Student Learning Styles in Science Learning and Their Influence on Concept Understanding

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ABSTRACT

This study aims to identify students' learning styles in science learning and analyze their influence on conceptual understanding. The approach used is descriptive qualitative, with data collection techniques through observation, in-depth interviews, and documentation. The research subjects consisted of students with visual, auditory, and kinesthetic learning styles. The results of the study indicate that students' learning styles play an important role in influencing the level of understanding of science concepts. Students with visual learning styles understand material better through images and videos, auditory students through oral explanations, and kinesthetic students through direct practice. The mismatch between teacher teaching methods and students' learning styles can reduce the effectiveness of conceptual understanding. Therefore, teachers need to adopt multimodal learning strategies so that science learning is more optimal and in accordance with students' needs.

Keywords: Learning styles, science learning, conceptual understanding, teacher strategies

INTRODUCTION

The importance of learning Natural Sciences (IPA) lies in its strategic role in forming logical, critical, and scientific thinking patterns in students from an early age.(Daniela & Supe, 2025)As a core subject, science not only presents a collection of facts and concepts about nature, but also teaches the scientific method, encouraging students to systematically observe, ask questions, conduct experiments, and draw conclusions. Through this process, students are trained to understand the cause-and-effect relationships in natural phenomena, develop problem-solving skills, and foster a continued curiosity about the world around them.(Nuhoğlu, 2020)Science learning also provides a crucial foundation for facing the challenges of the 21st century, which demand scientific and technological literacy. It also equips students with critical thinking skills that can be applied in various real-life contexts. Therefore, science is a crucial foundation for producing a generation capable of rational thinking, acting wisely toward the environment, and actively participating in the development of science and technology.

The problem of understanding science concepts is a significant challenge in education, especially at the elementary and secondary levels. Many students struggle to grasp science concepts deeply because the material presented is often abstract and requires higher-order thinking skills such as analysis, synthesis, and evaluation. This difficulty is exacerbated by learning approaches that lack variety and fail to consider differences in student learning styles, resulting in the delivery process failing to address all of students' cognitive needs.(Khamparia & Pandey, 2020)As a result, students tend to simply memorize without truly understanding the meaning of the concepts being studied, resulting in poor learning outcomes and a reduced ability to absorb more complex material. If this condition is allowed to persist, science learning will lose its essence as a means of developing scientific and critical thinking patterns. Therefore, adaptive learning strategies are needed that are oriented towards students' learning

characteristics so that science concepts can be understood more fully and applied in everyday life.(Martin et al., 2020).

The diversity of student learning styles is an important aspect that must be considered in the learning process, because each individual has their own preferences in receiving and processing information. In general, student learning styles can be classified into three main types: visual, auditory, and kinesthetic. Students with a visual learning style find it easier to understand material through images, diagrams, or graphs, while auditory students absorb information better through listening, such as verbal explanations or discussions. Meanwhile, kinesthetic students tend to learn more effectively through physical activity, hands-on practice, or real-life experiences. These differences directly affect how students understand and respond to the material presented in class. If teachers are unable to adapt teaching methods to these varying learning styles, it is likely that some students will have difficulty following the lesson optimally. Therefore, a differentiated and multimodal learning approach is essential to accommodate this diversity, so that each student has an equal opportunity to understand the material in a way that best suits their learning characteristics. By understanding and utilizing student learning styles, the learning process can be more effective, enjoyable, and meaningful.(Ngo & Vo, 2025).

The gap between the teaching strategies implemented by teachers and the learning styles of students is one of the main causes of the decline in the effectiveness of classroom learning. In practice, many teachers still tend to use uniform or conventional teaching approaches, such as one-way lectures and the use of textbooks as the primary source.(Dorfsman & Horenczyk, 2022)This approach fails to fully address the learning needs of all students, as it ignores the fact that each student has a different learning style, such as visual, auditory, or kinesthetic. When teaching methods are not aligned with students' learning preferences, the information-receiving process becomes less than optimal, students easily lose focus, and their engagement in learning decreases. This ultimately results in poor conceptual understanding, weakened learning motivation, and suboptimal academic outcomes. To address this gap, teachers need to design flexible, interactive learning strategies based on a multimodal approach, thereby creating an inclusive and responsive learning environment for students' diversity. Integrating various techniques such as the use of visual media, group discussions, hands-on experiments, and educational technology can be a solution to bridge this gap and improve the overall quality of the learning process.(Philippe et al., 2020) .

