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Needs Analysis of Physics E-Modules Based on Dual Space Inquiry Framework to Stimulate Students' Creative Thinking Ability on Static Fluid Material

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ABSTRACT

In order to encourage students' creative thinking regarding static fluid material, this study aims to assess the need for physics e-modules based on the Dual Space Inquiry framework. This research employs a development (R&D) methodology using the Dick and Carey instructional design model. Descriptive quantitative data analysis was used in the study. The results showed that students' creative thinking abilities were still categorized as low, with an average percentage of 24.22%. Observations revealed that the learning approach used had not effectively encouraged students' creative thinking, and that teachers were still relying on print-based instructional resources. Furthermore, based on a questionnaire completed by students, static fluid was identified as a topic that is difficult for them to understand. In light of these issues, there is a need for teaching materials that are both technology-based and capable of stimulating students' creative thinking skills. Therefore, the researchers propose a physics e-module based on the Dual Space Inquiry framework as a solution to enhance students' creative thinking in learning static fluid material.

Keywords: E-Module, Dual Space Inquiry Framework, Creative Thinking Ability, Static Fluid.

I. INTRODUCTION

In the 21st century learning era, the utilization of Technology, Information and Communication (ICT) in education is a necessity that cannot be ignored. Technological advances have changed the learning paradigm from conventional methods to more innovative, interactive and digital-based approaches. These developments are the impact of the development of science and one of the aspects that influence it is education. Those involved in education must be able to keep pace and follow these technological advances [1] . ICT utilization in education has four levels, namely *emerging*, *applying*, *infusing* and *transforming* [2] . ICT utilization at the *emerging* level is at the initial level, at the *applying* level is the belief about the role of ICT in improving the quality and quantity in schools, at the *infusing* stage, which requires efforts to integrate and incorporate ICT into the curriculum, and at the *transforming* stage, which has efforts to plan and renew the school governance system in a more diverse, characteristic and unique way. In physics education, particularly in teaching static fluid concepts, traditional lecture-based methods often make it difficult for students to engage actively and develop higher-order thinking skills. This challenge highlights the need to integrate ICT at higher levels moving beyond merely applying technology toward infusing it into the curriculum and transforming classroom practices. One promising approach is the development of a static fluid e-module based on the Dual Space Inquiry Framework, which aims to stimulate students' creative thinking through structured inquiry phases and interactive digital content.

In line with the growing trend of ICT in learning, where technology-based learning cannot be separated from the demands of 21st century learning. In the 21st century, students are required to have the ability to obtain, select and manage information to be utilized in everyday life. One of the abilities that must be possessed by Indonesian people in facing the 21st century is the ability to think creatively [3] . The ability to think creatively is important to be developed early, because it is expected to be a provision in dealing with life problems [4]. Creative thinking skills can be developed by implementing inquiry learning, which encourages students to seek and find answers to the problems given, so that students play an active role in the learning process [5] . In line with that, all activities carried out by students are directed to seek and find their own

answers to something that is questioned so that it can foster an attitude of confidence and creativity in conveying a new idea. Thus, the implementation of the inquiry learning model plays an important role in improving students' creative thinking skills.

The government has made various efforts to improve the quality of education, one of which is by improving the curriculum. The curriculum is not only seen as an ordinary document, but is an important document that makes education better to achieve the goals of national education, how to achieve this education if the educators still do not fully understand the curriculum that is being used now [6] . Therefore, educators must understand more about the curriculum that is being used now for a good teaching and learning process to achieve the desired learning objectives [7] . Efforts that teachers can make in overcoming this problem are to choose the right teaching materials and in accordance with the learning objectives in the learning process. Therefore, there is a need for innovation in learning activities, especially physics subjects in class [8] . The innovation can be in the form of selecting teaching materials that are able to accommodate students' creative thinking skills.

