

Differentiated Learning with the Problem Based Learning Model in Elementary School Science Learning: Literature Review

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Article History

accepted 26/11/2023

approved 26/12/2023

published 26/1/2024

Abstract

This research aims to present a comprehensive understanding of differentiated learning strategies using the problem based learning (PBL) model through a synthesis of relevant literature. The literature review method was carried out by investigating scientific articles, books, and publications related to the application of differentiated learning using the PBL model in the context of basic education. A critical analysis of the literature was carried out to evaluate the implementation, impact, and obstacles that arise in implementing these learning strategies. This article seeks to provide an in-depth view of the principles and practices of implementing differentiated learning with PBL at the elementary school level. The research results show that the application of differentiated learning using the problem based learning (PBL) model is carried out through four components, namely differentiation of content, process, product, and learning environment. This learning also has a positive impact on the science competency of elementary school students, such as improving learning outcomes. The obstacles encountered by teachers in implementation are difficulties in compiling and carrying out diagnostic assessments, compiling appropriate content, implementing differentiated learning using the PBL learning model according to grouping, and giving assignments that must suit the learning style of each student. The implications of this literature can guide educators in designing and implementing innovative learning strategies that suit students' needs.

Keywords: *Differentiated learning, Problem Based Learning, Elementary School Science*

Abstrak

Penelitian ini bertujuan untuk menyajikan pemahaman komprehensif tentang strategi pembelajaran diferensiasi dengan menggunakan model problem based learning (PBL) melalui sintesa literatur yang relevan. Metode tinjauan pustaka dilakukan dengan menyelidiki artikel ilmiah, buku, dan publikasi terkait penerapan pembelajaran diferensiasi menggunakan model PBL dalam konteks pendidikan dasar. Analisis kritis terhadap literatur dilakukan untuk mengevaluasi implementasi, dampak, dan hambatan yang muncul dalam penerapan strategi pembelajaran tersebut. Artikel ini berupaya memberikan pandangan mendalam mengenai prinsip dan praktik penerapan pembelajaran berdiferensiasi dengan PBL di tingkat sekolah dasar. Hasil penelitian menunjukkan bahwa penerapan pembelajaran diferensiasi dengan model problem based learning (PBL) dilakukan melalui empat komponen, yaitu diferensiasi isi, proses, produk, dan lingkungan belajar. Pembelajaran ini juga memberikan dampak positif terhadap kompetensi sains siswa sekolah dasar, seperti peningkatan hasil belajar. Kendala yang dihadapi guru dalam pelaksanaannya adalah kesulitan dalam menyusun dan melaksanakan penilaian diagnostik, menyusun konten yang sesuai, melaksanakan perbedaan pembelajaran dengan menggunakan model pembelajaran PBL sesuai pengelompokan, dan memberikan tugas yang harus sesuai dengan gaya belajar setiap siswa. Implikasi dari literatur ini dapat memandu pendidik dalam merancang dan menerapkan strategi pembelajaran inovatif yang sesuai dengan kebutuhan siswa.

Kata kunci: *Pembelajaran diferensiasi, pembelajaran berbasis masalah, IPA sekolah dasar*

Social, Humanities, and Education Studies (SHes): Conference Series p-ISSN 2620-9284
<https://jurnal.uns.ac.id/shes> e-ISSN 2620-9292



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INTRODUCTION

The 21st century is marked as a century of openness and globalization with the very rapid development of information technology and the growth of automation, where many routine and repetitive jobs are starting to be replaced by machines (Wijaya et al., 2016). These changes require that education be able to produce quality human resources who are able to develop communication skills across various differences, be able to collaborate, have a perspective, be able to express opinions, solve problems, and at the same time be able to create new things by analyzing opportunities, challenges, and capacities effectively. skilled (Widodo & Wardani, 2020). In line with this, in the new learning paradigm, the learning development framework is not a linear model but a continuous cycle. This is intended so that learning can provide teachers with greater freedom to develop learning plans and assessments based on the characteristics and needs of students (Sufyadi, 2021).

