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The need analysis of using physic e-module based PjBL–integrated STEM: The preliminary study research as a solution to improve problem-solving skills on light refraction material

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Abstract. This study aimed to determine the need for the development of an E-Module based on PjBL-integrated STEM as a learning resource for students on light refraction material. The research used mixed methods, which consisted of qualitative data and quantitative data. This research involved 76 respondents spread across several schools in Lampung Province. Based on the preliminary study conducted, it was known that the majority of students want to use STEM-integrated PjBL-based E-Modules as a learning resource with a percentage of 61.9%, while the use of E-Modules as a learning resource used by teachers is still low at only 9.5 %. The preliminary study also saw that the E-Module that was developed later could measure problem-solving abilities with a percentage of 52.4%. Based on this, the use of E-Modules as a learning resource is needed by students, so it is necessary to conduct a needs analysis for the development of an E-Module based on STEM integrated PjBL to improve problem-solving abilities in light refraction material.
Keywords: E-Module, PjBL, Problem Solving Ability, STEM

1. Introduction

The 21st-century brought about major changes in the relationship between technological developments and the world of education so that the relationship between the two became faster [1]. Along with the complex problems in classroom learning activities, students' competencies are not limited to process abilities but need to have 21st-century skills. The 21st-century skills known as 4C Ability include critical thinking and problem-solving, creativity and innovation, communication, and collaboration [2]. Problem-solving ability is one of the competencies that must be taught to students [3]. In physics, students are said to have problem-solving abilities if they can solve problems through problem-solving steps, namely formulating problems, describing problems, planning solutions, implementing solution plans, evaluating answers [4]. Based on this explanation, it can be concluded that problem-solving ability is one of the competencies possessed by students in understanding a problem then students find a solution to solve a physics problem and interpret the solution.

Based on research conducted by [6], problem-solving skills can increase learning activities, motivation to learn physics students. However, based on a survey conducted on 76 high school students in several schools in Lampung Province, the students' physics problem-solving ability had not been maximally trained. Students find it difficult when learning physics with the reason that they have to be

confronted with formulas and calculations, experiments or experiments, conceptual explanations at the same time. Also, in the learning process, the teacher has not fully used the facilities and infrastructure available at school so that students are not trained to do experiments or experiments. According to [7], there are three difficulties students have in understanding physics concepts, namely; there are learners 'errors in understanding phenomena during problem-solving, misreading or misinterpretation of the questions asked, and students' weak mathematical abilities.

Optics is a physics lesson that contains abstract material and phenomena. Understanding more complex and abstract phenomena cannot be achieved by students without involving submicroscopic and symbolic representations in their learning. An optical material, the knowledge possessed by students is different from the actual concept. According to [8], learning is greatly influenced by the knowledge possessed by a person. If new information is fully consistent with the knowledge possessed, new knowledge can be learned relatively easily. One of the materials in learning optics is light refraction. In a study conducted by [9] found that most of the learners in Thailand could not apply the principles of refraction to explain real-world situations.

The 2013 curriculum is a strategic step for the government to realize the challenges of the 21st century [10]. In the 2013 curriculum, some models are following the characteristics of the scientific approach, including problem-based learning models (Problem Based Learning), discovery learning models (Discovery Learning), and project-based learning models (Project Based Learning) [11]. Based on the characteristics described above, a suitable learning model is a PjBL model. The PjBL model is a learning model based on student work over some time to intensively investigate real-world problems or problems in an interdisciplinary approach to produce something concrete through individual efforts or pair work. Some of the advantages of using the PjBl model, namely: 1. Learning becomes more interesting and fun, 2. Students can use the knowledge they learn in everyday life, 3. Help students solve some of the problems they face in learning, 4. Help students in learning and practicing the skills acquired during learning [12]. According to research conducted by [13], the use of PjBL can improve higher-order thinking skills, students have awareness in the learning process, and teaching and learning activities tend to be more effective so that they can motivate teachers and students.

STEM (Science, Technology, Engineering, and Mathematics) is one of the 21st-century approaches that can be integrated with the PjBL model [14]. The STEM approach is expected to produce meaningful learning for students through the systematic integration of knowledge, concepts, and skills. With the STEM approach, students can solve problems, become better, become innovators and inventors, are independent, logical thinkers, and have technological literacy [15]. Based on research conducted by [16] states that STEM integrated PjBL-based learning can improve students' creative thinking skills.

The implementation of the 2013 curriculum requires teachers to master 21st-century skills, one of which is the use of technology in learning. This technological development provides opportunities in the world of education to access various information, both in the form of text, images, simulations, and sounds [17]. One form of opportunity for the use of technology that teachers can use is interactive learning resources in the form of project-based electronic modules (E-Modules). E-Module is a form of presenting independent learning materials that are arranged systematically into the smallest learning unit to achieve certain learning objectives which are presented in an electronic format which includes animation, audio, navigation which makes users more interactive with the program [18]. The advantages of using E-Module include that it can be integrated with the internet, and can directly play videos and music [19]. According to [20, 21] E-Module is one of the easiest learning resources to use because it can be studied anywhere and anytime, is more interesting, interactive, and can improve the quality of learning.

