

Analysis of the Need for Development of Teaching Materials in the Form of STEM-Based Electronic Modules

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Abstract: The purpose of this study was to analyze the needs of teachers for the development of teaching materials in the form of STEM-based electronic modules. Development using the ADDIE model (*Analysis, Design, Development, Implementation, Evaluation*). The data obtained through interviews with one of the physics teachers in Kerinci district, the results of the interviews are that in the learning process teachers have not used electronic modules with the STEM approach and require electronic modules with the STEM approach because the STEM approach focuses more on real-world problems or problems in everyday life. based on a combination of four aspects, namely *Science, Technology, Engineering, and Mathematics*, making it easier for students to understand the material, besides that it can also improve students' scientific literacy. So that researchers will carry out the development of STEM-based electronic modules.

Keywords: Electronic Modules; STEM; Teaching Materials

Introduction

21st century skills are skills students need to thrive in today's global economy (Motallebzadeh, Ahmadi, and Hosseinnia 2018). The 21st century skills are known as 6C, namely Critical Thinking, Collaboration, Communication, Creativity, Citizenship, Character (Afif et al., 2021). Learning in the 21st century is centered on the development of the industrial revolution in the 4.0 era. Every student needs these 21st century skills to compete with other students (Asrizal and Utami 2021). Chalkiadaki (2018) also stated that 21st century skills are important for students with the goal of academic and life success in the future. Education in the 21st century requires students to have complex knowledge accompanied by supporting skills (Zakiah and Sudarmin 2022). In the 21st century teachers must carry out teaching and learning in accordance with the demands of 21st century learning (Sumardi et al., 2020).

The 21st century learning pattern implies that a teacher must use digital technology, communication

facilities or appropriate networks to access, manage, integrate, evaluate and create information to function in the learning process. This is in accordance with Permendikbud No. 22 of 2016 concerning the standard of primary and secondary education processes. One of the contents of the standard process is the use of information and communication technology to improve the efficiency and effectiveness of learning. Based on the above, it is expected that teachers are able to apply information and communication technology in an integrated, systematic, and effective manner according to the situation and conditions including being able to utilize technology as a learning resource and learning media (Solihudin, 2018).

Education and teaching is a conscious process with a purpose. Education is one of the provisions to determine the direction of the nation to be better and to determine the development and progress of a nation. An education can be used as a means for each individual to get a broad reference of knowledge, for example relating to nature and life. So that with education, all things that

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do not know become known (Ferawati et al., 2020). One of the policies of education is the implementation of the 2013 curriculum. According to Yesika et al. (2020), the purpose of implementing the first 2013 curriculum is to change integrated character education in schools, both intra-curricular, extra-curricular and co-curricular.

Education is very important for us both as students, students, teachers, parents and others. This is supported by Joneska et al. (2016) in an effort to improve the quality of human resources and the survival of a nation both at present and in the future, the role of education is very important and needed. Therefore, improving the quality of education is a major concern for both parents, the community, teachers, the government and the students themselves. It aims to obtain advanced, creative and independent human beings, as well as adapting to advances in science and technology.

In today's world, the world of education is strongly influenced by the development of science and technology. Human life cannot be separated from science and technology, technological progress will run according to the times. For example, when the Covid-19 virus spreads in human life today, the learning process is carried out using *learning*, blended namely a blend of face-to-face and *online*. Hendri, Rasmi, and Ananda (2021) also said that Blended learning is learning that combines face-to-face (direct) learning and online learning or commonly known as online and offline learning. At the time of learning, of *online* course, utilizing technology in the learning process such as *whatsapp*, *e-learning*, *google classroom* and other applications depending on each teacher. In line with that Manalu, Hendri, and Rasmi (2022) states that in the online learning process (online media) many teachers use various applications such as WhatsApp, Google Meet, Google Classroom, and E learning

Physics is a branch of science that has a very important role in the world of education. According to Sambada (2012) physics is one of the branches of natural science (IPA) or science that studies natural phenomena that occur on this earth. With this physics learning, it is expected that students will master the concepts of natural science and be able to apply scientific methods based on scientific attitudes to solve the problems they face. Physics is part of *Natural Science* which is compiled based on facts, phenomena, and based on the results of experiments that have been carried out by physicists. Physics learning emphasizes more on direct experience to develop competencies so that students are able to explore and understand the natural surroundings scientifically.

