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Problem Based Learning Model in Science Learning on Skills Developed in Elementary and Junior High Education Units

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Abstract: The purpose of this research is to see the competencies that can be formed through the use of problem-based learning (PBL) learning models. This research uses the Systematic Literature Review (SLR) method. This research analyzes search results from Google Scholar, publish or perish and semantic schoolar databases with a span of the last 10 years. Based on the search results, 150 relevant articles were obtained and then filtered based on the inclusion criteria, 46 articles were used as primary studies. Each article in the data, then analyzed based on the capabilities developed from the research results. The results of the analysis of this article review can be drawn conclusions and findings that the learning model (PBL) has a good impact on improving hardskill and softskill abilities in science learning both at the elementary and junior high school levels. At the elementary level, PBL is able to improve critical thinking skills and increase learning motivation, junior high school level can improve science literacy and learning independence.

Keywords: Problem based learning; Skill developed; Science

Introduction

The 21st century focuses on the progress of the Industrial Revolution Era, which emphasizes the important of knowledge as a key element. However, having knowledge alone is insufficient to actualize the Industrial Revolution 4.0 Era, as it is essential to achieve a balance between knowledge and skills as the foundation for quality human resources in facing the times. The development of skills through habits and fulfillment of life needs based on knowledge is important. It is expected that learning in the 21st century can open up wider job opportunities and expand employment for the people of Indonesia, creating quality and superior human resources. To form superior human resources, educators are needed who are able to teach and educate through 21st century learning methods that are relevant to the progress of the Industrial Revolution 4.0 Era (Mardhiyah et al., 2021).

In the era of education that continues to develop, learning models have become the focus of attention for educators and researchers in an effort to improve student learning outcomes (Yanti et al., 2023). One such model is problem-based learning, which holds significance within the realm of education has proven effective in developing various skills and competencies of students. Such as the results of research Afikah et al. (2022) which states that problem-based learning strategies can improve student communication skills and problem-based and inquiry can improve higher order thinking skills. The results of the study Santosa (2022), the study demonstrated that the utilization of Problem-Based Learning (PBL) resulted in a notable enhancement in both the engagement levels and academic achievements of elementary school students. This improvement was evident through a marked increase in the average activity and learning outcomes of students, observed from the initial conditions to the conclusion. In addition, at the junior high school level as in research Retnaningsih et al. (2018) suggests Problem-based learning proves to be more efficacious compared to traditional learning methods when it comes to enhancing the mathematical critical thinking skills and self-regulated learning of junior high school students. And there are many more improvements in student

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learning outcomes from various levels by using this Problem Based Learning model, especially in learning.

This article aims to conduct a Systematic Literature Review (SLR) on the Problem Based Learning (PBL) learning model in the context of elementary and junior high school education unit levels. SLR is a systematic and comprehensive research method to identify, evaluate and synthesize previous studies relevant to a particular research topic. Presenting a systematic and detailed literature review, this article is expected to provide valuable insights for educators, researchers, and educational practitioners in understanding the potential and benefits of PBL in developing learners' skills at various levels of primary and junior secondary education units.

This study aims to delve into a comprehensive exploration of problem-based learning (PBL) in the context of elementary and junior high school education. Through an examination of research articles, the survey intends to scrutinize the effectiveness of implementing the PBL learning model. The primary objective is to identify the dominant abilities that contribute to enhancing learning outcomes. The findings of this research seek to provide insights into the practical application of PBL in diverse classrooms, with the ultimate goal of achieving learning objectives that are well-received by students.

Method

This research is a type of research that uses the Systematic Literature Review (SLR) method, where the SLR research method is a systematic and objective research method for collecting, evaluating, and synthesizing relevant evidence from various previously published literature sources (Suciati et al., 2022). The selected literature sources and in accordance with the required research keywords, then review and identify the selected journals in a structured manner according to the steps set out in the systematic literature review method (Triandini et al., 2019). This research uses three stages of systematic literature review (SLR) according to Hormadia et al. (2021) as shown in Figure 1.

Figure 1. Systematic literature review (SLR)

Planning

In the preparation of research using the systematic literature review model, the initial stage is planning. This stage involves determining the research topic, which is about the PBL learning model in science learning. Furthermore, article search criteria were determined based on publish or perish, semantic schoolar, and google scholar sources from the period 2013 to 2023. The keywords used in this research include Problem Based Learning in elementary and junior high school learning.

