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Differentiated Learning Strategies on Students' Science Learning Outcomes: A Systematic Literature Review

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Abstract: In the independent curriculum, differentiated learning is known. Differentiated learning views students differently and dynamically. In this case, teachers view learning from various perspectives. However, this does not mean that differentiated learning is individualized learning. Differentiated learning is a learning approach that adapts learning to the needs of students starting from interests, learning styles, student readiness and other characteristics. In the process, differentiated learning consists of two types, namely differentiation based on learning styles and differentiation based on learning abilities. This study aims to explore differentiated learning related to the research design used, the right learning model, the effect of differentiated learning on students' science learning outcomes and the profile of the use of differentiated learning in science learning at various levels of education. This study is a systematic literature review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses method. Publish or perish was used to collect data from Google Scholar with a span of 2021-2025, 1000 articles were identified and filtered based on criteria, resulting in 15 articles that met the criteria. Research on differentiated learning mostly uses Classroom Action Research (CAR) design. The learning model that is widely used is by combining differentiated learning strategies. Differentiated learning has a positive impact on student learning outcomes and activities. Differentiated learning can be applied at every level of education.

Keywords: Differentiated; Learning outcomes; Science

Introduction

New paradigm learning provides flexibility for educators to formulate learning and assessment designs according to student characteristics and needs. New paradigm learning ensures student-centered learning practices. Learning is a cycle that begins with mapping competency standards, planning the learning process, and implementing assessments to improve learning so that students can achieve the expected competencies (Wijayanto et al., 2024). The competencies in question are 21st century skills, namely Communication, Collaboration, Critical thinking and Problem Solving, and Creativity and Innovation skills (Dewi & Arifin, 2024). These skills must be mastered by students in order to prepare themselves to enter the world of work and real life. Science learning is contextual learning that provides direct learning experiences to students, and guides students to have basic scientific concepts that are applied in everyday life (Munkebye & Staberg, 2023). Therefore, it is necessary to present creative, innovative and fun learning in order to arouse students' interest in being able to actively discover the concepts, principles, theories and facts of science that are developed (Sitorus et al., 2022). Science learning in the Independent Curriculum has two elements, namely understanding science related to high-level thinking skills (HOTS) and process skills as an effort to hone thinking skills in investigations or research (Novita et al., 2023).

However, in reality, teachers are often fixated on the target of completing the material presented to students, without paying attention to the process and meaningful understanding in the learning. Science learning in schools faces several challenges that hinder the

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effectiveness of learning. Low student learning outcomes are often caused by monotonous and teacher-centered learning models that limit student activity (Amalia & Ratnaningrum, 2025). This is reinforced by the results of the 2018 Programme for International Student Assessment (PISA) survey published in March 2019, which portrayed the problems of Indonesian education. Indonesian students are still in the lowest ranks for reading, mathematics, and science measurements. In the reading ability category, Indonesia is ranked 6th from the bottom (74) with an average score of 371. Addition, the lack of adequate laboratory facilities and practical equipment can hinder the understanding of abstract concepts from the material being studied (Festiyed & Iswari, 2018).

There are several things that cause low student learning outcomes, including: teachers explain the material too quickly, learning media that are not optimally equipped, learning strategies still use strategies that are no longer varied, the delivery of material by teachers seems monotonous, the material delivered is not fully considered by students properly, lack of student response in expressing their opinions and knowledge during the learning process (Jensen et al., 2021). Differences in student abilities that are often ignored because of a uniform teaching approach are also an obstacle (Puspita et al., 2023). A teaching approach that is the same for every student certainly cannot meet the needs of every student, because their needs are also diverse. Therefore, a teaching approach is needed that is able to meet the needs of each student. In the independent curriculum, differentiated learning is known. Differentiated learning views students differently and dynamically. In this case, teachers see learning from various perspectives. However, this does not mean that differentiated learning is individualized learning.

