Analysis of The Need for The Development of STEM-PjBL Learning Models for Elementary School Students

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Abstract. This research is motivated by the need for data to develop STEM-PJBL learning models for elementary school students. The purpose of this study was to determine the analysis of the needs of the STEM-PJBL learning model for elementary school students. This research uses a descriptive method. In the early stages of the research, three objects became the focus: elementary school teachers, syllabi and teaching materials, and elementary school students. Methods of data analysis using Milles and Huberman techniques and data triangulation. The study results stated that the learning process in elementary schools had yet to find learning that linked science, technology, engineering and mathematics. In addition, learning in elementary schools has yet to implement project-based learning. So it was concluded that STEM-PJBL needs to be developed for elementary school students. The implications of this research can be used as a basis for developing STEM-PJBL learning models for elementary school students.

Keywords: elementary school students, learning models, needs analysis, STEM-PJBL.

1 Introduction

The learning model is a framework or approach used to deliver material and organise learning activities in class [1] . The learning model describes how the teacher arranges and delivers learning materials and how students are involved in the learning process [2]. The learning model guides teachers regarding the steps that must be followed in teaching, the types of activities that can be carried out, the roles of teachers and students, and appropriate evaluation strategies. This model includes various components such as learning objectives, learning strategies, resources used, interactions between teachers and students, and assessment and feedback [3]. Learning models can vary based on theories and approaches [4]. Each model has its characteristics and can be used in different learning contexts. The use of learning models assists teachers in planning effective learning and increases student engagement and achievement. By choosing and applying the right learning model, teachers can create learning environments that are interesting and interactive and follow students' learning needs, including learning models in elementary schools [5].

The learning model is important for elementary school students because it has several benefits that can improve learning and student achievement. Previous research stated that the use of appropriate learning models would be able to activate student engagement [6]. An interesting and interactive learning model can encourage students' active involvement in the learning

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process [7]. By actively involving students, they can build better understanding, develop critical thinking skills, and increase learning motivation. Using the right learning model will provide variety and diversity of learning [8]. Each student has a different learning style and learning needs. By using various learning models, teachers can provide variations in learning approaches to meet the needs of various students [9]. This learning model helps students feel involved and understand the material better. Using the right learning model will encourage student collaboration and communication [10]. The learning model encourages students to work collaboratively and communicate with classmates. This learning model helps build students' social skills and expands their understanding through discussion and exchange of ideas.

The right learning model will also improve critical thinking skills [11]. Some learning models, such as problem-based or project-based learning models, encourage students to think critically, analyze situations, and find creative solutions. It helps students develop deeper and critical thinking skills that are invaluable in their everyday and future lives. Learning models are also able to facilitate deep understanding [12]. A well-designed learning model helps students deeply understand the concepts being studied. Using various relevant learning strategies, resources and activities, learning models help students connect new concepts with existing knowledge and build a solid understanding. In addition, the use of learning models will also help students develop life skills [13]. In addition to focusing on academic knowledge, learning models can help students develop important life skills, such as communication, teamwork, problem-solving, independence and responsibility. This learning model equips students with the skills they need to face future challenges.

From this, it is clear that using learning models in elementary schools is very important for teachers to pay attention to achieve optimal learning quality. In choosing a learning model, teachers must pay attention to the developmental characteristics of the 4.0 era and the characteristics of elementary school students. In developing learning models for elementary school students, it is important to consider technological developments and student characteristics in the 4.0 era. Advances in digital technology, extensive connectivity, and rapid social change mark era 4.0. Therefore, the learning model must be adapted to the needs and challenges faced by students in this era. In addition, the learning model must also adapt to the developmental characteristics of elementary school students. Elementary school students are in the concrete operational period [14]. At this time, students must learn contextually so that learning must be carried out contextually.

