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The Effectiveness of E-Module in Improving Critical Thinking Skills of High School Students in Learning Physics

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Abstract: This paper was written to explain the influence or effectiveness of digital modules or physics e-modules in their contribution to improving the critical thinking skills of high school students or their equivalent. The descriptive qualitative study method is used to achieve the purpose of this paper. By using highly reputable international and national journals as references in the preparation of this paper. During this pandemic educator are required to design learning concepts and tools that can improve critical thinking skills, because critical thinking is a basic ability that must be possessed in the 21st century. From this paper it results that the use of e-modules in physics learning is very effective in improving students' critical thinking skills teach with various approaches.

Keywords: E-Module, Critical Thinking, Physics Education

Introduction

Quality human resources are also produced from quality education (Ayudia, 2014; Nurul Qomariah, 2012). So, both of them influence each other. Always innovating to design quality and fun education is the lifelong task of educators (Asyhari & Diani, 2017). This cannot be separated from educators' mastery of science and technology which is one indicator of success in improving the quality of education and human resources (Byun, Sung, & Park, 2017).

Quality human resources result from quality education (Raflesiana et al., 2019 ; Hu et al., 2019). So, the two influence each other one with another. Always innovate to design quality education and fun is the life-long task of educators (Putri & Ermawati, 2021; Saprudin & Hamid, 2021). Matter This cannot be separated from educators' mastery of science and technology become an indicator of success in improving the quality of education and source power human.

Technology information very contribute to process learning as means to develop students' skills. Doringin et al., (2020) state that technology will very help development skill participant educate especially Skills in think critical. Along with rapidly development technology information This very chance for apply e-learning. The use of e-learning in learning can provide many varied experiences for students (Hahn & Klein, 2023; Rohmatin et al., 2022). This will increase students' learning motivation.

With apply e-learning so will Lots benefit Which can taken including increasing the effectiveness and flexibility of learning (Hu et al., 2019; Rahmawati et al., 2020). Through e-learning, learning can be done When just and where just not bound by space and time.

One form of implementing e-learning is with digital modules or e-modules. E- This module has an advantage compared to normal modules, namely that it is interactive makes it easier navigation, playback audio/video, displays picture, And animation as well as be equipped with various tests and quizzes (Abbas, 2020; Pospiech et al., 2015; Sri & Mardhiyah, 2021). With the advantages of using electronics, this module can improve students' abilities.

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The use of e-modules can improve critical thinking skills by various approaches that can be applied (Mckenna & Altringer, 2020; Rohmatin et al., 2022; Saprudin & Hamid, 2021). With the module, it will provide concrete experiences for students so they can improve their skills students think (Liwång, 2020; Maison et al., 2020). Critical thinking skills are the skills to identify facts relevant, recognizing the limitations, assumptions or particularities associated with procedure Which used, And determine answer Which rational (Herpiana et al., 2019; Kirschner et al., 2018).

Thinking skills are part of a student's personal situational factors that indicate the level of intelligence in the learning process. The human way of thinking is divided into 2, namely divergent thinking (a way of thinking that looks for new paths) and convergent thinking (a way of thinking that follows paths) (Brooks, 2023). So, studying physics requires a divergent way of thinking, because physics has the characteristics of scientific process components related to problem solving procedures.

Students who have high cognitive test results tend to think critically. Critical thinking is a development that needs to be developed from an early age and is part of children's cognitive development as well as children's creativity in solving problems and problems faced by children (Herpiana et al., 2019; Rustam & Priyanto, 2022; Sabon et al., 2022). So, there is a close relationship between developing the learning process to improve cognitive and critical thinking.

One way to improve students' critical thinking skills is by provide direct learning experiences and provide various problems must searching for the solution. Besides from That, For Improving critical thinking skills can also be done using models Which facilitate interaction between student like, debate, discussion group, submit questions open, solve problem, Then evaluate And applying new concepts to solve problems in new situations (Aristiawan & Istiyono, 2020).

Physics is one branch of science. In physics students learn Work natural universe. So that, very important for participant educate For understand it well and correctly. Not a few participants think they are learning physics That difficult (Hartini et al., 2020; Maison et al., 2020). Participant educate feel that physics only contains abstract formulas and theories (Taqwa, 2019). In Study physics needed Skills think critical Which adequate Because physicsIan Which learn life daily.