The independent learning policy issued by the government aims to build an educational ecosystem that is more open and independent in learning in accordance with environmental, social, and geographical conditions (Jenyana, 2022). Learning principles are designed by taking into account the developmental stages and levels of achievement of students, adapting to learning needs, and reflecting different characteristics and developments so that learning becomes meaningful and enjoyable. Teachers must be aware of the different needs of students and consider them when designing learning activities to maximize their potential (Pande Nyoman et al., 2022).

However, most teachers still use the same strategy for all students (Alsubaie, 2020). As is known, each student has a different level of learning readiness, interests, talents, and learning styles (Wahyuningsari et al., 2022). They are using learning methods that do not suit their preferences resulting in most students having difficulty understanding the material being studied. Apart from that, Tomlinson (2001) stated that if the learning tasks received by students are in accordance with their abilities and understanding and are able to encourage students to work in the way they like, then the participants will learn even better.

Natural Sciences is one of the subjects that emphasizes providing direct learning experiences so that students better understand their natural surroundings. Therefore, the science learning process should take place in an interactive, inspiring, fun, and challenging manner, motivate students to participate, and create free space for initiative, creativity, and independence in accordance with the students' talents, interests, and physical and psychological development (Suja, 2020). Apart from that, science learning must also pay attention to environmental conditions and demands, which are always developing and are in line with the direction of complete human development (Ayu Sri Wahyuni, 2022). Another thing that teachers must pay attention to when teaching science is building students' mastery of concepts regarding the material being taught (Ramdani et al., 2020).

In fact, based on the results of the PISA (Program for International Student Assessment) study 2022, Indonesia's ranking experienced a decrease in its scientific literacy score, which previously in 2018 was 396, but in 2022 the score will only reach 383 (OECD, 2022). PISA results also show that only a small number of students are creatively and independently able to apply their knowledge of science to various situations, including unusual situations (OECD average: 7%). Yuri Belfali, Head of the Early Childhood and School Division, Directorate of Education and Skill, OECD, stated that teachers in Indonesia are classified as having the highest enthusiasm after Albania, Kosovo, and Korea. However, most teachers in Indonesia still do not understand the needs of each individual student (Kemdikbud, 2019).

Sometimes, without realizing it, every day teachers are faced with students with a variety of diversity who must be in one class as a unit (Minasari & Susanti, 2023). In a heterogeneous class, there are various students who have different

backgrounds, different interests, or learn at different speeds (Sarie, 2022). In the learning process, teachers must use various methods so that students are able to explore learning content and provide a variety of reasonable activities so that students understand, have ideas or information, and can demonstrate what they learn.

According to (Tomlinson, C. A., & Moon, 2014), differentiated learning is learning that accommodates, serves, and recognizes the diversity of students in learning according to students' readiness, interests, and learning preferences. The implementation of differentiated learning in the Independent Curriculum is in line with Ki Hajar Dewantara's educational philosophy (Herwina, 2021). Teachers must facilitate children so that they can learn according to their nature, namely the nature of nature and the nature of the times (Santika, 2023). Teachers can guide the development of students' potential according to their nature by liberating students to learn through the freedom given to students to develop their potential in ways that interest them (Sri Yanti et al., 2022). Students are not required to be the same in everything but can express themselves according to their own uniqueness.

The application of differentiated learning can be integrated into various learning models (Ayu Sri Wahyuni, 2022). One of them is the problem based learning model. The problem based learning model is a student-centered learning strategy that requires children to be skilled and sensitive to solving problems in their environment (Sarie, 2022). Apart from that, according to (Shoimin, 2016), the advantages of the problem-based learning model include: 1) training students to solve problems in real life; 2) equipping students to develop their own knowledge through solving research problems; 3) learning focused on problems so that they do not have unrelated material; 4) Students' scientific activities take place in groups; 5) Students are used to using knowledge sources from libraries, the internet, interviews, and observations; 6) Students have the ability to evaluate their own learning progress; 7) Students have the ability to communicate scientifically in discussions or presentations of work results; and 8) Each student's learning difficulties can be resolved through group work.