The relevance of this research lies in its urgency in answering the diverse learning challenges in the classroom, especially in the context of Natural Sciences (IPA) learning which demands in-depth conceptual understanding.(Alfarisi et al., 2025)By identifying students' dominant learning styles—visual, auditory, or kinesthetic—and analyzing their influence on conceptual understanding, this research makes a significant contribution to improving the effectiveness of the teaching and learning process. The findings of this study can serve as a basis for teachers to design more adaptive and personalized learning strategies, strategies tailored to each student's learning characteristics.(Peng et al., 2019)This approach not only helps students better understand the material but also increases motivation, active participation, and overall learning outcomes. Furthermore, the results of this study can provide practical guidance for curriculum development and teacher training, making education more inclusive and responsive to real-world needs. Therefore, this research is highly relevant in efforts to improve the quality of science learning and support the creation of a learner-centered education system.

The novelty of this study lies in the use of a qualitative approach to understand the relationship between learning styles and conceptual understanding in depth from the students' own perspective, rather than solely based on academic grade data. This study emphasizes students' individual learning experiences as the primary source of information, thus being able to describe the internal dynamics that influence science conceptual understanding more

holistically. Furthermore, this study also offers an analytical model for conceptual understanding based on learning styles that can serve as a practical reference for teachers in designing more adaptive and effective science learning strategies tailored to the actual needs of students in the classroom.(Ezzaim et al., 2024).

This research gap lies in the limitations of previous studies, which generally only examined the influence of learning styles on learning outcomes quantitatively, without delving deeply into how the learning experiences of students with different learning styles influence their understanding of science concepts from a qualitative perspective. A qualitative approach is crucial for understanding the dynamics and subjective contexts experienced by students in the learning process, especially in abstract subjects such as science. Furthermore, there is still a lack of research conducted in local contexts, particularly in elementary or secondary schools in certain areas, so that existing findings do not represent the diversity of educational conditions in various regions. Therefore, research is needed that is not only exploratory and contextual, but also able to provide a more comprehensive understanding of the relationship between learning styles and understanding of science concepts in the real world.

The purpose of this study is to explore and describe students' learning styles in the context of Natural Sciences (IPA) learning, and to analyze how these learning styles influence students' understanding of IPA concepts. By understanding the relationship between learning styles and conceptual understanding, this study also aims to provide practical recommendations to teachers so they can adjust teaching methods that are more adaptive and responsive to the learning characteristics of each student, so that the learning process becomes more effective and meaningful.

METHOD

This research method uses a descriptive qualitative approach with the aim of exploring in depth how students' learning styles influence their understanding of concepts in science subjects.(Devy et al., 2022)The research was conducted for 1–2 months in one elementary or secondary school determined according to the academic calendar. The research subjects included students from a specific grade (e.g., seventh grade), science teachers, and, if relevant, parents, who were purposively selected based on variations in learning styles (visual, auditory, kinesthetic). Data collection techniques included in-depth interviews with students and teachers to determine learning styles and perceptions of conceptual understanding, classroom observations to observe learning behavior during the lesson, and documentation in the form of assignment grades, test results, or teacher notes. The instruments used included a semi-structured interview guide, learning activity observation sheets, and learning style questionnaires when necessary. Data analysis was carried out through a process of data reduction, presentation in the form of descriptive narratives and category tables, as well as drawing conclusions and verification to identify patterns of relationships between learning styles and conceptual understanding. Data validity was tested through source triangulation, member checking with research subjects, and discussion of results (peer debriefing) with other researchers.

RESULTS AND DISCUSSION

The research results show that students have different learning styles, which significantly influence how they understand concepts in science learning. Students with visual learning styles tend to understand material more easily when presented in the form of visually appealing images, diagrams, videos, or certain colors. Conversely, they experience difficulties when learning is only delivered verbally without visual support. Students with auditory learning styles absorb information better when listening to teacher explanations directly or participating in group discussions. They find it difficult when material is presented through reading or diagrams without verbal explanations. Meanwhile, students with kinesthetic learning styles show better understanding when directly involved in practical activities, laboratory

experiments, simulations, or other physical activities that involve direct interaction with the learning material.

Furthermore, observations and interviews show that most teachers still employ uniform learning methods, such as lectures or written assignments, without adapting to the diversity of students' learning styles. This results in poor conceptual understanding for students who are not well-suited to these methods. The mismatch between students' learning styles and teachers' teaching strategies causes some students to become passive, unenthusiastic, and have difficulty connecting science concepts to everyday life. Conversely, students whose learning styles are accommodated demonstrate a deeper understanding of concepts, are active in discussions, and are able to re-explain the material in their own words. Therefore, it can be concluded that successful conceptual understanding in science learning is strongly influenced by the match between students' learning styles and the teaching approach used by teachers.