The ability to think creatively is important to develop from an early age, because it is expected to be a provision in dealing with life problems [4] . Creative thinking is a person's proficiency in analyzing new information, and combining unique ideas or ideas to solve a problem [9] . Creative thinking requires a child to have a variety of answers, have the ability to master a problem concept, convey ideas or ideas on a problem topic [10] . In line with opinion Pane et al [11] creative thinking is a mental activity related to sensitivity to problems, considering new information and unusual ideas with an open mind, and can make connections in solving the problem. From the above opinions, it can be defined that the ability to think creatively is the ability to provide new ideas by thinking and realizing their imagination. Creative thinking skills are also a means to achieve educational goals, namely for students to be able to solve high-level problems [12] . Therefore, this creative thinking ability needs to be developed in line with current technological developments.

Based on the distribution of questionnaires given to 24 students to see students' responses to physics learning, it is found that static fluid is one of the materials that is difficult for students to understand. In static fluid learning, students are expected to think and reason in mastering concepts to apply in everyday life. This is in accordance with the basic competencies, namely applying the laws of static fluid in everyday life. Therefore, learning in this material is not enough only through the delivery of theory, but also needs to be complemented with experimental activities.

Physics learning in the current era is learning that is balanced between the use of technology and the scientific approach. This approach requires a learning design that can accommodate both aspects. Learning design that can accommodate both aspects is *dual space inquiry*. This *dual space inquiry* integrates physical space and digital space simultaneously which allows students to explore physics concepts through direct experimentation and technology-based research [13] . Therefore, this learning design is able to improve creative thinking skills in line with technological developments and also apply inquiry learning.

Based on the above problems, teaching materials are needed that are able to improve students' creative thinking skills with innovative approaches and are relevant to the 21st century. The teaching materials must be technology-based so that they can facilitate interactive and flexible learning. In line with that, the teaching materials developed also apply the inquiry model, so that students are more active in the process of exploration, problem solving and independent discovery of concepts that can optimally develop students' creative thinking skills. One of the teaching materials that can improve creative thinking skills and is relevant to the 21st century is e-modules. In this research, the e-module in question is an e-module that is assisted by *Google Sites*.

E-modules are learning tools or means that contain material, methods, limitations and ways of evaluating that are systematically designed and attractive to achieve the expected competencies according to the level of complexity electronically [14]. The advantages compared to printed modules are that they are interactive, facilitate navigation, allow displaying/loading images, audio, video and animation and are equipped with formative tests/quizzes that allow automatic feedback immediately [15] . The purpose of *web google sites* is to help and facilitate students in the learning process and attract students to make learning more creative, innovative and efficient. One of the advantages of *google sites* is its ability to provide a variety of features that allow teachers to combine various elements such as trks, images, video and audio in one place, creating a more interesting and diverse learning environment. Therefore, these features can make students more active and able to increase their creative thinking skills.

Some previous studies support the urgency and potential of developing e-modules to improve creative thinking skills based on innovative approaches, showing that the results are not optimal. Based on research conducted by Hidayat (2023) states that the level of students' creative thinking skills is still not optimal, this is influenced by the learning model applied by the teacher in the learning process that is not effective [16]. Furthermore, research conducted by Armandita (2018) which states that students' creative thinking skills are still classified as moderate [17]. In line with that, research conducted by Yolanda (2021) said that the creative thinking skills of students in Indonesia are still lacking and students' creative thinking skills are not well

developed [18]. This happens because learning is still oriented towards teaching materials that are less interactive and learning still uses the lecture method. The results of this study indicate that creative thinking skills are still relatively low and need to be improved.

The e-module developed is based on *dual space inquiry framework* that aims to improve students' creative thinking skills. *Dual Space Inquiry Framework* (DSIF) is a learning concept designed to facilitate flexible learning in physics learning [13] . This framework is designed based on the characteristics of blended learning in the context of physics education. DSIF is a learning concept that utilizes the potential of physical and virtual spaces to facilitate inquiry-based learning. Physical space in DSIF refers to inquiry classrooms, while online space includes space on digital platforms. DSIF emphasizes the integration of digital technology throughout the learning process, facilitates diverse learning styles, and facilitates collaborative learning so that learners become more active and creative.