Teacher readiness before implementing differentiated learning must be considered. Teachers need to have a deep understanding of learning concepts and methods and be able to integrate technology in the teaching and learning process (Junedi et al., 2020). A misconception that often occurs in differentiated learning is that teachers have to make completely different learning plans for each child. This causes teachers to be reluctant to implement differentiated learning because it is not practical and efficient.

Even though the theory about the application of differentiated learning has long been introduced in the world of education, research on the practice or implementation of differentiated learning in the classroom is still very limited. Therefore, the author is interested in writing this article with the aim of collecting various pieces of literature related to the application of differentiated learning using the problem based learning model in fourth-grade elementary school science learning. This research is important to conduct to determine the implementation of differentiated learning through problem based learning. Implementing differentiated learning can improve students' science learning outcomes (Suwartiningsih, 2021). Apart from that, the use of critical thinking skills can also improve students' critical thinking skills (Bernadetha & Lamhot, 2020).

Previous research on this research topic includes differentiated learning to overcome the problem of lack of student activity (Sutrisno & Hernawan, 2023). This research shows that the use of differentiated learning by paying attention to learning styles can increase student activity based on five indicators, namely: focus, cooperation, expressing opinions or ideas, problem solving, and discipline. Second, Classroom action research regarding the application of differentiated learning which can improve elementary school students' critical thinking skills in science learning

(Avandra & Desyandri, 2023). The focus of the literature review carried out is to know about the implementation, impact, and obstacles that arise in implementing these learning strategies. This article attempts to provide an in-depth view of the principles and practices of implementing differentiated learning using the problem based learning model at the elementary school level.

METHOD

The method used in this research is a literature review. A literature review is a type of research that focuses on a specific topic of interest to critically analyze the contents of the manuscript being researched. This literature review uses literature sourced from national and international journals with updates from the last 7 years, namely from 2018–2024. The journals reviewed are those that meet the criteria in the form of research journal articles related to the application of differentiated learning using the problem based learning model in elementary school science learning.

The preparation steps of this research, according to Nur Asti Ramadhani (2022) are problem formulation, searching for literature relevant to the research topic, evaluating data, and carrying out analysis and interpretation. Research journals that match the theme are then collected, and a journal summary is made, including the name and year of publication of the journal, research title, research method, dependent variable measured, and a summary of the results or findings. Based on a review of the quality of scientific articles, 16 articles were obtained that were relevant to the research topic.

RESULTS AND DISCUSSION

The following are the results of a literature review of 16 research articles related to the application of differentiated learning using the problem based learning model in fourth grade elementary school science learning in table 1.

Table 1. Synthesis Analysis of Reviewed Literature

No.	Author & Year	Tittle	Research Method	The Variable	Research Result
1	(Atikah et al., 2023)	Application of Content and Process Differentiation Strategies in Learning Styles Based on Problem Based Learning Models	Qualitative Descriptive	Content and Process-Differentiated Learning	The content and process of differentiated learning have gone well. Students can learn naturally and efficiently.
2	(Dalila et al., 2022)	The Effect of Differentiated Learning in Problem Based Learning on Cognitive Learning Outcomes of High School Students	Quantitative Quasi Experiment	Cognitive learning outcomes	There is an influence of differentiated learning in the PBL model on students' learning outcomes in physics material.
3	(Ma'ruf Dharmaji &	Improvement of Student	Improvement of Student	Academic	Learning using the

	Astuti, 2023)	Achievement Through Problem Based Differentiated Learning	Achievement Through Problem Based Differentiated Learning	Achievement and Self-Efficacy	differentiation model with PBL increases significantly.
4	(Rosyid et al., 2023)	Profile of Order Thinking Ability in Differentiation-Based Problem Based Learning Models.	Quantitative	Higher Order Thinking Skills	Differentiation based problem based learning is effective for students in improving Higher Order Thinking Skills (HOTS).
5	(Solehudin & Rochmiyati, 2023)	Differentiated Learning Through the PBL model to improve Indonesian Language Learning Outcomes for Elementary School Students	Classroom Action Research	Learning Outcomes	Implementing differentiated learning can improve student learning outcomes.
6	(Prastiyan et al., 2023)	How can problem based learning integrated with TPACK and differentiated learning improve student concepts?	Classroom Action Research	Understanding Student Concepts	Students' understanding of concepts has increased after implementing PBL learning with TPACK and differentiated learning.
7	(Minasari & Susanti, 2023)	Application of the Differentiated Problem Based Learning Model based on Student Learning Styles in Biology Lessons	Qualitative	Student Learning Behavior	The differentiation-based problem based learning (PBL) learning model has an impact on changes in student behavior in learning.
8	(Dhahana Aris Saputra et al., 2023)	Analysis of the Application of Differentiated Learning with the Problem Based Learning Model to	Classroom Action Research	Interest Learning	The percentage of students' interest in learning at SDN