Conducting

The conducting stage is the implementation stage in SLR research. At this stage, the search for articles according to the criteria and suitability with keywords began. After selecting according to the inclusion and exclusion criteria from the existing population, 46 articles were selected. The inclusion criteria applied in this study are journals with clear SINTA and academic proceedings, journal publications in the last 10 years, experimental, qualitative, PTK, and development research types and elementary and junior high school education levels. The exclusion criteria included irrelevant titles, missing full text, irrelevant abstracts, and unclear conclusions. After the selection process was completed, the next step was to synthesize the data to analyze and evaluate the research results from various articles. Data synthesis in this study will be presented in a narrative manner.

Reporting

The reporting phase represents the concluding step in the Systematic Literature Review (SLR) method. During this stage, researchers articulate the findings of the analysis and assessment of journal reviews in accordance with a pre-established format.

Result and Discussion

The results of the study are outlined based on the SLR method from the results of the analysis of articles on the PBL model in science learning seen from the Hard skills and Soft Skills achieved and the level of the study so that conclusions can be drawn to determine the effectiveness of the PBL model when applied to the application of science learning. From the results of the article analysis, 43 articles were obtained that measured Hardskills and Softskills in science learning using the PBL model both at the elementary and junior high school levels.

Problem Based Learning (PBL) in Science Learning at Elementary Level

From the results of the article analysis, 19 articles were obtained that discussed the Problem Based Learning learning model that measured Hardskill and Softskill abilities in science learning at the elementary school level. The results of the article analysis are described in the following Table 1.

Table 1. The Results of the Article Analysis

Skills developed	Year of publication	Number of article findings
Hardskill		
Critical Thinking Skills	2020	3
	2018	1
Creative Thinking Skills	2022	1
	2018	2
Communication Skills	2018	1
Problem-Solving Skills	2020	
Reasoning Ability	2020	1
Concept Understanding Skills	2020	1
	2017	1
Softskill		
Learning Motivation	2022	1
	2021	2
	2018	1
Self-Regulated Learning	2022	1
	2021	1

From the analysis of articles focusing on science education through the implementation of the PBL model, the development of various hard skills in elementary-level science learning is evident. Specifically, there are four articles emphasizing the cultivation of critical thinking skills, three articles highlighting the development of creative thinking skills, one article focusing on communication skills, two articles delving into problem-solving skills, one article emphasizing reasoning skills, and another article addressing the enhancement of the ability to comprehend science concepts. One example of the results of the analysis of the review of hard skills is described in the following table 2.

According to the analysis presented in the table 2 above, it is evident that the Problem Based Learning (PBL) model contributes to the enhancement of critical thinking skills among elementary school students by explaining and providing motivation to solve problems, then organizing students in learning tasks related to the problem, in addition to motivating it also provides encouragement for students to gather information so that they can carry out experiments by preparing appropriate work which in the end can be evaluated by the teacher to get an assessment or addition from the teacher. This is in line with research according to Ananda et al. (2022), Misla et al. (2020), and Rauf et al. (2022) which show the same research results, namely the PBL model The research indicates that the model has the capacity to enhance the critical thinking skills of elementary school students. In addition to fostering critical thinking ability, as highlighted in the study. Hagi et al. (2021), Sulastri et al. (2022), and Novellia (2018) explained that PBL can improve the creative thinking skills of elementary school students. In addition to creative thinking skills, PBL can also improve the communication skills of elementary school students (Wulandari et al., 2018). Other research according to Yulistiana et al. (2020) and Wardani (2020) explains that the PBL model is effective in enhancing problem-solving skills during science learning in elementary school students. In addition, according to (Kurniawan et al. (2020) and Rahmadani et al. (2017) the PBL model can improve concept understanding.

Table 2. Example of PBL Article Analysis on Hardskill (Critical Thinking Ability) in Elementary Science Learning

Author name	Rahman et al. (2020)
Tittle	The Effect of PBL Model on Critical Thinking Ability and Science Concept Understanding of Grade V Students of SDN 30 Sumpangbita
Journal name	Edumaspul : Jurnal Pendidikan
Method	Quasi-experimental research
Results	The results of this study indicate the results of the Independent Sample Testpost test obtained a Sig. value of 0.000. Where 0.000 <0.05 then H0 is rejected and Ha is accepted, meaning that there are differences in critical thinking skills and understanding of students' science concepts in classes taught using the PBL model with classes taught without using the PBL model in grade V students of SDN 30 Sumpangbita. So, it can be concluded that in this study the Problem Based Learning (PBL) model has an influence on critical thinking skills and understanding of student science concepts.