During the learning process, of course, teaching materials are needed as student learning guides so that learning can run effectively and efficiently, be able to increase student independence, and easily understand

the material. The most effective teaching materials used in learning *online* are electronic modules (e-modules). Himawan and Ariswan (2023) states that the module as an independent teaching material has the advantage that students can find out the extent of their ability to absorb learning. According to Suarsana and Mahayukti (2013) the electronic module is a unit of ICT-based modules, the advantages of e-modules compared to print modules are that they are interactive, electronic modules can display images, audio, video and animation and are equipped with formative tests/quizzes that allow for feedback automatically immediately. In the current technological era, e-modules are an alternative to train students to learn better. Furthermore, e-modules provide students with breadth in accessing teaching materials (Suharyat et al., 2023). In addition, the electronic module is a new innovation in the world of education in the 21st century.

The right learning to use in the development of the 21st century is learning using the STEM approach because the STEM approach focuses more on real-world problems or problems in everyday life based on a combination of four aspects, namely *Science, Technology, Engineering, and Mathematics* (Siswanto 2018).

Based on the results of observations made at one of the SMAN Kerinci district, where in the learning process the teacher has never used a STEM-based electronic module but the teacher knows that there is a STEM-based electronic module. So far, teachers have used textbooks published by Marthen Kanginan, Erlangga and other relevant sources as well as using materials on the internet. Teachers also strongly agree that STEM-based electronic modules are developed, especially during learning *online* today. Therefore, researchers consider it very important to develop teaching materials in the form of STEM-based electronic modules. Because with STEM-based electronic modules, students can study independently at home, can work on questions and activities contained in the module, especially in physics subjects. In addition, the use of electronic modules is not limited to place and time, depending on the ability of students to use them. Then the electronic module with the STEM approach is also appropriate for the development of the 21st century.

Based on relevant research by Syahiddah et al. (2021), stated that the STEM-based physics e-module is able to provide solutions to problems found in everyday life because the material in the E-Module is integrated with the four STEM fields. In addition, this E-Module can be accessed online or offline via smartphone/PC. Then Arnila et al. (2021) research also states that the advantage of developing electronic modules using the Kivosft Flipbook Maker software is that the language is easy to understand, in which there are videos that can make students learn independently and can be accessed online, as well as display attractive images.

Furthermore, Ferdiani and Pranyata (2022) research stated that the use of STEM Project Based Learning-based E-Module in statistics material can improve students' creative thinking abilities in the blended learning process.

According to the ERIC (Education Resources Information Center) website dated April 9, 2023, as many as 199 articles have discussed the *STEM module*. One of the articles that discusses modules with the STEM approach is an article entitled "The STEM Approach: The Development of Rectangular Module to Improve Critical Thinking Skill" by (Retnowati et al., 2020). This article discusses the development of modules with a STEM approach to improve critical thinking skills. This article also discusses the importance of developing modules with the STEM approach because it can improve the quality of learning resources in schools, facilitate students in learning, increase students' critical power, enrich teacher media in the learning process, and increase student knowledge that integrates science, technology, engineering, and mathematics (STEM).

An analysis of the initial needs of teachers is carried out so that the products developed can match the needs needed in schools in learning. So that the product developed can be used and in accordance with the needs in learning. The purpose of this study was to analyze the needs of teachers and students for the development of teaching materials in the form of STEM-based electronic modules.

Method

In this study, an analysis of the needs of students and teachers was conducted in one of the senior high schools in Kerinci district. In this needs analysis, there are several activities, namely material analysis, literature analysis, student analysis and learning environment analysis. According to (Endriani et al., 2018) material analysis aims to identify competencies or skills that students must learn, including KI, KD, materials, assessment instruments and assessment indicators. Researchers analyzed KI, KD, and indicators that became a reference in developing products. In the literature analysis stage, the researcher completes a literature review related to research and analyzes

relevant research to support the product development process.