The formulation of the problem in this study is how to analyze the needs of physics e-modules based on *dual space inquiry framework* to stimulate students' creative thinking skills in static fluid material with the research objective, namely to analyze the needs of physics e-modules based on *dual space inquiry framework* to stimulate students' creative thinking skills in static fluid material.

II. METHOD

This study is a type of development research, also known as Research and Development (R&D). Development research refers to the process of creating new products or improving existing ones. The products developed may include student worksheets (LKPD), books, modules (printed or electronic), teaching materials, and more. To enhance students' creative thinking skills related to static fluid concepts, this study aims to design a physics e-module based on the Dual Space Inquiry Framework.

This research adopts the Dick and Carey instructional design model. This model employs a procedural and systematic approach, emphasizing that the application of instructional design should follow a sequence of well-defined steps Dick and Carey (2015) [19]. Each step in the Dick and Carey model has a clear purpose and is interrelated with the others. The following is a diagram illustrating the development stages based on the Dick and Carey model.

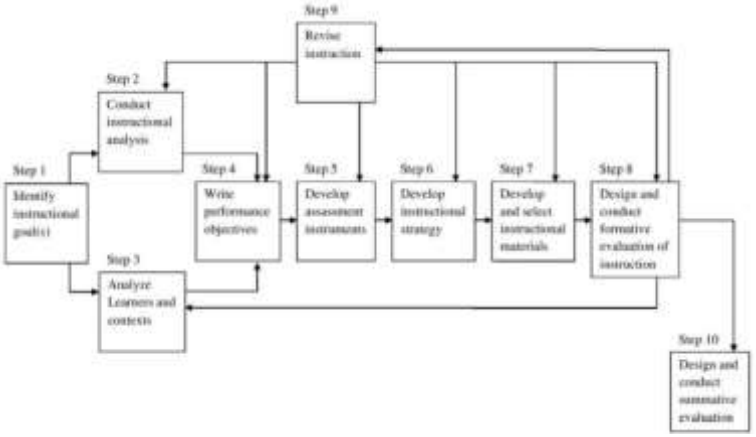

Fig. 1. Schematic of the Stages of the Dick and Carey Model

The subjects of this research were Class XI Phase F physics students at SMAS Semen Padang. The focus of the study is a physics e-module based on the Dual Space Inquiry Framework, aimed at enhancing students' creative thinking abilities. This study employed a quantitative descriptive approach for data analysis. Descriptive statistics were used to process and interpret the collected data in its original form, providing a clear picture of the existing conditions. The data were obtained using specific research instruments. The instruments used in this study included needs analysis sheets and creative thinking ability test sheets. These tools were designed to gather data that would support further research and development of the e-module. Data from the creative thinking ability tests were categorized according to each indicator of creative thinking, based on the framework proposed by Munandar (2012) [20]. The final index for each creative thinking indicator was then calculated. The following is the formula used to calculate the index for each indicator:

$$\%\ creative\ thinking\ skills = \frac{score\ obtained}{maximum\ score} \times 100 \qquad (1)$$

Table 1. Creative thinking ability categories

Total score range (%)	Creative thinking category
81-100	Very creative
61-80	Creative
41-60	Creative enough
21-40	Less creative
0-20	Not creative

Ref. [9]

III. RESULTS AND DISCUSSION

Based on preliminary research conducted at SMAS Semen Padang in grade XI phase F, it was found that students' creative thinking skills in physics learning were still relatively low and did not reflect the expected conditions. This was indicated by the results of a descriptive test consisting of eight questions arranged based on creative thinking indicators and focused on statistical fluid material. This instrument was adapted from the research of Syadza (2024) which has been tested for validity and reliability, so it is suitable for use to measure students' creative thinking abilities [21]. The results of the test showed that the average creative thinking ability of students only reached 24.22%, which is included in the less creative category.

