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The Effectiveness of the Visual, Auditory, and Kinesthetic Approach on High School Students' Understanding of Static Fluid Concepts: A Systematic Literature Review

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Abstract

Static fluid material often poses challenges in the physics learning process, as it involves complex abstract concepts for students to grasp. To address this issue, the VAK (Visual, Auditory, Kinesthetic) approach is considered a viable pedagogical alternative, allowing for teaching methods to be adapted based on students' learning styles. This study aims to evaluate the effectiveness of the VAK approach in enhancing the understanding of physics concepts, particularly in static fluid mechanics, using the Systematic Literature Review (SLR) method. Nineteen scientific articles published between 2016 and 2025 were analyzed in depth. The study focused on the application of visual strategies (through images and animations), auditory strategies (group discussions and verbal explanations), and kinesthetic strategies (practical experiments and interactive simulations). These articles were selected based on criteria such as full access to the manuscripts, clear relevance to the VAK approach in the context of physics education—particularly on static fluids—and having undergone peer review. The approach's effectiveness was evaluated by examining its contribution to enhancing students' conceptual understanding, reducing misconceptions, and fostering active engagement during learning activities. The analysis results indicate that the application of the VAK approach plays a significant role in helping students understand core concepts, such as hydrostatic pressure, Pascal's Law, and Archimedes' Principle, more comprehensively. This approach also enhances learning motivation and strengthens the connection between physics material and phenomena in everyday life. Therefore, the VAK approach can serve as a foundation for designing learning strategies responsive to students' learning styles. Furthermore, this approach has the potential to contribute to the development of more inclusive and contextual educational policies, as well as fostering physics learning experiences that are not only meaningful but also enjoyable.

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INTRODUCTION

Physics education is crucial for building students' scientific understanding and critical thinking skills. However, reality shows that many students still have difficulty understanding physics concepts, especially abstract and complex ones. This is often due to learning methods that emphasize memorizing formulas without a deep understanding (Heranyanti et al., 2021; Prastiwi et al., 2018). This situation highlights the need for a paradigm shift in physics learning from a results-oriented approach to one that emphasizes an in-depth understanding of concepts. Good concept understanding is important for mastering procedural knowledge at the next stage (Nisrina et al., 2016).

One physics topic that often causes students difficulties in understanding is static fluid materials. These difficulties arise because the material contains complex and abstract concepts, such as hydrostatic pressure, Pascal's Law, and Archimedes' Principle, which are not easily imagined or observed directly (Puspita et al., 2019; Yadaeni et al., 2018). A low understanding of these concepts often leads to misconceptions that can persist at higher levels of education (Dyahesita et al., 2019). For example, many students still understand pressure as a force that is always pointing downward (Kariotoglou & Psillos, 2019). This situation highlights the need for alternative approaches to bridge the gap between the material's characteristics and the way students learn. The VAK (Visual, Auditory, Kinesthetic) approach is considered relevant for addressing this challenge. This approach integrates the three main learning styles—visual, auditory, and kinesthetic—enabling students to access information through the channel that is most aligned with their learning preferences (Lutfiana et al., 2021; Siswadi et al., 2018). By providing students with the space to learn independently and actively according to their learning styles, the VAK approach can make the learning process more effective and meaningful (Rahmaniar et al., 2024). Shaidullina et al., (2023) emphasized that learning models based on learning styles, such as VAK, have a positive impact on students' cognitive achievements, as they enable information processing that aligns with individual tendencies and strengthens internal motivation. emphasized that learning models based on learning styles, such as VAK, positively impact students' cognitive achievements, as they enable information processing that aligns with individual tendencies and strengthens internal motivation.

In the context of static fluid, the application of VAK has high potential because the abstract nature of the material can be simplified through visualization and direct experience. Visual strategies, including images, diagrams, and simulations, help students understand the structure and interconnections among concepts (Kuswanto et al., 2023). Interactive discussions, verbal explanations, and question-and-answer sessions are practical for students with auditory-learning tendencies. Meanwhile, students with kinesthetic learning styles benefit more from hands-on practices, such as simple experiments or manipulation of concrete objects (Mahadi et al., 2022). Combining these three strategies can strengthen concept construction and reduce misconceptions, especially for abstract topics.

