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Elementary Teachers' Perceptions towards Learning Models related to Creative Thinking and Engineering Skills

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Abstract:

The 21st century competences needed by students can be developed by teachers through learning in schools. The purpose of this study is to investigate the perceptions of elementary school teachers about learning models that support creative thinking and engineering skills. This research used a survey method. The respondents were 40 teachers from different elementary schools located in one of the cities in Indonesia. Random sampling was used as a data collection technique. The research instrument was in the form of questionnaires and the data was collected by employing google form. The data were analyzed qualitatively and quantitatively. The results show that elementary school teachers knew various innovative learning models. The teachers also had positive perceptions about the implementation of creative thinking and integrated engineering skills. Then, the teachers selected the learning models that were properly suitable to provide the development of the creative thinking and enginering skills for elementary schools students.

Keywords: *Creative thinking, Engineering skills, Teacher perceptions.*

I. INTRODUCTION

The current education focuses on developing the set of skills students must have to live in a world that is changing rapidly with the development of digital technology [1]. The view of the concept of comprehensive education that integrates cognitive skills and technical skills is a very important priority to bring up 21st-century skills that include communication skills, collaboration, critical thinking and creativity [2], [3]. Creative thinking is an important and very supportive element to be implemented in the industrial revolution era 4.0 [4]. Creative thinking is at the forefront of human development in facing social and technological changes [5] as well as being an aspect of future economic success [6]. Creative thinking can be used in several learning contexts to enrich the acquisition of knowledge and skills [7].

Creative thinking becomes a provision in the implementation of engineering concepts in learning [4]. Without equipping students with creativity, teachers will find it difficult to direct students to interdisciplinary engineering learning. Teachers believe that engineering has a large impact on the daily lives of students [8]. Engineering makes science and mathematics integrated and allows students to engage with real-world contexts and authentic problems [9], [10]. Engineering learning involves students' psychomotor and cognitive to learn to overcome problems in a structured but creative way [11]–[14].

On the other hand, the implementation of learning concepts that integrate creative thinking and engineering skills requires the selection of appropriate learning models. There is a lot of research in developing creative thinking skills through learning in the classroom such as through inquiry [15], [16], problem-based learning [17], [18], project-based

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learning [19]–[21], PjBL-based STEM (Science, Technologi,

Engineering, and Mathematics) [22] and multiple intelligence instructional learning [23]. Then, some research also discusses the application of engineering learning with various models such as STEM [24], Inquiry [25], Problem-based learning [26] and Project-based learning [27].

However, research on the implementation of learning that focuses on integrating creative and engineering thinking skills in Indonesia is still rarely done. In practice, teachers experience difficulties in teaching and assessing this ability [4], [28]. It is important to know the understanding of elementary school teachers about various types of innovative learning models. Besides, it is also crucial to know the perceptions of elementary school teachers about the integrated implementation of creative thinking and engineering skills at the elementary school level in Indonesia. The focus of research on creative thinking and engineering carried out previously is on improving students' skills on these skills [29] but little attention is given to the perceptions and attitudes of teachers regarding creative thinking and engineering in explicit learning [30]. Investigating the teachers' perceptions towards learning models which foster the students' creative thinking and enginering skills is important to comprehend how the teachers teach in the class [31]. Therefore, the purpose of this study is to investigate the perceptions of elementary school teachers about learning models that support students' creative thinking and engineering skills.

II. METHOD

This study used a survey method with questionnaires as the research instrument. The questionnaires as a whole consisted of 12 questions with some choices of answers and open-ended answers. The open-ended questions aimed to express the perceptions of elementary school teachers about learning models that support creative thinking and engineering skills. A total of 40 elementary school teachers teaching in various grades were used as the respondents in this study. Random sampling was used as the sampling technique. The questionnaires were given to elementary school teachers from 32 elementary schools in one city in Indonesia from various educational backgrounds. The questionnaire data were collected through Google forms and then analyzed quantitatively and qualitatively. The quantitative data were presented in the form of the teachers' identity and knowledge about the learning models that have been automatically presented by the Google form. Meanwhile, the qualitative data were elaborated in the results of analysis of the teacher perceptions about creative thinking and engineering skills. Besides, other data analysis was in the form of elementary school teachers' perceptions of learning models that are considered suitable for developing elementary school students' creative thinking and engineering skills. The data regarding the research respondents are presented in Table 1.