Based on the results of the analysis of articles that discuss science learning using the PBL model, each soft skill ability developed when applied to science learning at the elementary level is 4 articles that discuss that Problem-Based Learning (PBL) has the potential to elevate the learning motivation of elementary school students, and 2 articles discuss that PBL can increase student learning independence. One example of the results of the analysis of the review of soft skills is described in the following table 3.

The results of the analysis that have been reviewed discuss the same thing, namely according to Arisanti (2022) and Solekhah et al. (2018) with research results showing that the PBL model can increase student learning motivation. The reason PBL learning models can increase student learning motivation is first, providing a relevant and real context in learning. When students are faced with problems that they consider important or interesting, they are more likely to be actively involved in the learning process. Reinforced by research by Hmelo-Silver et al. (2007) stated Students

tend to be more motivated when they can see the relevance of what they are learning to their real life. Secondly, PBL allows students to take a more active role in their learning process. PBL offers opportunities for students to engage in investigation and problem solving that is directly related to the real world. This can increase students' intrinsic motivation (Albanese, 2000).

Table 3. One Example of PBL Article Analysis on Softskill Ability (Student Learning Motivation) in Science Learning at Elementary Level

Author name	Yasmini (2021)
Tittle	Application of Problem Based Learning model to increase motivation to learn science
Journal name	Journal of Education Action Research
Method	PTK (Classroom Action Research)
Results	Conclusively, from the obtained results and discussion of the research, it can be affirmed that the implementation of the problem-based learning model leads to an enhancement in the motivation for science learning among Class IV Semester I students at SD N 3 Banyuasri, Buleleng District, Buleleng Regency during the 2020/2021 academic year. The implication of adopting this problem-based learning model is noteworthy, as it stimulates students to think creatively and imaginatively, introduces novel ideas, and fosters increased self-confidence among the students.

The findings of the examined analyses converge on a common theme, as outlined by Suari (2018), Wahyuningtyas et al. (2021), and (Khoirudin et al., 2022). These scholars assert that the Problem-Based Learning (PBL) model yields positive outcomes, particularly in enhancing students' learning motivation. Parallelly, Anjarsari et al. (2021) expound in their study that the PBL learning model exhibits a capacity to elevate the learning independence of elementary school students. Upon scrutinizing the analysis results table, a collective inference emerges from the 19 articles delving into science learning via the PBL model. At the elementary level, the PBL approach manifests a consistent development of hard skills, including critical thinking, creativity, communication, problem-solving, and comprehension of scientific concepts. Furthermore, the soft skills cultivated through PBL encompass heightened learning motivation and augmented student learning independence. Notably, the synthesis of insights from the 19 articles underscores the recurring theme that PBL significantly enhances critical thinking skills and amplifies the learning motivation of elementary school students.

Problem Based Learning (PBL) in Junior High School Learning

Based on the results of the article analysis, 27 articles were obtained that discussed the PBL learning model that measured Hardskill and Softskill abilities in junior high school science learning. The results of the article analysis are described in the Table 4.

Based on the analysis of articles focusing on science learning through the Problem-Based Learning (PBL) model at the junior high school level, various hard skills are identified. Specifically, three articles emphasize the development of creative thinking skills, while an equal number of articles, three in total, delve into critical thinking skills. Additionally, two articles are dedicated to the exploration of communication skills, another two to numeracy literacy skills, four to science literacy skills, two to concept understanding skills, and two to Higher Order Thinking Skills (HOTS). To illustrate one instance of the analysis results regarding hard skills, refer to the Table 5.

Table 4. Analysis of PBL Articles in Junior High School Learning.

Skills developed	Year of publication	Number of article findings
Hardskill		
Creative Thinking Skills	2018	1
	2016	1
	2013	1
Problem-Solving Skills	2015	1
	2014	1
Critical Thinking Skills	2019	1
	2015	1
Communication Skills	2019	1
	2018	1
Numeracy Literacy Skills	2023	2
Science Literacy Skills	2022	1
	2021	1
	2016	1
	2015	1
Concept Understanding Skills	2023	1
	2021	1
High Order Thinking Skill	2022	2
Softskill		
Self regulated learning	2020	1
	2019	1
Learning Motivation	2019	1
	2021	1
Self-Confidence	2018	1
Scientific Attitude	2022	1
	2018	1

Table 5. Example of PBL Article Analysis on Hardskill (Science Literacy) in Junior High Science Learning

Author name	Hartati (2016)
Tittle	Improving the attitudinal aspects of science literacy of junior high school students through the application of problem-based learning models in integrated science learning
Journal name	Eduscience
Method	Quasi Experiment
Results	Drawing conclusions from the carried out investigation, it can be deduced that applying the Problem-Based Learning (PBL) model to the experimental group holds the potential to notably improve the science literacy skills of students when compared to the control group. The PBL learning model is suitable for stimulating students' interest in scientific issues, increasing scientific inquiry, and encouraging students' sense of responsibility for the surrounding environment.

