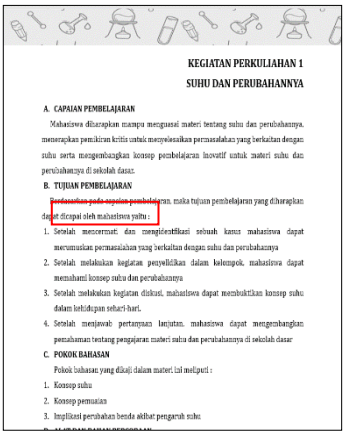
Based on Table 3, it can be seen that the revisions made include correcting word and sentence writing errors in the e-module, as well as revising the e-module cover by including the name of the course. The improved prototype 1 was then named prototype 2. Prototype 2 was followed by validation with competent experts (expert review).

2. *Expert Review* Result

Expert validation involved three experts who assessed aspects of content, language, presentation, and graphical feasibility. Validation involving experts is carried out with the aim of obtaining input and suggestions for improving the e-module that has been designed(Ula & Fadila, 2018). The assessment from the validator is also a reference to determine the validity of the e-module that has been developed (Violadini & Mustika, 2020). During the validation stage, prototype 2 was revised according to the suggestions given by the validators. The results of the e-module revision can be seen in Table 4.

Table 4. Revision according to Expert Review Suggestions

No	Suggestion	Revision	
		Before Revision	After Revision
1	The illustration on the cover was removed, and the type of writing on the cover was replaced with a clearer one.		
2	The identity of the e-module on the cover is clarified.		
3	On the cover the author's name is placed at the bottom		
4	Instructions for use should be clarified for easy understanding		
5	Add attractive headers and footers on each page of the e-module.		
6	After learning outcomes, add learning objectives		

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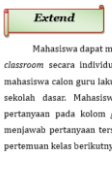
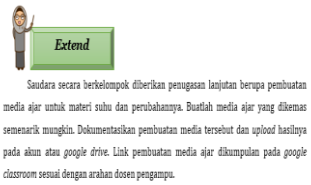
No	Suggestion	Revision	
		Before Revision	After Revision
7	Readings and learning videos for "elicit stage" and "engage stage" activities should be separated.		
8	The "extend stage" learning activities should be designed in the form of a project.		

Based on Table 4, it can be observed that the e-module improvements, according to the validator's suggestions, include (a) improving the cover, (b) clarifying the instructions for using the e-module, (c) adding headers and footers, and (d) improving the learning activities at the elicit, engage, and extend stages. At the end, the validator gave a score by filling out the validation questionnaire instrument. The results of the validator's assessment of prototype 2 can be seen in Table 5.

Table 5. Material Expert Assessment Results

No	Statement	Evaluation			
		SD 1	D 2	A 3	SA 4
1	Material is appropriate to learning outcomes			√	
2	The material presented is in accordance with student needs			√	
3	The activities in the e-module are in accordance with learning needs				√
4	The substance of the material presented is good and easy to understand			√	
Activities refer to the 7E LC model stages of integrated technological knowledge					
5	The phenomenon shared on Google Classroom is in the form of reading in accordance with the objectives of the "elicit stage"			√	
6	Observed learning videos for the problem identification process in accordance with the objectives of the "engage stage"			√	
7	Group discussions using a variety of online and offline learning resources according to the objectives of the "explore stage"				√
8	Presentation of group discussion report results according to the objectives of the "explain stage"				√
9	Proof of concept with simple experiments according to the objectives of the "elaborate stage"			√	

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No	Statement	Evaluation			
		SD 1	D 2	A 3	SA 4
10	Self-assessment of the material studied according to the objectives of the "evaluate stage"			√	
11	Follow-up questions given on Google Classroom according to the objectives of the "extend stage"			√	
	Average		81%		

Table 5 is an assessment of material experts who obtained an average score of 81% in the very valid category. Prototype 2 is considered to be in accordance with the learning outcomes and student needs and has led to the stages of the 7E learning cycle model being integrated with technological knowledge. Learning stages using the 7E learning cycle model can help create an interesting learning environment, increase curiosity and interest in learning, and help students find learning connections to the context of everyday life (Amini & Usmeldi, 2020; Mustika et al., 2023). In addition, the integration of technological knowledge understands and masters technology because this ability is needed by prospective teacher students to prepare themselves for future learning challenge (Mustika, Jamaris, et al., 2022).

Table 6. Linguist Expert Assessment Results

No	Statement	Evaluation			
		SD 1	D 2	A 3	SA 4
1	The language used is in accordance with the rules of good and correct Indonesian.				√
2	The user instructions information on the e-module is clear.			√	
3	The language used is simple, straightforward and easy to understand.			√	
4	The language used is communicative and interactive				√
	Average		88%		

Table 6 is an assessment from linguists with an average score of 85%, a very valid category. Prototype 2 has used appropriate language with easy-to-understand delivery and contains clear information. E modules are designed with simple language to ensure that the material presented can be understood by all students who have different levels of understanding (Simamora et al., 2019). The use of appropriate language makes it easier for students to learn independently, so they tend to be actively involved during the learning process.

Table 7. Media Expert Assessment Results

No	Statement	Evaluation			
		SD 1	D 2	A 3	SA 4
A.	Presentation				
1	E-modules have a clear identity.				√
2	The content of the e-module has a clear purpose.			√	
3	E-modules are presented systematically according to the material.				√
4	The e-module is presented with complete information and instructions for use.			√	
B.	Graphics				
5	The type of font used is appropriate and attractive.				√
6	The images and illustrations used are in accordance with the concept.			√	
7	The e-module display design is attractive and in accordance with the concept.			√	

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8	The cover appearance of the e-module is attractive.	√
	Average	84%

Table 7 is an assessment from media experts with an average score of 84%, which is very valid. Prototype 2 is considered appropriate from both the presentation and graphical aspects. The images presented in the e-module help in visualizing concepts that are difficult to explain only with words. Students can understand the information better through the images presented. Overall, the average score of the three validators was 84.3 in the very valid category. Based on the results of the validator's assessment, the e-module.

The findings of this study support the findings of previous research (Kurniawan Dwi et al., 2018), which explains that a valid e-module must be able to achieve learning objectives and have a description of the material with clear learning stages to make it easier for students to understand. The results showed that the e-model was in the good and very good categories. E-modules that have been tested for validity can then be tested to determine the practicality of the e-modules developed. In addition, (Mardia & Sundara, 2020) also explained that e-modules are teaching materials that can be used in lectures independently by students with the guidance of lecturers. Valid e-modules have a language order that is easy to read and understand and pay attention to the suitability of the appearance, starting from the cover, color selection, content layout, and placement of visual images. The results showed that, from the expert assessment, the e-module was in the valid category of language, content, and material. Thus, it can be stated that the science e-module based on the 7e learning cycle model integrated with technological knowledge is in the valid category and is suitable for continuing with the testing stage.

CONCLUSIONS AND RECOMMENDATION

The validity test of the science e-module based on the 7E learning cycle model integrated with technological knowledge begins with the self-evaluation test. The results of the self-evaluation test found that there were still shortcomings in the e-module. After the e-module was revised, it was continued with an expert review consisting of three expert validators, including material experts, language experts, and media experts. The e-module was revised according to the suggestions made by the validators. The validator then gave an assessment by filling out an expert validation questionnaire. The final results of the three-aspect assessment obtained an average of 84.3% in the very valid category. It is concluded that the e-module that has been designed is valid and feasible to proceed to the practicality and effectiveness test stages.

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