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The Validity E-Module Science based on Computational Thinking Approach to Improve Logical Thinking Skills

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Abstract:- This study aims to produce a Computational Thinking-based Science e-module to improve students'logical thinking skills. This development research uses the ADDIE development model, including Analysis, Design, Development, Implementation, and Evaluation. Data collection uses e-module validation instruments, teacher and student response questionnaires, and logical thinking ability tests. The results of the study show that the IPA e-module based on computational thinking is valid, because the e-module validation results meet the valid requirements. Thinking computation-based science e-modules are practical because the teacher and student response questionnaires are in the very practical category. In addition, the logical thinking ability test instrument is effective because: (1) students' logical thinking skills in limited trials and large-scale trials usually increase, while the n-gain values in limited trials and large-scale trials are respectively 0, 73 and 0.77 with the high category. Thus the thinking computation-based science e-module which is developed is feasible to improve logical thinking skills in science learning.

Keywords:- *Creative Problem Solving, Newton's laws on Gravity, Problem-Solving Skills, Teaching Materials.*

I. INTRODUCTION

The 2013 curriculum places emphasis on character education to face the challenges of the 21st century which focuses on life skills with its 4Cs, namely Creativity, Communication, Critical Thinking, and Collaboration (Sa'ddiyah et al., 2021). In the 2013 curriculum, it is explained that there are changes to content standards, namely the emergence of core competencies that must be implemented in every lesson, including science learning, which consists of four (4) parts, namely spiritual attitu.des, social attitudes, knowledge and skills (Sugihartini et al, 2017). Application includes planning, implementation and evaluation.

In government regulation No. 65 of 2013, the learning process in educational units is carried out in an interactive, inspiring, fun, challenging and motivating way for students to participate actively. This can be done by providing sufficient space for students to be able to develop creativity and independence in accordance with the students' talents, interests, physical and psychological development. Therefore, the role of a teacher is very necessary to be able to play an active role in designing learning media that is tailored to the needs in this era of industrial revolution 4.0.

In keeping with the times, there will always be updates in the learning process. Currently, technological developments have made digital device users dominate and their influence on the world of education cannot be avoided (Rahmawari, 2021). Basically, education encourages humans to develop their potential so that they are able to face every change that occurs due to advances in science and technology (Dwikristanto et al, 2022).

Technological advances that have occurred in the 21st century in the era of industrial revolution 4.0 have made critical thinking, creativity, communication and collaboration the main competencies to face the challenges of a rapidly changing world, requiring the ability to think logically and systematically to solve them (Buitrago, 2021) . With the Computational Thinking Approach, students can be directed to have the ability to think logically, mathematically, mechanically, combined with modern knowledge about technology and digitalization (Ansori, 2020). Therefore, students must be equipped with Computational Thinking Skills.

In 2011, Wing expanded the definition, stating that computational thinking is the thought process required in formulating problems and solutions, so that these solutions can become effective information processing agents in solving problems. Conceptually, there are 4 pillars in Computational Thinking: (1) decomposition is reducing a problem or complex system into smaller and more manageable parts, (2) pattern recognition is looking for similarities or patterns contained in the problem, (3) abstraction is focusing on only important information and ignoring other information that is less relevant, and (4) algorithm is determining step by step solutions to overcome problems or procedures that must be carried out to solve problems (Kamil, 2021; Azmi & Ummah, 2021). The computational thinking approach can not only be used in developing computer applications, but can also be applied in all scientific disciplines. One of them is in Natural Sciences, where people who have this ability can more easily solve complex problems (Sari et al., 2022).

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An absolute requirement for achieving success in science learning is understanding concepts, because most science learning is a science that involves studying natural phenomena and their mechanisms which are based on reality and require proof to gain understanding and mastery of concepts. Therefore, the ability to think logically plays a very important role in understanding and learning concepts in science to obtain better achievements for students (Purwanto, 2012).

Students need logical thinking skills when they want to explain why and how a result was obtained, when solving problems, and when drawing conclusions. It is important for every student to have it because from here they gain mental discipline and learn to determine whether their train of thought is correct or not (Octaria, 2017; Wulandari & Fatmahanik, 2020). Based on this, it is very important that educators can apply learning that not only guides students to master the material but also guides them to the ability to think logically.