Based on descriptions on, so will We look more in about contribution or effectiveness from e-module to enhancement Skills think critical participant educate And,indicators which influence development the from various corner look.

Method

Method Which used in study This that is use approach descriptive qualitative, and the type of research used is library research, namely collect data or written work scientific relating to the object of research or collection of data of a library nature. Literature study is a data collection technique by conducting a review study of books, literature, notes,and reports relevant to issues related to the problem Which solved (Saprudin & Hamid, 2021; Tytler et al., 2013). According to Aladag & Sahinkaya (2015) on study studies literature mostNo must There is four characteristics, including: 1) writer Which face to face direct withscript, 2) data References Which Ready used, 3) data References is source secondary, And 4) the condition of library data is not limited by space and time. Based on this, data sources Which used is source data secondary. According to Rustam & Priyanto (2022), data secondary is source data Which No give data in a way direct. Source data secondary whichused are notes or documents such as books, literature and readings from the media, site, website. And so on Which its nature support needs study. So that source these can be analyzed and presented in the results of the discussion so that a discussion can be created conclusion. The Figure 1 is the flow of the research method used.

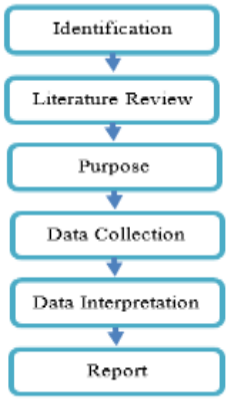

Figure 1. Research Flow

Result and Discussion

Elecetronic Module (E-Module)

According to Mckenna & Altringer (2020) developing process skills-based e-modulesScience can improve science process skills. Shelton (2016) states that developing web-based e-modules to increase competency achievement students' knowledge.

Meanwhile, according to Kinney (2017) stated that developing web-based electronic modules as a physics learning medium Which can increase performance study participant educate. So, can concluded that the importance of developing electronic modules as attractively as possible in the pandemic era like this, so that the child more motivated for study and makes it easier child in understandmaterial physics. And one task for educator physics in develop device learning that is with conceptualize material like that appearance so that participant educate no experience misconceptions when learning independently.

E-modules present information in a structured, interesting and level manner high interactivity. E-module is used to improve understanding of concepts material presented by educators. In learning with this e-module, educators easy enter animation or music Which can increase motivation, interest, activity, And ability think critical participant educate (Maison et al., 2020; Erlina et al., 2022). Saprudin & Hamid (2021) revealed that writing modules is a process of preparing material learning that is packaged systematically so that students are ready to learn it achieve competency. From this explanation, e-modules must be arranged with a suitable structure good and appropriate approach to the material to avoid participant misunderstandings educate in study. Suitability between draft preparation content module and approach whichused can be analyzed first with PCK. The following is a picture of the physics e-module.

Critical Thinking Skills

Skills think critical is ability base which must owned participant educatein the 21st century. Critical thinking refers to making decisions based on analysis, synthesis and evaluation of information (Rustam & Priyanto, 2022 ; Herpiana et al., 2019).

Peter opinion that step For build think critical in solveThe problem is abbreviated as IDEALS, namely 1) Identify, finding the main idea of the problem faced; 2) Define, finding facts that limit the problem, 3) Enumarete, determine possible answers to the problem in a reasonable manner 4) Analyze what is the best answer to take a choice 5) List, stating the right reasons why the selected answer is the best; 6) self-correct, rechecking actions For solve the problem which was missed (Planinic et al., 2019; Rustam & Priyanto, 2022).