Table 1. Data of the Respondents

Respondents		Percentage
Gender	Male	45
	Female	55
Education	Bachelor degree	92.5
	Teacher professional Education program	2.5
	Master degree	5
Classroom teacher	Teacher of 1st Grade	15
	Teacher of 2nd Grade	10
	Teacher of 3rd Grade	20
	Teacher of 4th Grade	25
	Teacher of 5th Grade	12.5
	Teacher of 6th Grade	17.5
Teaching experience	< 1 Year	7.5
	1 - 5 Years	15
	6 – 10 Years	10
	> 10 Years	67.5

Next, the sample questions contained in the questionnaires are presented in Table 2.

Tabel 2. Example of questions on the questionnaires

No.	Questions
1.	What learning models do you know? Choose the model you know. □ Inquiry □ Discovery Learning □ Cooperative Learning □ Contextual Learning □ Learning Cycle □ Problem-Based Learning □ Project-Based Learning □ STEM □ Others _____
2.	Have you implemented the learning model in accordance with the syntax? □ Not sure

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	☐ 50% sure have done it ☐ 70% sure have done it ☐ 100% sure have done it
3.	Explain the syntax of one of the learning models you know!
4.	Are creative thinking and engineering skills important to be taught to elementary school students? ☐ Yes ☐ No
5.	If your answer is "Yes", give reasons for the importance of creative thinking skills and engineering skills to be taught to elementary school students!
6.	In your opinion, which learning model is suitable for developing creative thinking skills and engineering abilities of elementary school students? You may choose more than one choice. ☐ Inquiry ☐ Discovery Learning ☐ Cooperative Learning ☐ Contextual Learning ☐ Learning Cycle ☐ Problem-Based Learning ☐ Project-Based Learning ☐ STEM ☐ Others ___
7.	Explain your reasons for choosing the learning model(s) to teach creative thinking and engineering skills to elementary school students!

III. RESULT AND DISCUSSION

The importance of the teachers knowing various innovative learning models aims that the teachers are able to choose a learning model that is suitable with the subject matter and skills to be taught to students [31]. The first data present the knowledge of elementary school teachers about innovative learning models. The data were obtained from the answers of the teachers who chose the learning models they knew in the questionnaires. The results of further surveys about respondents' knowledge regarding learning models are presented in Fig. 1.

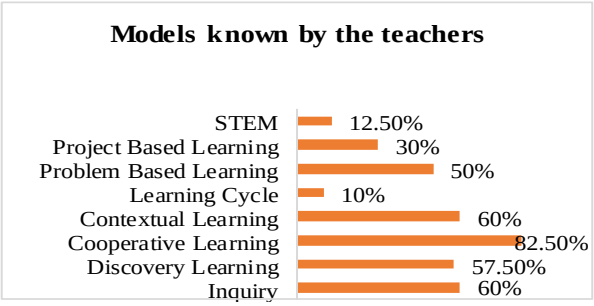

Fig. 1 Percentage of learning models known by the teachers

According to Fig. 1, the respondent did not know all the models in the questionnaires. Most respondents knew the cooperative learning model and contextual learning. The teachers' knowledge of learning models varied with different educational backgrounds, teachers knew innovative learning models. Teachers who had taken professional teacher education and who had completed their master's degrees knew more about learning models including STEM. Apart from that, another factor influencing teacher knowledge is teaching experience [31], [32]. This teacher's knowledge affects the effectiveness and quality of student learning in the class [33]. Some implementation of learning models that had been carried out in primary schools as an effort to improve the ability to think creatively were problem-based learning [17] and project-based learning [19]. Besides, STEM is one of the efforts implemented by the schools to develop engineering skills [34], [35]. While previous studies have focused on improving creative thinking and engineering skills, it is also necessary to know the teacher's perceptions of the importance of creative thinking and engineering skills. The teachers' perceptions of the creative thinking and engineering skills were obtained from the teachers' answers in the questionnaires. From these answers, conclusions can be drawn based on the similarities of the grades taught.The results of the analysis of teacher perceptions about the ability of creative thinking and engineering skills are presented in Table 3.