Differentiated learning is a learning approach that adapts learning to the needs of students starting from interests, learning styles, student readiness and other characteristics (Maulani et al., 2023). In the process, differentiated learning consists of two types, namely differentiation based on learning styles and differentiation based on learning abilities. The form of differentiated learning in the classroom can include four types, namely, process differentiation, product differentiation, environmental differentiation and content differentiation. Process differentiation relates to differences in the learning process by providing tiered activities, having guiding questions or challenges, creating individual student agendas, varying time, developing varied activities, and using easy grouping. Product differentiation relates to differences in billing products to students by providing challenges or diversity of variations and choosing what products they are interested in. Differentiation of the learning environment can be done by providing variations or differences in the atmosphere of the learning place. Content differentiation relates to differences in the content of the material taught to students in response to students' learning readiness, interests, or learning profiles (visual, auditory and kinesthetic) or even a combination of the three. Students with a tendency towards a visual learning style are able to process information well by seeing.

Generally, they enjoy using visual media such as: pictures, diagrams, videos, posters, animations, concept maps, colors, symbols, and graphics to help them process information. Compared to students with a typical visual learning style, students with a tendency towards an aural learning style are able to process information well by listening. Students listen to lectures, attend tutorials, stories and jokes to be able to understand information. And the last is students with a kinesthetic learning style. Students with a tendency towards a kinesthetic learning style, find it easier to absorb information by practicing directly. When in class, they use all five senses to understand information; going to the laboratory for field visits; using the "trial and error" method; and listening to and remembering real examples that are happening (Alhafiz, 2022). Several research results on differentiated learning show that differentiated learning can improve student learning outcomes (Suwartiningsih, 2021; Wardaniati, 2023; Saparwadi et al., 2023). This is in line with the research results of Fitri & Erita (2023), showing that the application of the Discovery Learning and Problem Based Learning models based on differentiated learning can improve student learning outcomes.

Research by Astiti et al. (2021), Tanesib et al. (2022), and Rezkia et al. (2024), shows that the development of teaching materials based on differentiated learning can improve student learning outcomes. Furthermore, the results of research by Saputri et al. (2025) and Safitri & Admoko (2024), show that the application of differentiated learning assisted by learning media such as Quizizz and PhET is effective in improving student learning outcomes and learning activities. Student learning activities in the learning process are one indicator of the desire to ask questions, submit opinions, do assignments and answer teacher questions. With student activity, it will create better learning motivation which will ultimately improve student learning outcomes. Based on the description above, the formulation of the problem to be answered through this research is as follows: What are the research designs that use differentiated learning in science learning? What are the learning models that use a differentiated approach in science learning?; Does differentiated learning affect students' science learning outcomes?; and What is the

profile of the implementation of differentiated learning at the level of education?

Method

This SLR process uses the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method to evaluate and filter relevant articles on the effects of differentiated learning on science learning. The first step is to determine the research needs and set clear objectives to identify the effects of differentiated learning on science learning outcomes. The main keywords used in the article search include "differentiated learning", "differentiated," learning outcomes", and "science". Using the Publish or Perish search engine, data was collected from Google Scholar. The articles searched were limited to between 2021 and 2025. The next stage is the identification stage, which aims to examine the same articles. The same articles will be excluded from the analysis. Furthermore, the article title screening stage is based on the title containing differentiated learning in science learning.

The next screening stage is carried out by reading the article abstract. The articles included are based on the following criteria, namely: research results explaining the effect of differentiated learning on science learning, research using qualitative, quantitative, research and development methods, and research areas at elementary and secondary education levels. Articles that pass this stage are then reviewed thoroughly to ensure that they meet all the inclusion criteria that have been set. To maintain objectivity, the review process is carried out by two researchers simultaneously. If there are differences in the review results, a discussion is held to reach an agreement. This aims to minimize bias and ensure the accuracy of the selection process. The entire procedure is explained in detail in Figure 1.