		Elementary School Students' Learning Interests.			Plamongansari 02 is classified as very high after implementing differentiated learning using the PBL model.
9	(Manalu et al., 2023)	The Effect of the PBL Model with Differentiated Learning Strategies on High School Students' Concepts and Process Science Skills	Quantitative	Understanding science Concepts and Process Science Skills	Students who learn using the PBL model with differentiated learning strategies have a better understanding of science concepts and process science skills than those using conventional learning.
10	(Shafira et al., 2023)	Application of the Problem Based Learning Model Based on Differentiation Based on Students' Learning Styles in Biology Lessons on Ecosystem Material for Class X SMA	Qualitative Descriptive	Learning Style	Students have different learning styles, namely visual, auditory, and kinesthetic. Apart from that, the implementation of differentiation-based PBL has a positive impact, namely that students can express their potential according to their interests.
11	(Sarie, 2022)	Implementation of Differentiated Learning with the Problem Based Learning Model in Class IV Elementary School	Qualitative Descriptive		The implementation of differentiated learning makes students very

		Students			happy and enthusiastic about participating in learning.
12	(Hadi et al., 2022)	Differentiated Learning Design Containing Problem Based Learning (PBL) Supports Students' Critical Thinking Skills in the New Normal Era Post-Covid-19 Pandemic	Library Research	Critical Thinking Skills	The design of differentiated learning strategies contains problem based learning through literacy, critical thinking, collaboration, communication and creativity stages.
13	(Mulbar et al., 2018)	Application of the Problem Based Learning Model with Differentiated Learning Strategies for Class VIII Students	Classroom Action Research	Learning Outcomes	Student learning outcomes have increased.
14	(Fitra, 2022)	Differentiated Learning from a Progressivism Perspective in Science Subjects	Literature Review	Application of Differentiated learning	The application of differentiated learning in science lessons is in accordance with John Dewey's progressivism school, namely that education develops according to the times and students are given the freedom to develop their potential and abilities.
15	(Sumarni, 2023)	Efforts to Increase Student Interest in Learning Through Differentiated Learning with the	Classroom Action Research	Interest Learning	Differentiated learning with the Problem-Based Learning (PBL)

		Problem Based Learning Model in Social Sciences Lessons			learning model can increase students' interest in learning in social studies lessons.
16	(Suwartiningsih, 2021)	Application of Differentiated Learning to Improve Student Learning Outcomes in Science Subjects, Land, and Life Sustainability in Class IXb, Even Semester, SMPN 4 Monta, Academic Year 2020/2021	Classroom Action Research	Learning Outcome s	Increasing student learning outcomes in science subjects on the subject of land and the sustainability of life in the classroom

Based on the results of the analysis of 16 journal articles regarding the application of differentiated learning using the PBL model, the following data can be presented, namely that the type of research used is mostly classroom action research. There are still very few types of development, qualitative and quantitative research. This makes it possible to carry out other research related to this research topic using development, qualitative, and quantitative methods. The research instruments used mostly test instruments because they measure learning outcomes from the cognitive aspect. Meanwhile, another instrument used was a questionnaire to determine learning styles, learning interests, and attitudes towards implementing differentiated learning integrated with problem based learning.

Based on the research results above, the implementation of differentiated learning through problem-based learning has gone well. This can be seen from students who are able to learn naturally. Apart from that, differentiated learning also makes students learn efficiently because they can learn according to their respective learning styles. For example, students can learn according to visual, auditory or kinesthetic learning styles. Students also feel happy and more enthusiastic in participating in learning.