In addition, the VAK approach allows teachers to design learning according to student profiles. Teachers who understand students' learning styles can design relevant and engaging learning strategies and activities. According to Utaminingsih in

Visual-based learning media can help students who are vision-dominant understand the structure and relationships between concepts. Auditory students will be helped more by this study (Kuswanto et al., 2023). The stages of VAK learning include preparation, delivery, training, and performance evaluation, which encourage students to be actively engaged in the process. With the application of VAK, students become more involved, independent, and motivated to learn physics in a more meaningful way (Heranyanti et al., 2021).

METHODS

This study applies the Systematic Literature Review (SLR) method to explore and evaluate several studies related to applying the VAK approach in the physics learning process, especially on static fluid. An SLR is a systematic, transparent, and replicable approach to reviewing scientific literature to answer specific research questions (Snyder, 2019; Triandini et al., 2019).

Several strict inclusion and exclusion criteria were established to ensure the relevance and validity of the data. Articles included in this review had to meet the following inclusion criteria: first, the article was open access; second, the articles were published between 2016 and 2025 to ensure that the data described reflected the latest developments in the literature; third, the articles came from scientific journals or conference proceedings that had undergone a peer-reviewed process; and fourth, the content of the articles explicitly discussed the VAK learning approach and its relationship with static fluid materials or topics in physics learning. Meanwhile, exclusion criteria were applied to filter out inappropriate articles, such as articles that were not available in full text, articles published before 2016, non-journal documents such as theses, dissertations, reports, or books that did not undergo a peer review process, and articles that did not discuss the VAK approach or were not relevant to statistical fluid learning.

The article was searched through three central databases often used in education and science studies: Google Scholar, ERIC, and ArXiv. These three databases were chosen because they are known to have a wide range of verified scientific articles and provide access to the latest research (Bergamaschi et al., 2016). Through this process, 76 articles were collected using keywords relevant to the study's focus, namely, conceptual understanding, physics learning, statistical fluids, and the VAK approach. From the initial search results, 76 articles were identified as having the potential to be analyzed further.
In the initial screening stage, 16 articles were eliminated because they were published before 2016. Furthermore, a feasibility test was conducted on the topic, and full-text availability was assessed, eliminating 15 other articles. Finally, 19 articles met all the criteria and were worthy of further analysis. The articles were classified based on the dominant VAK learning strategy (visual, auditory, or kinesthetic). The data were then analyzed using a thematic approach to identify patterns of application, effectiveness, and their contribution to enhancing the understanding of statistical fluid concepts. A flowchart detailing the application of PRISMA to studies published between 2016 and 2024 is shown in Figure 1. To demonstrate the transparency of the process, all stages of article selection were visualized using a PRISMA diagram (Figure 1).

Figure 1 illustrates the PRISMA 2020 flow diagram outlining the four main stages—identification, screening, eligibility, and inclusion—applied to studies published between 2016 and 2024. In the identification phase, 76 records were retrieved from the three databases. After screening by publication year, 16 articles were excluded from the review. The eligibility assessment excluded 15 more articles due to misalignment with the research focus or unavailability of the full text. Ultimately, 19 studies were deemed suitable and included in the detailed review. This flow diagram enhances the credibility of the literature selection process by ensuring systematic filtering and replicability based on clearly defined inclusion and exclusion criteria. This research, with this method, is expected to provide a broader understanding of how the VAK approach can be an innovative alternative in static fluid learning and inspire physics teachers to develop more varied learning based on student characteristics.