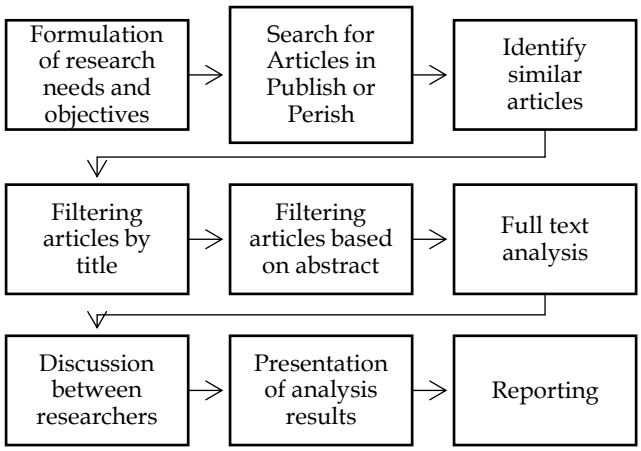

Figure 1. Data collection, analysis, and reporting procedures

The data obtained are presented systematically in the form of tables to facilitate interpretation and preparation of reports. The article selection process is described in a PRISMA diagram that includes the number of articles found in the initial stage, the number of articles excluded during screening, and the number of articles fully analyzed and finally used in the study. The final result of this process is a comprehensive report on the effect of differentiated learning on science learning. With these steps, the SLR process is carried out systematically, transparently, and accountably.

Result and Discussion

This literature review aims to provide information related to research designs that use differentiated learning in science learning, learning models that use differentiated approaches in science learning, types of learning outcomes influenced by differentiated approaches in science learning, and profiles of differentiated learning implementation at educational levels. This search resulted in 1000 articles. Then, identification was carried out to find articles that had similarities so that 33 articles were obtained. A total of 925 articles that did not have similarities were then reviewed based on their titles. A total of 17 articles used the literature study method. The criteria used to select articles were articles that contained differentiated approaches in science learning. This screening process resulted in 25 eligible articles. The screening process was continued by reading the abstract. The selection of articles was based on several criteria: articles that explained the influence of differentiated approaches on science learning, articles on qualitative, quantitative, and research and development research methods, and the screening process resulted in 15 articles. The entire identification and screening process is explained in detail in Figure 2.

Based on 15 articles that have been analyzed, there are several research designs that are commonly used in differentiated learning research in science subjects. Several research designs found are presented in Figure 3.

Research using the Classroom Action Research (CAR) research design is the most widely used, this design is generally used to see the effectiveness of implementing differentiated learning in the classroom context. CAR is usually carried out in several cycles, with each cycle including planning, action, observation, and reflection. Research by Nefianthi et al. (2023), Asnawi et al. (2024), and Hidayat et al. (2024), used CAR to see the effect of differentiated learning on student learning outcomes. Research using the Experimental research design, this design aims to test the effect of differentiated learning on student learning outcomes in

a more controlled manner. Experimental designs usually involve two groups, namely the experimental group that receives differentiated learning treatment and the control group that receives conventional treatment. Research by Akhiruddin et al. (2024) and Dalila et al. (2022), used an experimental design to test the effect of differentiated learning on student learning outcomes. Research using the Development or R & D research design, this design aims to produce differentiated learning products, such as teaching modules or student worksheets (LKPD).