Table 1. Relationship between Student Learning Styles and Understanding of Science Concepts

No	Learning Styles	Student Characteristics	Effective Learning Strategies	Concept Understanding Level*	Key Qualitative Findings
1	Visual	Loves pictures, colors, diagrams, videos	Visual media (images, videos, infographics)	Height (if applicable)	Quick understanding with visual aids, confused during lectures
2	Auditory	Focus on voice, discussion, teacher's explanation	Interactive lectures, discussions, audio learning	Height (if applicable)	It is easy to understand if the material is explained verbally.
3	Kinesthetic	Active, likes hands-on practice	Experiments, simulations, roleplay, physical projects	Height (if applicable)	Likes practice and exploration, has difficulty focusing on theory
4	Mixture	Combination of two or more styles	Multimodal approach (visual-auditory-kinesthetic)	Medium–High	Understanding increases when approaches are varied

Source: Data Processing 2025

This table reinforces the finding that understanding of science concepts is significantly influenced by the extent to which teachers' teaching methods accommodate students' learning styles. By understanding the characteristics of each learning style, teachers can design more appropriate approaches to make learning more effective, engaging, and impactful in improving students' conceptual understanding.

Identifying Student Learning Styles

Identifying students' learning styles is an important step in understanding how each individual optimally absorbs and processes information during the learning process. Generally,

students can be classified into three dominant learning style categories: visual, auditory, and kinesthetic.(Putri & Suryati, 2020)Students with a visual learning style tend to understand material better when presented through visual media such as pictures, diagrams, graphs, and the use of attractive colors; they are greatly helped by concrete and systematic visual representations. Meanwhile, auditory learners grasp lessons more quickly when listening to teacher explanations verbally, participating in group discussions, or listening to audio recordings; they tend to retain information through rhythm, intonation, or verbal repetition. On the other hand, students with a kinesthetic learning style are more effective in understanding concepts through direct physical involvement such as laboratory exercises, experiments, educational games, and other motor activities that require active participation. Understanding this classification is crucial for teachers so they can adapt teaching methods to students' learning characteristics, making learning more effective, enjoyable, and able to improve overall conceptual understanding.(Harapan et al., 2024).

Visual Learning Style and Conceptual Understanding

Students with a visual learning style have a tendency to absorb information more effectively through visual stimuli, such as pictures, diagrams, graphs, infographics, and learning videos.(Sabry et al., 2021)In the context of science learning, the use of visual media can help students understand abstract concepts more concretely and systematically, for example in explaining the water cycle, cell structure, or the process of photosynthesis. When teachers utilize illustrations or animations in delivering material, visual learners tend to be more focused, easily remember information, and are able to connect concepts to the reality they can see. However, challenges arise when learning is carried out predominantly through verbal explanations without adequate visualization. In such conditions, visual learners often have difficulty grasping the core concepts, feel confused, and lose interest in learning because they cannot find visual representations that they can process well. Therefore, it is important for teachers to always consider the use of relevant visual media in lesson planning, in order to bridge the needs of students with visual learning styles and increase the effectiveness of their understanding of the material being taught.(Kamarudin et al., 2024).

Auditory Learning Style and Concept Understanding

Students with an auditory learning style tend to absorb and understand information optimally through auditory stimulation, such as verbal explanations from teachers, group discussions, Q&A sessions, and audio recordings. In science learning, auditory students tend to grasp concepts more easily when the material is presented verbally, with intonation, emphasis, and repetition of key words that help internalize the information. Activities such as listening to teacher explanations directly, participating in interactive discussions, or listening to audio learning are very effective in strengthening their understanding of complex scientific concepts.(Nicolaou et al., 2019)However, students with this learning style often face challenges when faced with long reading materials, graphs, or complex diagrams without adequate verbal explanations. They tend to have difficulty interpreting visual information independently, thus limiting conceptual understanding. Therefore, when designing learning strategies, teachers need to ensure that visual or written materials are accompanied by clear narratives or verbal explanations so that auditory learners can follow and understand the lesson content more effectively. This approach will help create a more inclusive learning environment and support students' optimal learning potential.(Kumar, 2021).