Then at the stage of student analysis, researchers conducted interviews with teachers in Physics Subjects to analyze the needs of teachers and students in learning. interview is a direct dialogue between researchers and research sources. Interviews are divided into two, namely structured/guided interviews, namely there are interview guidelines prepared by researchers and unstructured or unguided interviews, namely researchers do not prepare interview guidelines. At this stage the researcher conducted a structured interview, where the researcher got initial information about the existing problems. Furthermore, the analysis of the learning environment can be seen from the environment in the school, each school has a different learning environment. The research flow can be seen in Figure 1.

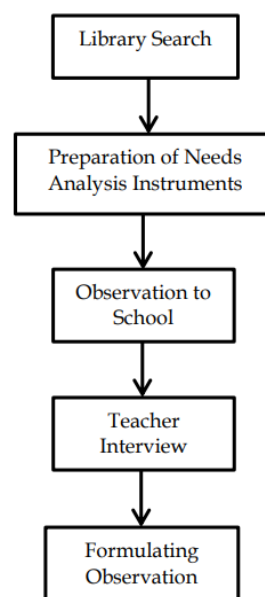


Figure 1. Research Flow

Result and Discussion

Based on the results of interviews conducted with Physics Learning Teachers regarding the need for teaching materials in the form of STEM-based electronic modules and the importance of developing this product, it can be seen in Table 1.

Table 1. Analysis of The Needs of Physics Teachers

No	Questions	Answers
1	What curriculum is used in this school?	Curriculum 2013
2	How is technology used in learning activities? Like the use of smartphones, computers?	Well, in learning activities the teacher uses various learning media such as laptops to display ppt media, animations, the use of practicum tools that exist in the learner's environment, smartphones are used to find sources of information relevant to learning. Smartphones should only be used in activities if necessary.

No	Questions	Answers
3	How is the use of media in learning activities during Covid-19?	The use of media in learning activities during Covid-19 is good. Teachers use the google classroom application, WA and others to support learning. It's just because SMAN 12 Kerinci is located in a less strategic area and the signal is lacking. So applications such as zoom, google meeting are difficult to use. Considering the area where students live is inadequate
4	What textbooks are used in learning? Which book is it from?	Packages published by Marthen Kanginan, Erlangga, and other relevant sources.
5	When teaching the material on temperature and heat, what difficulties/obstacles did you experience?	The obstacle I experienced was in the existing practicum tools. There are inadequate tools in schools.
6	Are there any practicums carried out on temperature and heat materials?	The practicum carried out is only in the form of a virtual lab such as the Phet application.
7	Do you use modules during the learning process?	Inconsistent, the use of modules adapted to the material being taught.
8	What kind of modules are used? What is the print module?	Print modules and electronic modules
9	Where do the modules used come from? Created yourself, from the internet, or from a publisher's published module.	Made by the teacher himself.
10	Do you know about STEM-based e-modules (electronic modules)? Have you ever used STEM-based e-modules?	You know but have never used or implemented it in school.
11	According to your mother, do electronic modules (e modules) with a collaborative approach inspire students' enthusiasm for learning?	Can. All learning methods are actually good. However, in its application to students, we must really understand the students. What kind of learning method is needed. Due to different conditions and environments, different methods are needed.
12	Are you interested in developing STEM-based electronic module teaching materials with a collaborative approach? why?	Strongly agree. because STEM-based electronic module teaching materials are very good if applied and taught properly and correctly.
13	What kind of teaching materials do you expect from online learning during the current Covid-19? What is an example of a STEM-based electronic module (e-module) with a collaborative approach?	Yes, I totally agree with electronic-based e-modules. STEM is one of the approaches that is currently being intensified for 21st century learning.

Based on the results of interviews that have been conducted, it shows that the school in the learning process has implemented the 2013 curriculum where in general the learning applied to the 2013 curriculum has five stages, namely observing (observing), asking, trying, and concluding. In the 2013 curriculum, students are required to be more active so that the learning process is more student-centered, not teacher-centered. One of the assessments applied to the independent curriculum is Authentic Assessment is a global awareness assessment process and a process that requires that students must demonstrate a deeper understanding of the thoughts, motivations, and actions of various cultures to successfully respond to communities and workplaces that go beyond their comfort level. currently (Retnawati et al., 2016).