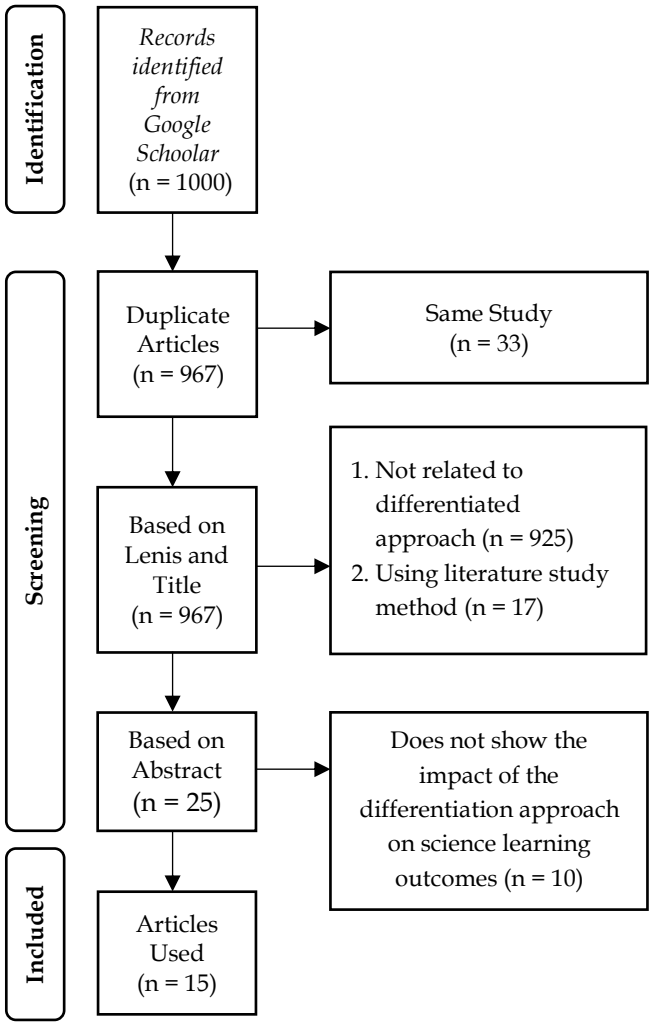

Figure 2. PRISMA diagram

Research by Kurniasi et al. (2025), uses a development design to produce LKPD based on differentiated learning to improve student learning outcomes. Research using a Qualitative research design, this design aims to analyze differentiated learning can address the diversity of student needs and the impact of differentiated learning (Fadhilah et al., 2023; Dhani et al., 2023). Several models/approaches commonly used in research on differentiated learning in science learning found in the 15 articles are presented in Figure 4.

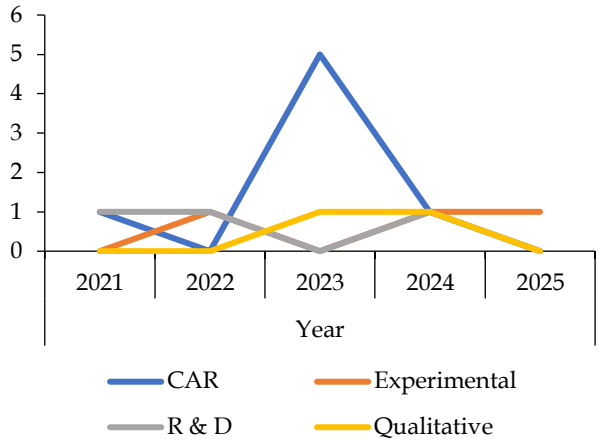

Figure 3. Commonly used research designs from 2021-2025

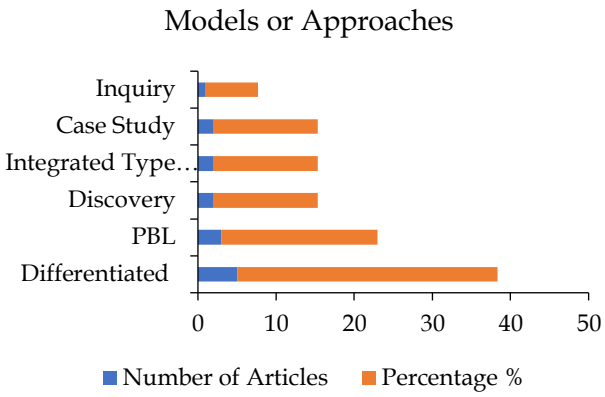

Figure 4. Commonly used models or approaches

Research using a differentiated learning approach, this strategy emphasizes adjusting learning to students' learning styles. Teachers can divide students into groups based on their learning styles, such as visual, auditory, and kinesthetic. Then, the teacher provides materials and assignments that are appropriate to the learning style of each group. Research by Fahrozi & Sutikno (2024), uses a differentiated learning model and has been proven to improve student learning outcomes. Research using the Problem-Based Learning (PBL) model, this model emphasizes solving real problems faced by students Faqiroh (2020). The teacher acts as a facilitator who helps students identify problems, gather information, develop strategies, and evaluate results. The PBL model can be integrated with differentiated learning to accommodate the various learning needs of students. Research by Buntu et al. (2025) and Dewi et al. (2023), used the PBL model integrated with differentiated learning. Research using the Discovery Learning model, this model encourages students to

discover their own knowledge through the process of exploration, observation, and investigation (Ningrum et al., 2022; Hasmirah et al., 2024). The teacher acts as a facilitator who provides opportunities for students to learn actively and find their own answers to the questions asked (Sun et al., 2023).