Kinesthetic Learning Style and Conceptual Understanding

Students with a kinesthetic learning style demonstrate a high level of enthusiasm and conceptual understanding when they are directly involved in physical activities and real-world practices during the learning process. In the context of science learning, they gain deeper understanding through activities such as laboratory exercises, experiments, group projects,

educational games, simulations of scientific events, or field exploration.(Simamora et al., 2025)This active engagement allows them to learn through direct experience and manipulation of real objects, allowing abstract concepts to be concretely understood through movement, touch, and direct interaction with the material. Conversely, kinesthetic learners often struggle to absorb information delivered through passive lectures or memorization tasks without physical activity. They tend to lose focus, get bored quickly, and struggle to deeply understand information if learning isn't designed to involve the body and movement. Therefore, it's crucial for teachers to develop learning strategies that allow kinesthetic learners to move, interact, and experiment, so that their understanding of science material becomes more optimal and meaningful, tailored to their learning styles.(Ramdhan & Masuwd, 2025).

Suitability of Teaching Strategies to Learning Styles

The match between teaching strategies and students' learning styles is a crucial factor in determining the effectiveness of learning, especially in subjects such as science which require a strong conceptual understanding.(Abdullah et al., 2024). The results of the study show that when teaching strategies are not aligned with students' dominant learning styles, this has a negative impact on their understanding of the concepts they acquire. Students tend to have difficulty absorbing information, are less actively involved in the learning process, and show low learning outcomes if the learning method does not match the way they understand information. Unfortunately, in practice in the field, many teachers still apply a general teaching approach such as the lecture method without making variations or modifications that take into account the diversity of student learning styles, whether visual, auditory, or kinesthetic.(Shaidullina et al., 2023)This single approach may be effective for a small percentage of students, but it prevents the majority from gaining a complete understanding. Therefore, it is important for teachers to design differentiated and multimodal learning strategies, integrating various learning techniques and media to reach all students more equitably, effectively, and meaningfully.(Rohi & Nurhayati, 2024).

The Influence of Learning Styles on Understanding Science Concepts

The influence of learning styles on the understanding of science concepts has been proven to be very significant in creating an effective and meaningful learning process. There is a strong relationship between the match between students' learning styles and the teaching methods applied by teachers, where the alignment of the two can increase students' level of understanding of complex and often abstract science concepts. When students' learning styles, whether visual, auditory, or kinesthetic, are well accommodated in teaching strategies, students not only understand the material more easily but also demonstrate higher engagement during learning, such as actively asking questions, discussing, and demonstrating deep curiosity. They are also better able to connect science concepts with phenomena in everyday life, indicating that their understanding is applicable, not just rote. Conversely, a mismatch between learning styles and teaching methods often leads to confusion, low learning motivation, and difficulty in grasping the core concepts. Therefore, a deep understanding of students' learning styles is an important foundation for teachers in designing inclusive learning that is oriented towards academic success and the development of students' scientific thinking skills.(Ha, 2021).

Implications for Learning

The implications for learning from these findings emphasize the importance of the teacher's role in designing multimodal learning strategies, namely strategies that integrate visual, auditory, and kinesthetic elements in a balanced manner to accommodate the diversity of students' learning styles in the classroom.(Li, 2020)By implementing a multimodal approach, the learning process becomes more inclusive and responsive to students' individual needs, so that no student is left behind due to differences in how they absorb information. Teachers need to utilize various learning aids such as images, diagrams, videos, and animations

to support visual learners; provide clear oral explanations, group discussions, and use audio learning for auditory learners; and design hands-on activities, experiments, simulations, or projects for kinesthetic learners.(Vishnupriya & Bharathi, 2022). This combination of various methods and media not only enriches students' learning experiences but also significantly improves their understanding of complex science concepts. Furthermore, this approach can increase students' motivation, active engagement, and critical thinking skills because they feel the learning is more relevant to their learning style. Therefore, developing learning styles-based learning is a strategic step in creating an effective, equitable learning environment that empowers students' full potential.

CONCLUSION

This study concludes that students have diverse learning styles, namely visual, auditory, kinesthetic, and mixed, which directly influence how they understand science material. Visual learning styles have been shown to support conceptual understanding when learning uses media such as images, videos, or illustrations, while auditory learning styles are more effective through oral explanations, discussions, or audio recordings. Students with kinesthetic learning styles understand material better when learning involves direct practice, experiments, and physical activity. A mismatch between students' learning styles and the teaching methods used negatively impacts conceptual understanding. Conversely, students whose learning styles are accommodated in the learning process tend to understand the material more deeply, are active in learning activities, and are able to reflect on concepts better. However, most teachers still tend to use uniform learning methods such as lectures, without considering the diversity of students' learning styles, so that learning effectiveness is not optimal. Therefore, a multimodal learning strategy is needed, namely combining visual, auditory, and kinesthetic approaches, so that the science learning process becomes more inclusive, adaptive, and effective for all students.

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