However, based on the literature analysis that the researchers did, it was stated that the learning model appropriate to developments in the 4.0 era still needed to be improved [15-17]. Therefore researchers want to develop a learning model that fits the characteristics of the 4.0 era and the characteristics of elementary school students. One of the suitable learning models is the STEM learning model [18]. The STEM learning model is a learning approach that integrates concepts in science, technology, engineering, and mathematics in a relevant and meaningful context [19]. STEM learning promotes an interdisciplinary approach, in which students learn science and mathematics concepts separately and see the relationships and interrelationships between these disciplines. In STEM learning, students are invited to think critically, ask questions, collect and analyze data, and design solutions to real problems.

This STEM learning model will be integrated with the project-based learning (PJBL) model. The PjBL (Project-Based Learning) model is a learning approach centred on a specific project

or task involving students in carrying out a series of activities that have direct relevance to the real world [20]. In this model, students work actively and collaboratively to complete projects or assignments that require problem-solving, research, data collection, analysis, and presentation of results [21]. In PjBL, students can apply the knowledge and skills they have learned in a real context. They work in teams, communicate, collaborate, and think critically to achieve the set project goals [22]. In addition, PjBL also encourages students to develop 21st-century skills, such as communication skills, problem-solving, creativity, collaboration, and critical thinking. The PjBL model can provide students with a more in-depth and meaningful learning experience because they are actively involved in projects or assignments directly relevant to everyday life or the real world [23]. While working on projects, students can develop critical skills, adaptability, teamwork, and other competencies essential for success in the real world [24]. The researchers are interested in developing the STEM-PJBL (Science, Technology, Engineering, Mathematics - Project-Based Learning) model for elementary school students.

Therefore to develop this model, researchers must find out the importance of developing this model. This process was carried out to analyze the need for developing the STEM-PJBL model for these elementary school students. This research aims to analyze the needs of STEM-PJBL development for elementary school students.

2 Method

This research uses a descriptive method [44]. In the early stages of the research, three objects became the focus: elementary school teachers, syllabi and teaching materials, and elementary school students. A total of 30 elementary school teachers were interviewed in this study. The second object studied was the syllabus, teaching materials and student worksheets to see if there were variations in learning styles and levels of student knowledge that were considered in elementary school learning materials and their implementation. The number of students involved in gathering this information was 50 people.

Two data collection techniques were used in this preliminary research: interviews and documentation [45]. Interviews were used to obtain information about the learning model used by the teacher. The instrument used was an interview guide sheet. Meanwhile, documentation is used to obtain data about the STEM-PJBL-based learning model and its implementation. The documents used include syllabi, textbooks, and student activity sheets (LKS) for elementary school students. The instrument used is a document assessment sheet. The initial test assesses the achievement of scientific reasoning and students' argumentative performance in learning in the digital era. The instruments used are scientific reasoning test sheets and students' argumentative performance. The data obtained were then analyzed using a qualitative descriptive analysis technique.

3 Result and Discussion

The combination of STEM-PJBL for elementary school students in the learning process is very important to be developed in the 4.0 era. The learning model is important to develop because it greatly influences the quality of learning. The learning model must focus on the learning process's effectiveness and achievement of learning objectives. Elementary school teachers'

knowledge regarding STEM-PJBL-based learning still needs to improve. The results of the analysis of teacher needs can be seen in the following figure:

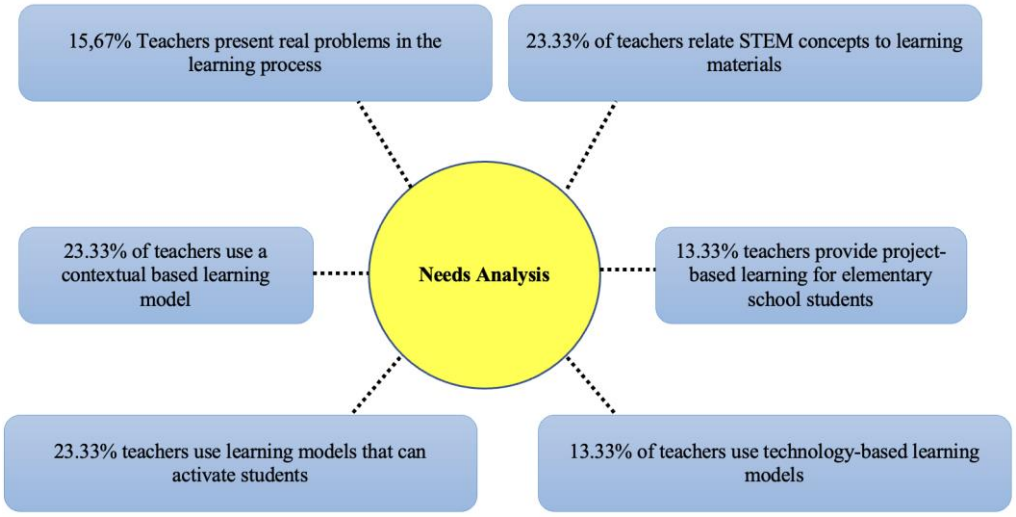

Fig 1. The results of the analysis of the needs of the teacher aspect

From Figure 1, it can be seen that 15.67% of teachers present real problems in the learning process, 23.33% of teachers relate STEM concepts to learning materials, 13.33% of teachers provide project-based learning for elementary school students, 23.33 % of teachers use contextual-based learning models, 13.33% of teachers use technology-based learning models, and 23.33% of teachers use learning models that can activate students. These results prove that elementary school teachers still need to present real problems in the learning process in elementary schools optimally. Other analysis results stated that teachers still did not link STEM concepts to learning materials, teachers had not provided project-based learning for elementary school students, teachers had not optimally used contextual-based learning models, teachers had not optimally used technology-based learning models, and teachers had not optimally used learning models. They were learning that can activate students. This fact proves that STEM-PJBL has yet to be implemented in the learning process in elementary schools.

Then the results of the analysis of the student aspect can be seen as follows:

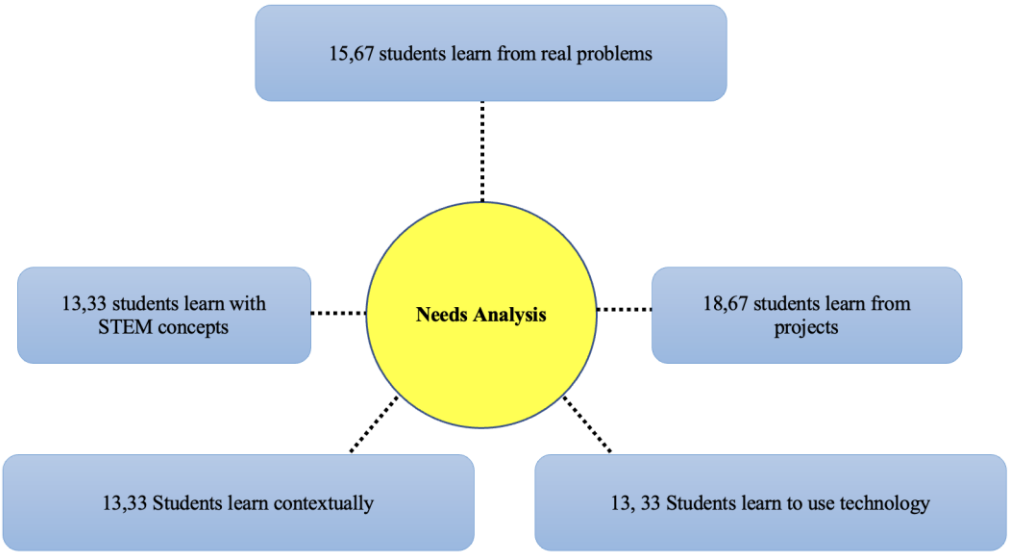

Fig 2. The results of the analysis of the needs of the student aspect

Figure 2 shows that 15.67% of students learn from real problems, 13.33% of students learn from STEM concepts, 18.67% of students learn from projects, 13.33% of students learn contextually and 13. 33% of students learn using technology. This proves that STEM-PJBL learning has not been implemented well in elementary school students.