In general, students' low logical thinking abilities can be caused by several factors, namely (1) inappropriate learning and use of media; (2) learning at school tends to be very theoretical and not related to the students' environment; and (3) there are still many educators who do not utilize the environment as a learning resource (Sari & Hoiriyah, 2020).

Based on a preliminary study conducted by researchers in learning Natural Sciences (IPA) at MTs. Raudhatul Jannah Kotabaru knows that students' logical thinking abilities are still not well directed and are only slightly visible. This is reinforced by test data on students' logical thinking abilities in learning Natural Sciences (IPA) during pre-research observations. The test results showed that 59.375% of the 32 students did not achieve a completeness score, which means that students' mastery in science learning, especially in their logical thinking abilities, could be declared weak. At the time of the researcher's observations, during the learning process there were still many students who tended to imitate and memorize the learning material and did not try to understand it. Students are not encouraged to explore their knowledge of the material being studied, this is because the presentation of Natural Sciences (IPA) material does not yet take the form of problems that can provide encouragement to students to be able to solve problems towards a conclusion in stages.

The results of this research are also in line with previous research which stated that students' logical thinking abilities were still in the low category. This is because students' abilities in the communication aspect, thinking aspect and application aspect are still low in strengthening arguments based on basic thinking. Although the level of difficulty of the questions given by the teacher has been adjusted to the level of students' abilities, namely, difficult, medium and easy. However, in the process, there are still many students who get low grades and need to improve their logical thinking skills in the learning process (Anggraini and Irawan, 2021; Swestyani et al., 2015). Thus, efforts are needed to improve students' logical thinking abilities in science learning.

Factors that make students not active in exploring knowledge and do not have their own initiative in learning are the presentation of material, and the lack of provision of teaching materials that suit the needs and conditions of students in this era of very rapid technological development (Linda , et al., 2021). One teaching material that can be used is by using e-modules. In reality, during the learning process, the teaching materials used are predominantly textbooks or regular printed modules, where printed modules are less practical to carry everywhere because they are relatively large and heavy, not equipped with audio and video in them, only There are only graphic illustrations, and do not have a big influence on students being able to learn independently.

One of the media that should be used in this era of digitalization is an Electronic Module (E-Module). E-module is the development of printed modules in digital form using certain devices such as computers and Android which are packaged more interactively, and in which there are teaching materials designed in a structured manner according to the curriculum used (Lestari & Parmiti, 2020; Puspita et al., 2021). The advantages of using e-modules in the learning process are that they are more practical to carry anywhere, production costs are cheaper, the presentation can be equipped with audio, animation and video, which can make it easier for students to orient learning material to problems, organize students for independent learning, guide individual or group investigation (Sugihartini & Jayanta, 2017).

Based on this, researchers are interested in developing e-modules based on computational thinking so that students feel that science is useful in everyday life, and the hope of this research is that students' logical thinking abilities in science learning will increase. Therefore, to overcome this problem, steps are needed to be taken by developing an E-Module based on a Computational Thinking approach to improve students' logical thinking abilities. Using a computational thinking approach will create human qualities that can keep up with the current pace of technological development.

II. METHOD

The type of research used is research and development (R&D). The model used is the ADDIE (Analyze, Design, Development, Implementation, and Evaluation) model. The trial design in this study is a one-group pretest-posttest design. The explanation of the research steps is presented in Table 1.

This research was conducted at MTS Raudatul Jannah Kotabaru. The test subjects in the study were 32 students. The subject of the study was teaching material for Energy for Live through computational thinking approach to improve logical thinking. The instruments used consist of instruments of validity of teaching materials. The validity

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assessment instrument aims to determine the validity of the teaching material based on the results of the validator's assessment.

Data collection techniques are carried out through validity assessments. The validity assessment is carried out by two academics and one practitioner in the field of physics. Assessment of validity by putting a tick on the column of the grading scale for each aspect with a scale range of 1 to 4. Data analysis was carried out by averaging the total score for each aspect assessed and the results were adjusted to the criteria in Table 2.