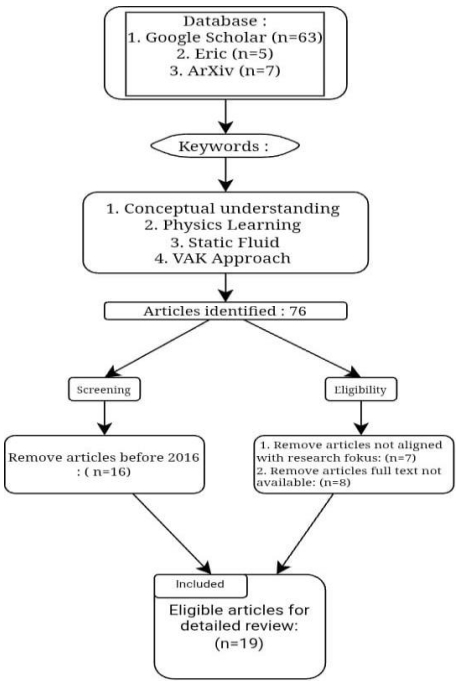

Figure 1 Flow diagram detailing the application of PRISMA to studies published between 2016 and 2024

RESULTS AND DISCUSSION

Application of the VAK Approach in Physics Learning

The VAK learning model is an approach that utilizes three primary senses, namely vision (visual), hearing (auditory), and movement (kinesthetic), in receiving information so that the learning process becomes more comfortable and helps students improve their understanding and effectively increases their participation in learning (Kuswanto et al., 2023; Nurellah et al., 2016). The Visual, Auditory, and Kinesthetic (VAK) model can optimally involve students in discovering and understanding a concept through physical activities such as demonstrations, experiments, observations, and active discussions, and can reach every student's learning style (Andriani et al., 2022). Through this approach, students feel helped in understanding the subject matter because the activities are varied and adapted to the learning that students like best (Deamita & Yasin, 2024). Similar findings were also reported by Shaidullina et al. (2023) in their systematic review that integrating learning style-based learning strategies, such as VAK, can increase the effectiveness of science education. Students' understanding will be deeper and more sustainable when learning involves multiple senses, such as visual, auditory, and kinesthetic.

Students' conceptual understanding of static fluid is generally low (Dyahesita et al., 2019). This can be seen from the many conceptual errors that occur in subtopics such as hydrostatic pressure, Archimedes' Principle, and Pascal's Law, which reflect students' weak mastery of basic concepts and difficulty in understanding their relationship with other materials (Andriani et al., 2022).

Additionally, teachers' use of learning approaches and models that are less aligned with the characteristics of students and the classroom situation also impacts the effectiveness of the learning process (Hasanah et al., 2023). Therefore, the suitability of the learning model used with the material must be reviewed by an educator before carrying out learning

activities (Yulianci et al., 2020). One approach that has proven effective in improving students' conceptual understanding is the VAK learning model because it can adapt to each learner's needs and learning styles (Khasanah et al., 2019). This is also supported by a study by Kusairi et al. (2017), which developed a web-based iTutor system for static fluids. The system recognizes individual students' learning difficulties and presents material that suits their learning style tendencies, making learning more effective.

Applying the VAK approach to static fluid learning will be more interactive, fun, and tailored to each student's learning needs. This approach can increase the effectiveness of the learning process by involving students' various learning styles, namely, visual, auditory, and kinesthetic (Hariyani & Sejati, 2019). This approach helps students feel more involved because they can learn most comfortably through seeing, hearing, or moving directly during learning activities.

Classification of the VAK Approach in Physics Learning

Every student has a different way of understanding information, and the VAK approach accommodates this diversity through three main learning styles: visual, auditory, and kinesthetic. A learning style is a student's preferred method of absorbing information, making them feel more comfortable and focused when following the learning process (Larasati & Widyasari, 2021). Visual, auditory, and kinesthetic (VAK) is a learning model that summarizes the potential students need to process information. In this context, the Visual, Auditory, and Kinesthetic (VAK) approach is one of the learning models that can activate students' various learning potentials to process information more optimally (Farizi et al., 2022; Mansyur et al., 2022).

To understand how the VAK approach works in learning, it is important to explain each visual, auditory, and kinesthetic learning style. Each style has different approaches and techniques to help students absorb material more effectively, according to their individual learning styles.