Another review is seen from the syllabus aspect. The teachers' syllabus still uses a conventional syllabus, where the average learning model is scientific. In the syllabus, there is no integration of learning science, technology, engineering and mathematics. Likewise, a review of textbooks and student worksheets shows that the learning process developed is scientific learning. In the textbooks and worksheets, the STEM elements are not integrated. Then in the textbooks and worksheets, more material still needs to be related to students' real problems. The researchers' findings also stated that in the textbooks and worksheets, no project activities could be carried out. The textbooks and worksheets do not involve technological elements in the learning process. This fact indicates that STEM-PJBL has yet to be implemented in elementary schools. Overall, from the results of the needs analysis that was examined from the aspects of teachers, students, syllabus, textbooks and worksheets, it was concluded that there was no STEM-PJBL-based learning implemented in elementary schools, so it was necessary to develop STEM-PJBL-based learning models to improve the quality of learning in elementary schools.

STEM-PJBL is a learning approach combining science, technology, engineering, and mathematics concepts with a project-based learning approach. This approach aims to develop 21st-century skills in students while deepening their understanding of STEM concepts. In STEM-PJBL, students engage in real projects that challenge them to apply STEM knowledge and skills in everyday life contexts. They work in teams to design, plan and execute projects involving science, technology, engineering and mathematics elements. Students are also invited to hone critical thinking, collaboration, creativity, and communication skills during this process. In STEM-PJBL, students learn theoretical concepts and experience practical experiences that involve solving real problems. They learn to work in teams, identify problems, find solutions,

conduct experiments, and analyze data. Through these projects, students develop technical skills and technological utilization relevant to STEM fields [25-27]. The STEM-PJBL approach is especially important in the 4.0 era because of the high competency requirements in science, technology, engineering, and mathematics. To face the challenges posed by technological advances and digital transformation, students need to have 21st-century skills that include problem-solving, critical thinking, collaboration, creativity, and communication [28-31]. STEM-PJBL helps students develop these skills holistically while deepening their understanding of STEM concepts, preparing them for a future filled with innovation and complexity.

On the other hand, the 4.0 era, marked by the rapid development of digital technology, made STEM-PJBL very suitable for elementary school students. There are several reasons why this approach fits the needs of students in this era. First, STEM-PJBL provides students opportunities to engage in learning experiences relevant to the real world. In the 4.0 era, students need skills that can be applied in real-world contexts, such as problem-solving, teamwork, and creativity [32-34]. Through STEM-based projects, students can face real challenges and develop practical skills they can apply daily. Second, STEM-PJBL involves the use of technology as a learning tool. In the 4.0 era, technology has become an inseparable part of our lives. By using technology in learning, students can develop digital literacy, information processing skills, and the ability to adapt to technological developments [35-37]. STEM-PJBL enables students to use digital devices, software, and other technology-based learning tools to explore, create, and solve problems.

Third, STEM-PJBL encourages students to think critically and creatively. In the 4.0 era, the ability to think critically and creatively is very valuable [38-40]. STEM-PJBL allows students to develop analytical, evaluative and innovative thinking skills through challenging projects. Students are invited to find new solutions, connect different concepts, and think outside the box. Finally, STEM-PJBL prepares students to face the rapidly changing world of work in the future. In the 4.0 era, the world of work is increasingly influenced by technology and innovation [41-43]. STEM capabilities are becoming increasingly important in a variety of industries. By exposing primary school students to the STEM-PJBL approach, they can develop an initial interest in and understanding of STEM concepts, which can form a basis for further exploration at higher levels of education.

In conclusion, STEM-PJBL is a learning approach following the characteristics of the 4.0 era. This approach allows elementary school students to engage in real experiences, use technology as a learning tool, develop critical and creative thinking skills, and prepare them for a future that is influenced by STEM so that the development of STEM-PJBL for elementary school students is very appropriate to develop.

4 Conclusion

From the results of the analysis of the needs of the teacher and student aspects it is stated that the learning process carried out in schools still does not present real problems in the learning process, learning still does not involve STEM components, the project-based learning process has not been implemented, the learning implemented is still not contextual, learning has not used learning technology-based and learning still does not activate students. From the syllabus

aspect, textbooks and worksheets also do not describe the STEM-PJBL-based learning process. The results of the analysis state that there is no STEM-PJBL learning process in elementary schools, so it needs to be developed in the learning process in elementary schools.

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