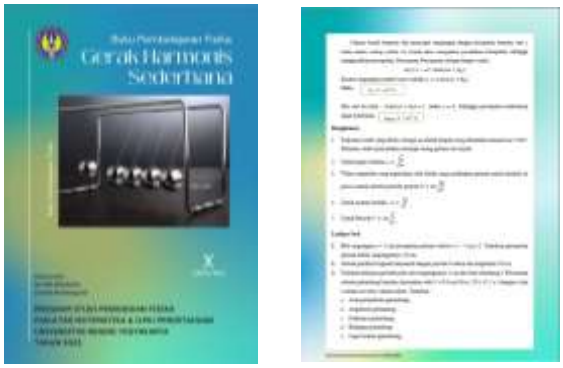

Figure 2. Image of The Physics E-Module

From the explanations above, it can be concluded that critical thinking skillscan improved with various approach. Approach Which used the contains aspects of literacy, direct practice, discussion, and writing. At the final stage, writer write aspect final is write Because with write various skills willhoned and at the same time tested.

E-Module Effectiveness in Improving Critical Thinking Skills

In study Which done by Wahyuni et al. (2020) about effectivenesse-module based problem solving to Skills think critical participant educate. Generated table in Table 1. From Table 1 this can stated that development e-module which carried out by educators to students succeeded in improving aspects of skills critical thinking (IDEALS) with steps that begin with realizing the problem, formulate problems, formulate hypotheses, collect data, test hypotheses, and interesting conclusion.

Table 1. Average Critical Thinking Ability Test Results

Indicators	Average		Average KD (%)	Categories
	KD I (%)	KD II (%)		
Identify (I)	86.66	80.00	83.33	Very Effective
Define (D)	86.66	86.66	86.66	Very Effective
Enumerate (E)	84.44	86.66	85.50	Very Effective
Analyze (A)	86.66	80.00	83.33	Very Effective
List (L)	80.00	86.66	83.33	Very Effective
Self-Correct (S)	80.00	82.22	81.11	Very Effective
Average	84.07	83.70	83.88	Very Effective

Table 2 Comparison Of <g> Per Indicator of Critical Thinking Skills

KBK Aspect	Pretest Average		Posttest Average		N-Gain	
	Value	Qualifications	Value	Qualifications	<g>	Categories
Interpretation	42.50	Moderate	75.83	High	0.58	Moderate
Analysis	41.67	Moderate	75.00	High	0.57	Moderate
Evaluation	34.58	Low	59.58	Moderate	0.38	Moderate
Inference	42.08	Moderate	72. 92	High	0.53	Moderate
Explanation	48.33	Moderate	82.50	High	0.66	Moderate
Self-Regulation	52.50	Moderate	83.33	High	0.65	Moderate

Based on research conducted by IM Suarsana and GA Mahayuti (2013) produce picture table 3. From picture the can stated that skills students' critical thinking can increase and be categorized as high. In that module writer use e-module as tool help Study. E-module the integrate problem become a topic of discussion forum and held an online quiz.

Table 3 Measures Data on Multi-Tribal Critical Thinking Skills Test Scores

Data Size	Value
Average	31.40
Standard Deviation	10.60
Maximum Score	44
Minimum Score	20
Ideal maximum score	50

Research conducted by Uma et al. (2023) The resulting table looks like above which states that critical thinking skills can be improved by students through learning with e-modules. In this research, researchers developed a module by making the appearance of the modules equipped with videos as attractive as possible animation. Then the e-module is structured based on the process oriented guided model syntax inquiry learning (POGIL). The e-module is integrated with social science issues and questions think critical.

From three points explanation results study can concluded that Skills think participant educate can improved with e-module. E-module Which interesting for participant educate. Producing this interesting e-module cannot be separated from the skills of the educators or module maker in processing physics concepts, using an appropriate approach with the material and application carried out. With this, the quality of education will improve will increase and also correlate with improving the quality of human resources in Indonesia.

Conclusion

Electronics module proven effective in increase skills think critical participant educatein study physics. E-module which generated from sophistication ICT sir now can increase quality source Power man through Education. E-modules that are prepared with appropriate concepts, materials and approaches will make it easier for students to learn physics. So that physics becomes a lesson that is of great interest to students.

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Contribution Authors
Arimbi conceptualized the research idea, research design, methodology design, data analysis, and wrote the original draft. Jumadi and Supahar guided, wrote the review and edited, supervised and validated the instruments used in the research.

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The authors declare no conflict of interest. The data published in this article, whether in data collection, analysis, data interpretation, in writing the manuscript or in the decision to publish research results, has no conflict of interest with other parties.

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