Apart from that, the impact of differentiated learning through problem based learning on the results of this research includes being able to improve student learning outcomes. Student learning outcomes include learning outcomes for physics, science, social studies, science process concepts and skills. Apart from that, differentiated learning is also able to develop literacy, critical thinking, collaboration, communication and creativity. The impact of differentiated learning also allows students to develop their potential and abilities according to their interests. Students' HOTS abilities when using differentiated learning through PBL also increase. This learning is also able to have an impact on changes in student behavior in learning. Students' interest in learning was very high after differentiation learning was implemented using the PBL model.

The results of the literature review show that learning outcomes are the variables most often measured in the application of differentiated learning. Apart from learning outcomes, other variables measured are learning interest, learning style, and critical thinking skills. This shows that the dependent variable measured in differentiated

learning is still very limited and less varied. So, if it is related to 21st century skills, research on the application of differentiated learning using the new problem based learning model reaches critical thinking skills. For other skills, namely the ability to collaborate, communicate, and have creative thinking skills, no relevant research has been found. Previous research also revealed that problem based learning can improve students' critical and creative thinking abilities (Ulger, 2018).

Teachers' obstacles in implementing differentiated learning using the problem based learning model are difficulties in preparing diagnostic assessments, carrying out diagnostic assessments, compiling appropriate content, implementing differentiated learning using the PBL learning model according to the grouping of learning style needs, and giving assignments that must be in accordance with each student's learning style (Sumarni, 2023). The challenges in differentiated learning are the large number of students, lack of time for planning, and limited group activities in learning (Pande Nyoman et al., 2022).

Another finding from the article review is that science learning has not applied the essence of science as a whole. The essence of science is science as a product, science as a process, and science as an attitude (Sayekti, 2019). Only research from Manalu et al. (2023) measures process skills in differentiated learning with the PBL model. In this research, data showed that students' science process skills increased through this learning because they were able to build understanding and knowledge through their own experiences.

The data obtained from the analysis of research results indicates that there is still little data regarding the use of the four components of differentiated learning, namely content differentiation, process differentiation, product differentiation, and learning environment. Content differentiation is carried out through students' readiness, interests, and learning profiles. Process differentiation is carried out through tiered activities, developing varied activities, and grouping students according to their characteristics. Product differentiation can be done by giving students choices in how to express their desired learning (Hadi et al., 2022). Meanwhile, the learning environment includes the personal, social, and physical structure of the class (Wahyuningsari et al., 2022).

However, in general, the implementation of PBL-integrated differentiated learning can accommodate all students' needs in studying science according to the students' interests and learning profiles. Differentiated learning is able to provide opportunities for students to show what they understand (Mulyawati et al., 2022) and is recognized as effective learning to achieve maximum learning outcomes (Variacion et al., 2021), especially cognitive learning outcomes. Cognitive abilities are abilities related to the participant's mastery in the cognitive domain. Anderson, L. W., & Krathwohl (2002) revealed that the cognitive domain contains behavior that emphasizes intellectual aspects, such as knowledge, and thinking abilities such as lower-order thinking skills (LOTS), middle-order thinking skills (MOTS), and higher-order thinking skills (HOTS). Hardianti (2018) stated that analyzing students' cognitive abilities is important to help teachers find out their academic achievement and the level of achievement of students' cognitive abilities during the learning process. The results of this research can contribute to improving the implementation of differentiated learning, especially in using problem based learning. Apart from that, it can be used as a reference in improving the differentiated learning process.

CONCLUSION

Based on the literature review that has been carried out, it can be concluded that: 1) The principle of implementing differentiated learning using the problem based learning model is carried out through four components, namely content differentiation, process differentiation, product differentiation, and learning environment differentiation.

2) The application of differentiated learning with a problem based learning model has an impact on student learning outcomes. 3) Teachers' obstacles in implementing differentiated learning using the problem based learning model are difficulties in preparing diagnostic assessments, carrying out diagnostic assessments, compiling appropriate content, implementing differentiated learning using the PBL learning model according to the grouping of learning style needs, and giving assignments that must be in accordance with learning styles every student.

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