Based on the results of the review analysis in the table above, it explains that the PBL learning model is able to improve science literacy skills. This learning model has great potential to improve science literacy because it can increase student involvement in science topics and integrate knowledge that can help understand the relationship between science concepts. Based on Hartati's research (2016), PBL learning model is suitable to be applied to stimulate students' interest in scientific issues, increase scientific inquiry, and encourage students' sense of responsibility for the surrounding environment.

This is in line with the results of research according to Kurniawati et al. (2021), that PBL can improve science literacy ability. In addition to science literacy skills, according to research Siviani et al. (2018), Khoiri et al. (2013) and Yulianingtias et al. (2016), PBL models can improve creative thinking skills. In addition, according to research Sumiantari et al. (2019) and Dewi et al. (2014) stated that PBL can improve problem solving skills. According to Hartati et al. (2015) and Rahmawati (2019), PBL can improve critical thinking skills. According to research by Wulandari et al. (2018), Nurhayati et al. (2019) and Wati et al. (2019) explained that problem-based learning can improve science communication. In addition to science communication, according to research Putri et al. (2023) and Masliah et al. (2023) that PBL can also improve numeracy literacy skills. Other research according to Murdaningrum et al. (2023) and Junaid et al. (2021), PBL learning models can improve concept understanding. According to Sari et al. (2022), PBL can also improve higher order thinking skills.

In addition, the results of the analysis of articles that discuss science learning using the PBL model, each soft skill ability developed when applied to science learning at the middle school level is 2 articles discussing that PBL can increase junior high school students' learning motivation, 1 article discussing that Problem-Based Learning (PBL) has been found to boost self-confidence in junior high school students, with two articles specifically addressing this aspect. Additionally, two articles discuss the positive impact of PBL on fostering scientific attitudes among junior high school students. Furthermore, one article explores how PBL contributes to enhancing learning independence in this student group. An illustrative example of the soft skills analysis results is provided in the table 6.

Table 6. Example of PBL Article Analysis on Softskill Ability (Students' Scientific Attitude) in Junior High Science Learning

Author name	Hartini (2019)
Tittle	Improving Independence and Achievement of Science Learning through Problem Based Learning assisted by Student Worksheets
Journal name	Paedagogie
Method	PTK (Classroom Action Research)
Results	Student learning independence has increased from pre-cycle (13.02), cycle I (17.09), and cycle II (20.02). This is due to the PBL learning model assisted by problem-based LKS making students enthusiastic about discussion, discipline in doing and collecting assignments, not depending on others, being confident, having the initiative to learn the class situation, being conducive, all students working on individual assignments

Based on the review of the article above, it explains that the PBL learning model is able to increase the learning independence of junior high school students. In PBL, students are required to find relevant information to understand and solve the problems given. This strengthens students' independence in finding sources of information and analyzing their reliability and relevance. According to Maftuh (2023), PBL promotes students' learning independence by encouraging them to conduct independent and critical searches for information.

The results of the analysis, the conclusion is that of the 24 articles that discuss science education employing the Problem-Based Learning (PBL) model, each hardskill ability developed when applied to science learning at the junior high school level is the ability to think critically, creatively, communication, problem solving, numeracy literacy and science literacy. As for the soft skills that are

formed from learning this PjBL model are learning motivation, student scientific attitudes, student learning independence and student confidence in learning. However, from the analysis of 24 articles, a significant number of them highlighted that Problem-Based Learning (PBL) was effective in enhancing science literacy skills and self regulated learning among junior high school students.

Conclusion

The results of the analysis based on the study with SLR conclude the findings that the learning model (PBL) has a good impact on improving hardskill and softskill abilities in science learning both at the elementary and junior high school levels. This PBL model has been widely applied in learning activities. The results of the analysis clearly show that the articles found mostly say that this PBL model can improve critical thinking skills and learning motivation at the elementary level. PBL can improve science literacy skills and learning independence at the junior high school level. This PBL learning model is highly recommended to be implemented in science learning by looking at the learning material so that learning objectives can be achieved properly.

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