1. Visual

The visual learning style relies on the creation or recall of visual images. The characteristic of this learning style is the tendency for students to pay attention to information through images or objects, and to prefer reading and observing (Trianasari et al., 2019). This aims to help students focus their attention on learning the material. Focusing on learning objects is crucial for students to understand and absorb the material better (Bire et al., n.d.). In static fluid learning, the visual learning style can be applied through learning media, such as images, diagrams, or animations, to illustrate concepts like hydrostatic pressure, Pascal's Law, and Archimedes' Principle. The use of visual media such as images, animations, and virtual media has been proven effective in improving the understanding of static fluid concepts and students' cognitive abilities, especially in fluid pressure material and Archimedes' law, because it can help overcome the abstract nature of physics material and make it easier for students to visualize the concepts learned (Nisrina et al., 2016).

Here are some examples of visual learning styles that have been proven to improve students' understanding based on the results of previous research:

(1) Powtoon audio-visual media effectively improves student understanding, with a validity of 92.11% and an N-gain of 0.81 (Ambarsari et al., 2025).
(2) Simple teaching aids facilitate visualization of the concept of pressure and Archimedes' principle (Natasa et al., 2023).
(3) E-LKPD based on the Learning Cycle 7E model using the Canva application. This interactive and engaging media increases students' motivation and understanding of static fluid (Sitinjak et al., 2024).

2. Auditory

The auditory learning style is a learning method that uses the sense of hearing as the primary means of receiving and processing information (Mahadi et al., 2022). According to Irawati et al. (2021), individuals with auditory learning styles have many characteristics. They tend to choose a sitting position where they can hear clearly, even though their view of the front is limited. When they feel bored, they often talk to themselves, chat with friends next to them, or sing songs. Learning materials are easier to understand when read aloud, as they quickly pick up information through hearing. They also remember the content of discussions more easily, such as reading aloud, and memorize better by reading aloud or listening to audio recordings. Additionally, they enjoy discussing, asking questions, and explaining topics in depth, and they prefer working in groups. However, they can feel distracted if there are other sounds when they are focused on listening to the teacher's explanation. In static fluid learning, auditory style can be optimized through strategies such as interactive lectures, group discussions, audio playback of concept explanations, and oral presentations that encourage students to actively ask questions and explain back the material that has been learned (Anggraeni et al., 2018).

3. Kinesthetic

The kinesthetic learning style is a method of absorbing information that involves physical activity, such as using hands and feet. Learning in this style is more effective when information is received through body movement, touch, and direct involvement in an activity (Rahmawati & Gumiandari, 2021). Individuals with a kinesthetic learning style easily grasp lessons when they move, touch, or take action, so that practice or learning experience is obtained directly (Supit et al., 2023). Students with this learning style must include physical activity in their learning. For example, laboratory experiments or role-plays that involve body movement would be very effective. The kinesthetic approach helps students feel more connected to the material. It allows them to learn through real-life experiences, thus having a significant impact on improving concept understanding compared to the traditional lecture method (Korff et al., 2016).

The VAK approach helps students understand the material according to their learning style and allows teachers to develop learning strategies that are more responsive to students' needs. When visual students are facilitated with images and animations, auditory students are invited to discuss and listen to the verbal explanations actively. Kinesthetic students are engaged in hands-on practice, making the learning process more meaningful. This strategy improves students' cognitive learning outcomes at various educational levels by creating a fun and participatory learning atmosphere (Siswadi et al., 2018). In addition, using VAK in learning can also increase students' activeness and motivation because they feel cared for according to their respective learning preferences (Endang, 2022). In fact, in applying this approach, it was found that students not only experienced an increase in concept understanding but also in social skills, such as working together, expressing opinions, and showing confidence during learning activities (Lutfiana et al., 2021).

The impact of the VAK approach on students' concept understanding

Previous research has revealed various strategies to improve students' understanding of physics concepts, including the Visual, Auditory, and Kinesthetic (VAK) approach. This model adapts teaching methods to students' dominant learning styles and aligns with the theory of multiple intelligences by allowing learners to process abstract information through the most suitable sensory channels (Kusumawarti et al., 2020). Studies have consistently shown that the VAK approach can enhance engagement, motivation, and depth

of conceptual understanding through multimodal learning activities, such as visual media, verbal interaction, and hands-on experiments (Elisa et al., 2019; Rukmana et al., 2018).