A closer look at Munandar's four indicators of creative thinking fluency, flexibility, originality, and elaboration shows weaknesses across all aspects. In the fluency indicator, students demonstrated difficulty generating multiple ideas, as evidenced by repetitive and minimally varied answers. The flexibility indicator was also low, as students tended to use the same approach to problem-solving without considering alternatives. Originality appeared to be lacking, as most student answers were general and lacked unique ideas. Meanwhile, in the elaboration indicator, students were less able to develop ideas in depth, as evidenced by brief and indetailed explanations.

This low level of creative thinking ability is inextricably linked to the learning environment, which is still dominated by conventional approaches. Observations show that physics learning in the classroom is still teacher-centered, employing lecture methods and the use of print-based media. Students are not actively involved in the thinking process and are not given sufficient space to explore ideas or conduct independent investigations. Student motivation also appears low, and student interaction in discussions or problem-solving has not developed optimally. These findings are supported by previous research showing that inquiry-based learning and technology can foster the development of higher-order thinking skills. Nugraheni et al. (2021) emphasized that without an innovative approach, physics learning tends to be reduced to mere memorization of concepts and fails to develop students' creativity [22]. In more detail the results of the student creative thinking ability test according to the creative thinking indicators can be seen in table 2.

Table 2. Students' creative thinking ability test results

Creative Thinking Ability Indicator	Percentage	Category
Fluency	31,25	Less creative
Flexibility	25	Less creative
Originality	25	Less creative
Elaboration	15,63	Not creative

Based on table 2, it can be seen the percentage of students' creative thinking skills on each indicator. In the table above, it can be seen that the fluency indicator has a high percentage and the *elaboration* indicator has the lowest percentage. So it can be concluded that students' creative thinking skills are still classified as less creative.

Related to creative thinking skills, some research shows that the results are not optimal. Based on research conducted by Hidayat (2023) states that the level of students' creative thinking skills is still not optimal, this is influenced by the learning model applied by the teacher in the learning process that is not effective [16]. Furthermore, research conducted by Armandita (2018) which states that students' creative thinking skills are still classified as moderate [17]. In line with that, research conducted by Yolanda (2021) said that the creative thinking skills of students in Indonesia are still lacking and students' creative thinking skills are not well developed [18]. This happens because learning is still oriented towards teaching materials that are less interactive and learning still uses the lecture method. The results of this study indicate that creative thinking skills are still relatively low and need to be improved.

The second problem is a problem related to the teaching materials used, which are not in accordance with the indicators of creative thinking skills. This can be seen from the observations made. Based on the observations made, it can be seen that the teaching materials used by teachers consist of printed books from publishers, modules and LKPD. The three teaching materials are still not in accordance with the criteria for creative thinking skills. Whereas physics subjects contain a fairly wide range of material. In addition, there are still teachers who have not fully implemented the steps of innovative learning models, which can lead to decreased student motivation and involvement in the learning process.

This problem is in line with the research findings of Haspen, Syafriani, and Ramli (2021) developing guided inquiry-based physics e-modules for dynamic electricity material, proven to be valid and effective in increasing student creativity because the modules are arranged following the steps of creative thinking [23]. In line with that, Ratnawati et al (2023) presented an interactive e-module based on Google Sites for static and dynamic electricity materials [24]. This module was validated (78%) and proven to increase the n-Gain of students' creative thinking skills from moderate to high categories.

The third problem is that the teaching materials used still do not fully apply technology, this can be seen from the questionnaire filled out by the teacher. Based on the questionnaire, teachers still use printed teaching materials. In the current digital era ICT plays an important role in physics learning. However, teaching materials used in schools for physics learning still do not fully utilize technology. Plus students are allowed to bring *cell phones* to school. As a result, students' attention to learning becomes unfocused because teachers still use teaching materials that have not been assisted by technology and do not attract students' attention.