The application of K-13 in various types and levels of education basically refers to the National Education System Law Number 20 of 2003 and Government Regulation of the Republic of Indonesia Number 19 of

2005 concerning Standard National Education. In addition, based on the Regulation of the Minister of Education of the Republic of Indonesia Number 22 of 2006 concerning Standard Content and Regulation of the Minister of National Education of the Republic of Indonesia Number 23 of 2006 concerning Graduate Competency Standards. In addition, changes to K-13 are the mandate of the 1945 Constitution in an effort to educate the life of the nation and government to fight for and implement a state education system regulated by law (Wachidi et al., 2020).

Teaching materials used by teachers in the learning process are in the form of printed books, and modules, both printed and electronic modules. In learning activities the teacher uses various learning media such as laptops to display ppt and animations, the use of practicum tools that exist in the student environment, then smartphones are used in finding sources of information relevant to learning. In addition, learning activities during Covid-19, teachers also use Google

Classroom, Whatsapp and other applications to support learning. It's just that because SMAN 12 Kerinci is located in a less strategic area and the signal is lacking, applications such as zoom, google meeting are difficult to use. The modules used by teachers in learning activities are not yet STEM-based but teachers know that there are STEM-based modules and teachers also strongly agree with the module. STEM-based electronics were developed.

In the 21st century learning integrates literacy skills, knowledge skills, skills and attitudes as well as mastery of technology. Electronic modules are a new innovation in the world of 21st century education and electronic modules are also among the most effective teaching materials in online learning. Sari et al. (2019) states that one of the teaching materials that can make learning more interesting and interactive is the e-module. Seruni et al. (2020) state E-module in the form of a flipbook has a page edit function and can create interactive book pages by inserting images, videos from YouTube, MP4, audio videos, hyperlinks, quizzes, flash, etc. This learning media is appropriate to use as an innovation in industrial revolution 4.0 and 21st-century learning. E-modules can be used as teaching materials to meet learning outcomes effectively. In addition, e-modules can be applied in the blended learning learning process (Bachri et al., 2021). Then according to Siswanto (2018) the right learning to use in the development of the 21st century is learning using the STEM approach (*Science, Technology, Engineering, and Mathematics*). Because the STEM approach focuses more on real-world problems or problems in everyday life based on four aspects, namely *Science, Technology, Engineering, and Mathematics*.

In its application, STEM education does not only focus on cognitive development but also on effective and psychomotor development because STEM education provides opportunities for students to be active in learning by working together, disciplined, helping each other so that STEM education is suitable in the formation and development of aspects of knowledge (cognitive), aspects of attitude (effective) and aspects of skills (psychomotor) (Sartika, 2019). Then according to Priskasari, Hartiwi, and Indrawati (2019) the purpose of the STEM approach is to increase students' understanding of how things can work and improve students' use of technology, as well as introduce Engineering before going to college. Engineering is directly involved in problem solving and innovation. Learners must learn about Engineering and develop skills and abilities appropriate to the Engineering Design Process (EDP).

Thus, in order to be able to provide collaborative, interactive, interesting, practical teaching materials, which can be used anytime and anywhere, it is also hoped that it can improve students' scientific literacy so

that a product is produced in the form of STEM-based electronic module teaching materials on temperature and heat material.

Conclusion

This study was conducted to analyze the needs of teachers and students for teaching materials. Based on the results of an interview with one of the physics teachers where in the learning process the teacher has not used an electronic module with a STEM approach and requires an electronic module with a STEM approach because the STEM approach focuses more on real-world problems or problems in everyday life based on a combination of four aspects, namely *Science, Technology, Engineering, and Mathematics* so as to make it easier for students to understand the material, it can be used by students not only at school but anywhere and anytime, besides that it can also improve students' scientific literacy. Based on this, it can be used as a reference in the next development process, namely developing teaching materials in the form of STEM-based electronic modules.

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Author Contributions

Validating the instrument, guiding the research process and writing articles, Dian Pertiwi Rasmi and Menza Hendri; Creating research instruments, conducting research and writing articles, Riza Azriyanti.

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Conflicts of Interest

There is no conflict of interest in this research. Funding plays a role in validating instruments, guiding research and the process of creating articles.

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