A systematic review of 19 articles identified several common patterns in the literature. First, integrating VAK strategies effectively clarifies complex concepts, such as hydrostatic pressure, Pascal's Law, and Archimedes' Principle. Second, combining learning styles rather than relying on a single dominant style improves knowledge retention and concept transfer ability. Third, VAK-based learning enhances cognitive outcomes and boosts communication skills, self-confidence, and collaboration. These findings suggest that the strength of the VAK approach lies in its ability to personalize learning while supporting an inclusive and contextual physics learning process. This study expands on previous research by mapping the specific roles of each learning style in addressing abstract physics content and emphasizing the importance of designing learning that aligns with the diverse cognitive profiles of students.

The VAK approach has been proven to significantly improve the effectiveness of physics learning, especially in static fluid materials. This material is often difficult to teach because of its abstract nature and requires a strong conceptual understanding (Novianto et al., 2018). Students can more easily understand concepts such as pressure and fluid laws through a learning process involving direct visual, auditory, and physical activities. This emphasis on the link between abstract concepts and everyday phenomena aligns with Ogundeji et al., (2019), who found that students' understanding improves when they classify and explain the scientific phenomena observed in their environment. This approach also helps overcome learning barriers caused by differences in learning styles, making learning more inclusive and holistic (Andriani et al., 2022; Novianto et al., 2018).

Other research shows that the VAK approach can improve students' ability to connect concepts, which is very important in understanding material such as static fluid, which is closely related to real contexts and across topics (Apipah et al., 2018). This is also in line with Pascu (2024), who explained that visual learning styles help improve student focus and memory, and auditory styles support the process of reflection and learning from mistakes. Kinesthetic styles encourage the strengthening of logic, reasoning, and practical understanding of the subject. Similar findings were also presented by Almasri (2022), who stated that the kinesthetic learning style became a significant predictor of student engagement and satisfaction in science simulation-based learning. These findings reinforce the importance of aligning teaching approaches with students' learning styles to foster active engagement and a deeper understanding of abstract concepts.

Despite criticisms of VAK's theoretical basis, mainly due to the limited empirical evidence supporting its validity, the approach is still considered to be of practical benefit. Li et al. (2016) emphasize that although the concept of learning styles is still debated in the academic domain, its application in specific learning contexts can provide learning experiences that are more inclusive and responsive to individual needs.

Support for the effectiveness of the VAK approach is also reinforced by research (Lutfiana et al., 2021), which shows that this approach can significantly improve physics learning outcomes. Students are more active in the learning process, show a better understanding of concepts, and experience an increase in learning completeness.

In conclusion, the VAK approach, which integrates visual, auditory, and kinesthetic styles, allows teachers to create diverse and interactive learning experiences tailored to students' characteristics. This approach enhances engagement and motivation and strengthens the conceptual understanding of abstract materials, such as static fluid.

CONCLUSION

The VAK (Visual, Auditory, Kinesthetic) approach has been proven to improve students' understanding of physics concepts, especially those in static fluid material, which tends to be abstract. Integrating the three learning styles allows students to absorb information through the most appropriate channel, thus creating a more active, varied, and meaningful learning experience. This approach can also bridge physics concepts with everyday experiences, contributing to a stronger conceptual understanding.

The findings of this study have practical implications for physics teachers in designing adaptive learning experiences tailored to the diversity of students' learning styles. The VAK model can be used as an alternative contextual and inclusive approach, particularly when supported by interactive learning technology. However, the limitation of this study lies in its literature-based approach without direct field testing. Therefore, further research is needed to test the effectiveness of implementing the VAK model in various real learning contexts.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest in this work.

AUTHOR CONTRIBUTIONS STATEMENT

WC conceptualized, designed, and prepared the initial draft, whereas SMS and LM reviewed, validated, and evaluated the article content.

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