Empirical support for this problem is shown by Taufik Solihudin's research [25] , which developed a web-based e-module for static and dynamic electricity. The e-module was designed using the ADDIE model and validated by material experts (82.8%) and multimedia experts (78.1%), with teacher (85.7%) and student (80.2%) responses showing a "very good" assessment. More importantly, the pre-test and post-test showed an increase in N-Gain value of 0.84 for static electricity and 0.87 for dynamic electricity. These results show that the web-based e-module is not only feasible and practical, but also able to increase knowledge attainment as well as student attraction compared to printed teaching materials.

Based on the distribution of questionnaires given to 24 students to see students' responses to physics learning, it is found that static fluid is one of the materials that is difficult for students to understand. In static fluid learning, students are expected to think and reason in mastering concepts to apply in everyday life. This is in accordance with the basic competencies, namely applying the laws of static fluid in everyday life. Therefore, learning in this material is not enough only through the delivery of theory, but also needs to be complemented with experimental activities.

Based on the results of the needs analysis, physics e-modules based on the *Dual Space Inquiry Framework* proved to play an important role in creating learning experiences that facilitate students' creative thinking processes. This e-module contains a series of activities that combine physical and virtual thinking spaces, so that students not only understand the material theoretically, but are also encouraged to produce solutions to the contextual problems given. This confirms that physics learning can be facilitated effectively through a structured yet flexible approach, as developed in the *dual space* framework.

Theoretically, this e-module contributes to the development of teaching tools that combine cognitive and constructivist approaches. This approach is relevant to meet the challenges of the Merdeka Curriculum, which demands contextual, differentiative, and oriented learning to strengthen higher-level thinking skills. This finding contributes to enriching the repertoire of physics learning media that is digitally based but still deep in thought process.

IV. CONCLUSION

Based on the results of the needs analysis conducted through literature studies, observations, and questionnaires to teachers and students, information was obtained that physics learning, especially in static fluid material, still faces various obstacles, namely students' creative thinking skills are still classified as less creative, the teaching materials used are not technology-based and have not been able to stimulate creative thinking skills. The majority of teachers and students stated that the materials used so far have not been sufficient to encourage the exploration of ideas and innovative problem solving.

The results of the needs analysis of the use of physics e-modules based on the *Dual Space Inquiry Framework* show that this teaching material is able to provide an effective learning experience in stimulating students' creative thinking skills in static fluid material. This e-module is designed not only to convey information, but also to provide space for students to build conceptual understanding independently, while encouraging them to explore various approaches in solving real problems relevant to everyday life. This finding

answers the main research question, namely whether e-modules with a two-space inquiry approach can encourage the development of students' thinking creativity in understanding abstract physics material.

Students using this e-module showed active engagement in the learning process as they were presented with explorative activities that combined concept understanding with application through case studies. Their creative thinking skills were stimulated through activities that encouraged them to ask questions, develop ideas and develop solutions from various perspectives. Teachers also said that this module helped them create a more open and challenging learning atmosphere for students, and in accordance with the demands of the 21st century competency strengthening-based curriculum.

The uniqueness of this e-module lies in the application of the *Dual Space Inquiry Framework*, which is different from the usual inquiry-based learning approach. This module emphasizes the importance of developing two thinking spaces: physical space and virtual space. Combining these two spaces in a series of learning activities results in a more thorough and in-depth learning process, which has not been found in previous physics learning modules.

Thus, it can be concluded that the physics e-module based on the *Dual Space Inquiry Framework* has innovative potential to be a teaching material that is not only informative but also transformative. The advantages of this module are not only in its digital format and visualization, but in its structure that supports the development of creative thinking as part of meaningful learning. This research makes an important contribution to the development of technology-based physics teaching tools and pedagogical approaches that are more complex and in accordance with current learning needs. In the future, this e-module has the potential to be developed on other materials in physics and other fields of science that demand in-depth understanding and higher order thinking skills.

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