Table 1. Explanation of the Stages of Teaching Material Development with the ADDIE Model

Development Steps	Activity
Analyze	Analysis of existing products and needs in the field, analysis of the curriculum, analysis of material characteristics.
Design	The teaching materials are designed to contain logical thinking skills and are arranged based on a computational thinking.
Development	Activities in this, researchers develop teaching materials based on development design.
Implementation	The products that have been developed are applied to real situations, namely in teaching and learning activities.
Evaluation	The evaluation stage is divided into two, namely, formative and summative.

The validation result data is calculated with the average total score for each aspect assessed and the results are adjusted to the criteria in Table 2.

Table 2. Criteria for Aspects of Validity of Teaching Materials

NA Percentage (%)	Qualification
85< NA≤100	Very Valid
70< NA≤85	Valid
55< NA≤70	Fairly Valid
40< NA≤55	Less Valid
0< NA≤40	Invalid

Adapted from (Widoyoko, 2017)

III. DISCUSSION

The validity of the computational thinking-based science e-module in this research as a whole is categorized as valid and can be used with revision. Some scores achieved in each aspect are classified as very valid, and some are classified as valid. The validator gave good marks and provided suggestions/input for improving the e-module, including improving the front cover, improving the foreword, adjusting the color contrast of the e-module so that it is more clearly visible, and enlarging the font.

The e-module developed has been adapted to the e-module preparation guidelines. The e-module cover page is equipped with images related to the topic of energy in living systems. The final part of this e-module is equipped with a formative test to determine understanding of the topics studied and to measure students' logical thinking abilities.

The e-module development process pays attention to the characteristics that an e-module must have, namely self-instructional, self contained, stand alone, adaptive, user friendly, consistent, delivered using electronic media, utilizing various electronic media functions, utilizing various application features, and needs to be designed carefully. The e-module includes components in computational thinking which are expected to improve students' logical thinking abilities.

Table 3. Results of Validity of E-Modul

No	Assessment Aspect	Validator					Average	%	Information
		V1	V2	V3	V4	V5			
1.	Content Eligibility	4.00	4.37	4.00	5.00	3.62	4.20	84.00	Valid
2.	Language	4.57	4.28	3.85	5.00	3.28	4.20	84.00	Valid
3.	Sajian	4.28	4.14	3.71	4.85	3.28	4.06	81.14	Valid
4.	Graphics	4.10	4.10	3.70	4.60	3.60	4.02	80.40	Valid
5.	User convenience	4.67	4.67	4.00	4.83	3.83	4.40	88.00	Very Valid
6.	Consistency	4.00	4.00	4.00	4.33	3.33	3.93	78.67	Valid
7.	Format	4.50	5.00	3.50	5.00	4.00	4.40	88.00	Very Valid
8.	Design view	4.00	3.67	3.00	4.00	3.33	3.60	72.00	Valid
9.	Usefulness	4.00	4.33	3.67	5.00	4.00	4.20	84.00	Valid
	Average							82.24	Valid

Table 3 shows that the validation results of the science e-module based on computational thinking by 5 validators in the valid category. In terms of format and ease of use, the e-module is categorized as very valid. This shows that the e-module being developed really pays attention to the format used in the e-module. One thing that must be considered is what device will be used when students use the e-module (Susiana, et al. 2017). This science e-module based on computational thinking adapts the e-module format which can be opened via smartphone and laptop, designed in such a way that students are not confused when using it. The user-friendliness aspect in the very valid category shows that computational thinking-based science e-modules make it easier for students to access learning and make it easier for teachers to communicate learning more effectively in a timely manner.

In the usefulness aspect, it is categorized as valid. This shows that science e-modules based on computational thinking can provide great benefits to students, namely as a solution to be able to use technology wisely, explore interesting, interactive learning resources, and answer curiosity so that they can increase learning motivation and improve learning. the ability to think in accordance with the objectives of the e-module being developed.

IV. CONCLUSION

Based on the results of research and development, it can be concluded that the e-modul science based on computational thinking approach is declared valid to be given to students as a learning resource, especially in improving locgical thinking.

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