Based on research conducted by [22], the use of E-Module which is integrated with science process skills can improve students' critical thinking skills and learning motivation. However, based on the results of a preliminary study conducted, teachers have not maximally used E-Modules with a percentage of 9.5%, so that the use of E-Module is still an opportunity to be developed as an interactive learning resource.

There have been many studies using PjBL-based E-Modules to improve critical thinking skills, but

there has not been any research on the development of STEM-integrated PjBL-based E-Modules to improve problem-solving abilities in light refraction material. Based on the above research, this study aims to analyze the needs of developing STEM integrated PjBL-based E-Module as a solution to improve student problem solving on light refraction material.

2. Method

This study used a mixed-method, consisting of qualitative data and quantitative data. The sampling technique was conducted by purposive sampling. Data collection was done by giving questionnaires to students. The questionnaire was given to 76 students, for each question students used a four-point Likert scale [23]. Respondent was asked to state the following Tabel 1.

Table 1. Students' Statement

Statement	Information
SS	Strongly agree
S	Agree
TS	Disagree
STS	Strongly disagree

The questionnaire contains 13 questions, 6 statements about students' perceptions of learning physics, 3 statements about the desired learning model when learning physics, and 4 statements about the desired learning resources when learning physics. Qualitatively, the data and information obtained during the research study are analyzed and then interpreted**.**

3. Results and Discussion

Analysis response of the students toward difficulty od problem-solving in physic lesson consists of six questions which the students were asked to choose one answer from the question that was given to them. The statements about the difficulty of problem-solving in the physic lesson are presented below

Table 2. The Students' Statements about the Difficulty of Resolving Problem in Learning Physic

S1	I like a physic lesson
S2	I consider that physic lesson is hard and boring
S3	I have trouble when completing the problem in the question
S4	I have trouble in using equation or formula in the question
S5	I have trouble analyzing graphic and picture
S6	I have trouble concluding the material that was learned

S1 statements are meant to know the preference for the physic lesson. The data that was obtained about 61.9 % of students dislike physic lesson. The S2 statement is purposed to recognize the students' responses regarding the difficult subject. Moreover, the questions S3-S6 are general perception about learning physic. The data that are obtained supposed that most of the students believed difficulty during the physic lesson because they must be challenged with equation and formula, experiment and testing, conceptual explanation at the same time. It is proved with the 65, 72% percentage. This finding is maintained with the research by [24] that assumed there are three students' difficulties in getting the concept of physic, namely; there is misunderstanding from the students in knowing the phenomena during resolving the problem, misread or ma misinterpret from the question that asked, and the students' mathematic skills that are still low.

Analysis response of the students through the intended learning model during the learning process consists of three questions. Those questions are presented in table 3.

Table 3. The students' Response toward Intended Learning Model

S7	The Intended learning model during the learning process
S8	The learning model that was used could be integrated with STEM
S9	The learning model that was used could simplify the understanding of the concepts of physic and could be applied in daily life.

Table 3 presents students' needs towards a learning model that was used by the teacher during the learning process. On the question S7, 47,6% of students wanted the PJBL model, 31,4% of students wanted PBL, 15,2% of students wanted direct learning, and 5,8% of students wanted contextual learning. The statement in S8 is aimed to know the learning model that was used in the classroom and could be integrated with STEM. The obtained data said that the PjBL model is most widely chosen as integration with STEM explicitly 61,7% of students were choosing it. The S9 statements are pointed to identify the students' response toward the learning model that was used could shorten the perception of the physic concept and could be applied in daily life. The obtained data said that 71,4% of students agree about this statement. It is supported by [25] who said that applying the PjBL model learning process could increase the students' creativity.

The students' analysis response toward the need for interactive learning source has four statements. Those statements are presented in Table 4.

Table 4. The Students' Response toward the Need of Intended Learning Source during Learning Process.

S10	The source of learning that was used by the teacher during the teaching process
S11	The teacher used interactive learning source during learning physic
S12	Learning source that would be developed carry physic problem-solving skills
S13	Learning physics would be attractive if using interactive E-Module.

Table 4 presents the learning resource requirements that are used as alternatives in learning. S10 statement is intended to determine the learning resources used by physics teachers when teaching. The data obtained was 71.4% of teachers still using textbooks as a learning resource. In the S11 statement, as many as 85.8% of students want the teacher to use interactive learning resources when learning. Also, the S12 statement is intended to determine the response of students to learning resources that will be developed containing the ability to solve physics problems. From the data, it was stated that 52.4% of students wanted learning resources to be developed containing problem-solving abilities. Finally, the S13 statement is intended to determine the use of E-Modules which can be used as an alternative interactive learning resource for physics. From the data obtained 61.9% of students stated that learning physics would be more interesting if using an interactive E-Module as a learning resource. Based on the data described, it is clear that the opportunity to use e-modules as a learning resource is still very large. These findings are confirmed by research conducted by [26] who stated THAT the use of E-Module oriented to problem-solving abilities is considered to improve student learning outcomes.

4. Conclusion

Based on the data from the results of the needs analysis conducted, it can be seen that the development of an interactive E-Module as an alternative source of learning needs to be done. The finding in the field is that most teachers still use textbooks as a learning resource so that the use of E-Modules is an

opportunity in learning. The E-Module that will be developed will contain animation of physical phenomena, problem-solving skills, and project worksheets-integrated STEM.

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