The Discovery Learning model can be integrated with differentiated learning to accommodate various learning styles of students. Research by Trihartini et al. (2025) and Ilma et al. (2024), used the Discovery Learning model integrated with differentiated learning. Research using the Connected Type integrated learning model, this model is an integration that can connect materials in the same lesson, with the assumption that students cannot automatically understand the relationship between the material being studied and other materials. The connected integration model emphasizes the need for integration between the fields of study themselves. Research by Silfiyani et al. (2024) and Maulida et al. (2024), used the integrated Connected Type learning model integrated with differentiated learning in the development of teaching materials. Research using the case study approach, this approach collects data through direct observation, in-depth interviews with teachers and students, and documentation analysis, which is then analyzed using triangulation techniques to ensure the validity and reliability of the results. Research by Kholidah et al. (2024), Wahyudi et al. (2023), and Sujadi et al. (2024), used the case study approach to evaluate the application of differentiated learning in classroom learning.

Research using the Inquiry model, this model allows students to obtain information while exploring knowledge independently through the process of asking questions, testing hypotheses, and drawing conclusions. The inquiry model provides opportunities for students to hone their critical, creative thinking skills, and problem-solving abilities, which provides space for students to be actively involved in the midst of learning activities. Research by Rahmawati et al. (2024), Nur'aini et al. (2023), and S et al. (2025) used the integrated inquiry model of differentiated learning. Differentiated learning has been shown to have a positive effect on students' science learning outcomes. Most studies show that the application of differentiated learning can improve students' science learning outcomes. Research by Kobi et al. (2023), shows a significant increase in student learning outcomes after implementing differentiated learning. Research by Arsita & Astawan (2022), used the N-gain test to measure the effectiveness of treatment on learning outcomes (Fortuna & Aeni, 2024).

The results showed that differentiated learning based on the inquiry model with PhET media was more effective in improving students' science learning outcomes compared to conventional learning. Increasing student activity is also an indicator of the success of differentiated learning. Research by Mukhibat (2023) and Prihandono et al. (2023), shows that the application of differentiated learning can increase student activity in the learning process. Differentiated learning can be applied at several levels of education. Based on Figure 5, the influence of differentiated learning in science learning can improve student learning outcomes at the Elementary School (SD) level with a percentage of 47%. Differentiated learning can also be applied at the Junior High School (SMP) and Senior High School (SMA) levels with percentages of 33% and 20% respectively.

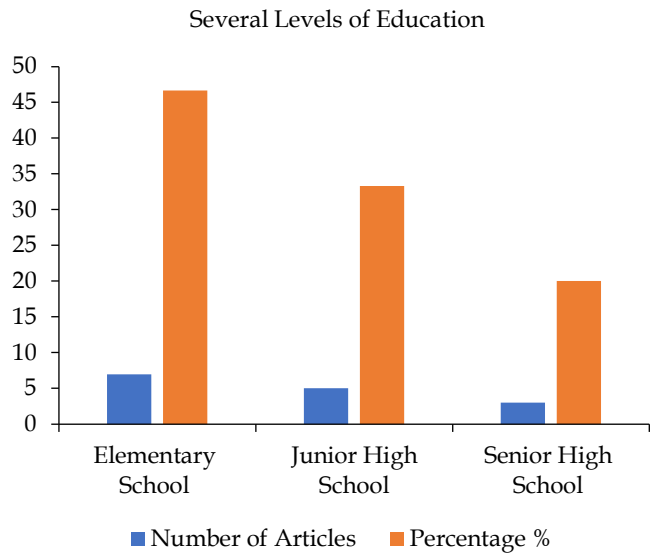

Figure 5. Application of differentiated learning at several levels of education

Conclusion

Differentiated learning is an effective approach in science learning. The results of the literature review show that in the period 2021-2025, research on differentiated learning mostly uses the Classroom Action Research (CAR) design. The learning model that is widely used is the differentiated learning model. Differentiated learning has a positive impact on student learning outcomes and activities. The implications of this review indicate that educators and researchers need to continue to integrate differentiated learning into science learning practices to improve learning effectiveness.

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I.G.Y.P. searched for articles, analyzed data, and wrote the manuscript; I.W.R. and I.N.T. reviewed the manuscript. All authors have read and approved the published version of the manuscript.

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The author declares no conflict of interest in writing this article.

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