Table 3. The teachers' perceptions of creative thinking and engineering skills

Classroom Teacher	The teachers' perceptions
Teacher of 1st Grade	Creative thinking and engineering skills are developed to prepare students to have adequate skills and are ready to face all

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	the changes that occur.
Teacher of 2nd Grade	Creative thinking and engineering skills help to develop students' ability in other aspects.
Teacher of 3rd Grade	Creative thinking and engineering skills develop students' mindset to be more creative and advanced so that the level of the student thinking increases to the level of higher-order thinking.
Teacher of 4th Grade	Creative thinking and engineering skills make learning fun because students understand the lesson and they can be creative during learning. Also, students can develop the knowledge they have in their daily lives.
Teacher of 5th Grade	Creative thinking and engineering skills make students ready to face the fast-paced era of technology and information in this century.
Teacher of 6th Grade	Creative thinking and engineering skills train students' way of thinking by developing a high level of reasoning so they can create ideas to solve real problems.

Based on Table 3, the teachers had the perception that integrated creative thinking and engineering skills can be taught to students at the elementary school level. The skills to think creatively can be taught in various ways [36] as well as engineering skills [14]. The teachers teaching at lower-grades viewed that creative thinking and engineering skills are developed so that students have overall skills and can perform a higher-level of thinking. Meanwhile, the teachers teaching at higher-grades argued that creative thinking and engineering skills are developed so that students can solve real-life problems and are ready to face challenges in the 21st century. In addition to teachers' perceptions about creative thinking and engineering skills, the questionnaires also asked the teachers to choose one of the innovative models deemed appropriate for developing creative thinking and engineeering skills as well as writing their reasons for choosing that learning model that could integrate the two skills in the learning process. As a result, teachers chose to apply inquiry learning, discovery learning, cooperative learning, contextual learning, learning cycles, problem-based learning, project-based learning, and STEM. Then, the reasons presented by the teachers in the selection of the learning models were drawn based on the similarities of the model selections. Some teacher's perceptions regarding the reasons for choosing certain learning models are briefly displayed in Table 4.

Table 4. Selection of models for developing creative thinking and engineering skills

No	The chosen models	Percentage	Teachers' perceptions on the chosen models
1	Inquiry learning	10.3	Students can make observations through experiments and construct their own knowledge.
2	Discovery learning	5.1	It trains students to think analytically to solve problems they are facing.
3	Cooperative learning	15.4	It develops student collaboration skills so that collaboration can be performed in generating new ideas.
4	Contextual learning	5.1	The lessons are presented in the form of contextual learning so that it becomes meaningful for students.
5	Learning cycles	2.6	It assists students in mastering the concept of lessons so that it can be a reference in making ideas or creative work.
6	Problem based learning	30.8	Students are required to solve problems by finding effective ways of solving them. In the learning process, the ability to think creatively will emerge because they must bring up ideas in solving problems.
7	Project based learning	10.3	It trains students to think creatively and produce new ideas or new work.
8	STEM	20.5	It combines science, technology, engineering and mathematics that can hone students thinking mathematically and creatively in applying science so that they can

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			make useful engineering work. This model can develop 4C's skills to equip students in the industrial revolution 4.0 era.

Based on Table 4, teachers had been able to choose a learning model that can develop students' creative thinking and engineering skills based on their belief. This shows the readiness of the teachers to collaborate on the two skills in elementary school learning. Engineering-oriented learning provides opportunities for students to think creatively, collaborate in teams, exchange ideas for solutions, solve problems, make decisions based on data, communicate design, and practice to face failure [14]. There are several reasons for the importance of introducing elementary school students to engineering: students must recognize that engineering products surround their lives; engineering projects encourage students to apply the concepts of science and mathematics when dealing with problems; and then engineering process improves student understanding through manipulation of science [14], [37].

CONCLUSION

It is important to know about teachers' perceptions and knowledge about learning models that support creative thinking and engineering skills. The teachers' perceptions of the learning model can predict the likelihood of teacher teaching practices in the classroom. Based on the analysis of 40 elementary school teachers, different perceptions and knowledge of these teachers are influenced by their educational background and experience in teaching practice. Besides, it is known that the teachers have positive perceptions on creative thinking and engineering skills. According to the teachers, these skills can be developed in learning so that elementary school students have a creative mindset, high logical reasoning and other skills that are important to have in this era of the industrial revolution 4.0. According to the teachers, the integration between creative and engineering thinking skills can be applied with various learning models such as inquiry, discovery learning, cooperative learning, contextual learning, learning cycles, problem-based learning, project-based learning, and STEM. This research is expected to contribute to the perceptions of elementary school teachers towards learning models that support the development of creative thinking and engineering skills in elementary school students so that it can become the basis for the implementation of engineering learning at the elementary school level in the future.

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