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UNDERSTANDING LEARNING STYLE: VISUAL, AUDITORY, READING/WRITING, AND KINESTHETIC (VARK) IN MATHEMATICS LEARNING

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ABSTRACT

Understanding students' preferred learning styles is crucial in enhancing teaching and learning effectiveness, especially in subjects that are often perceived as challenging, such as mathematics. The VARK model, comprising Visual, Auditory, Reading/Writing, and Kinesthetic modalities, offers a framework for identifying how students best process and retain information. In the context of university mathematics, the VARK approach can help explain differences in student performance, engagement, and problem-solving strategies. Visual learners may benefit from graphs, diagrams, and symbolic representations, while auditory learners respond well to discussions and verbal explanations. Reading/Writing learners are more comfortable with textbooks, problem sets, and formal proofs, whereas kinesthetic learners prefer hands-on activities, real-world applications, and interactive problem-solving. In this study, 30 engineering students were given questions to evaluate their learning style. Results show that most students have Kinesthetic and Visual learning styles. Recognizing these diverse preferences allows educators to design more inclusive and adaptive instructional strategies, blending multiple modalities to address varied student needs. Ultimately, integrating the VARK model into mathematics education can foster deeper conceptual understanding, improve learning outcomes, and support lifelong learning among university students.

Keywords: learning styles, mathematics, VARK, engineering students, instructional strategies

Introduction

Mathematics is widely regarded as one of the most essential yet challenging subjects in higher education. University students, regardless of their field of study, often encounter mathematics as part of their core curriculum, particularly in engineering, science, technology, and business-related programs. However, many students perceive mathematics as abstract, difficult, and intimidating, leading to anxiety and low performance. This challenge is not solely a matter of ability but is often influenced by the way students receive, process, and apply mathematical knowledge. Understanding how students learn, therefore, is a critical step toward improving teaching effectiveness and fostering deeper engagement with mathematical concepts.

The VARK model of learning styles, introduced by Fleming and Mills (1992), provides a framework to categorize learners based on their preferred sensory modality: Visual, Auditory,

Reading/Writing, and Kinesthetic. Each learning style influences how students absorb and retain new information, as well as how they approach problem-solving in mathematics. For instance, visual learners may benefit from diagrams, graphs, and symbolic representations, while auditory learners may prefer lectures, discussions, and verbal explanations. Similarly, reading/writing learners thrive with textbooks, worked examples, and notes, while kinesthetic learners grasp mathematical concepts more effectively through real-world applications, experiments, and hands-on tasks. Recognizing these differences in learning preferences can shed light on why some students struggle with mathematics when traditional teaching methods are heavily skewed toward one style.

Given the diversity of student populations at universities, adopting a one-size-fits-all approach to mathematics instruction is no longer sufficient. Incorporating VARK-informed strategies allows educators to design more inclusive learning environments that accommodate multiple learning preferences. This integration not only enhances comprehension and performance but also encourages students to engage more actively with mathematics, thereby reducing anxiety and fostering positive attitudes toward the subject. Exploring the connection between VARK learning styles and mathematics learning at the university level is therefore essential to improving teaching practices, supporting student success, and preparing learners with the problem-solving skills required for lifelong learning in their academic and professional careers.

Literature Review

Learning styles have long been a topic of interest in higher education research, with the VARK model emerging as one of the most widely used frameworks for understanding how students learn. Fleming and Mills (1992) introduced the VARK model to classify learners into four categories: Visual, Auditory, Reading/Writing, and Kinesthetic. Numerous studies have demonstrated that students have diverse preferences for processing information, and these preferences can influence their learning outcomes, motivation, and attitudes toward specific subjects. While some students demonstrate a single dominant learning style, many are multimodal, meaning they use a combination of VARK modalities depending on the learning context. Recognizing this diversity provides educators with insights into designing instructional strategies that are inclusive and effective.

In the context of mathematics, learning styles play a particularly important role because the subject requires the integration of abstract reasoning, symbolic representation, and problem-solving skills. Visual learners often find diagrams, flowcharts, and spatial representations useful in understanding mathematical concepts, while auditory learners benefit from verbal explanations, classroom discussions, and peer collaboration. Reading/Writing learners are generally more

comfortable with lecture notes, textbooks, and problem sets, whereas kinesthetic learners prefer hands-on approaches, such as applying mathematics to real-life scenarios or engaging in interactive simulations. Studies by Hawk and Shah (2007) and Surjono (2015) highlight that when mathematics instruction is closely aligned with students' learning preferences, their comprehension and performance improve significantly. Conversely, a mismatch between teaching strategies and learning styles may contribute to poor engagement and mathematics anxiety.

Recent research further emphasizes the value of multimodal teaching approaches in mathematics education. Leite, Svinicki, and Shi (2010) found that students who were exposed to multiple learning modalities developed greater flexibility in approaching mathematical problems, ultimately enhancing both their understanding and long-term retention. Moreover, adopting VARK-informed strategies has been shown to reduce learning barriers for students who struggle with mathematics by offering alternative pathways for comprehension. For example, incorporating visual graphs with step-by-step written explanations, alongside verbal discussions and real-world applications, ensures that students with different preferences can access and engage with the material. Literature suggests that integrating VARK into mathematics instruction at the university level is not only beneficial but necessary for addressing the diverse learning needs of modern students.

Methodology

This study adopts a descriptive survey design. A sample of 30 engineering students from UiTM Pulau Pinang enrolled in undergraduate mathematics-related courses was selected. The VARK questionnaire (Fleming & Baume, 2006) was administered to identify individual learning preferences. Data were analyzed using descriptive statistics to give view on their learning styles.

The VARK model, developed by Fleming and Mills (1992), is one of the most widely recognized frameworks for understanding individual differences in learning preferences. The acronym stands for Visual, Auditory, Reading/Writing, and Kinesthetic, representing four sensory modalities through which students commonly absorb, process, and retain information. Unlike rigid categorizations, VARK emphasizes that learners may rely on a single dominant mode or adopt a multimodal approach, using different preferences in different contexts. This flexibility makes VARK particularly useful for educators, as it highlights the need for instructional strategies that incorporate multiple teaching methods to meet diverse learner needs. Table 1 shows the description of VARK.

Table 1. Description of VARK Learning Styles

Learning style	Description
Visual	Learners process information best when it is presented graphically or symbolically. They respond well to diagrams, flowcharts, graphs, and spatial representations that make abstract ideas more concrete. In mathematics, visual learners benefit from seeing problems illustrated step by step, such as through geometric diagrams or visual models of algebraic functions.
Auditory	Learners prefer listening and speaking as their primary means of learning. They thrive in environments where discussions, explanations, and verbal problem-solving are emphasized. In mathematics, this could include engaging in group discussions about solutions, listening to explanations of problem-solving strategies, or verbally explaining steps to peers.
Reading/Writing	Learners prefer textual materials such as lecture notes, textbooks, and written problem sets. These learners often excel in mathematics when they are provided with detailed worked examples, written proofs, and step-by-step instructions. Their strength lies in organizing knowledge through lists, definitions, and summaries.
Kinesthetic	Learners learn best by doing, experimenting, and experiencing. They prefer practical, hands-on tasks that connect abstract ideas to real-world contexts. In mathematics, kinesthetic learners are more engaged when they can apply mathematical concepts to real-life problems, conduct simulations, or manipulate physical objects to represent abstract principles, such as using geometric tools or interactive digital software.

In this study, the students were evaluated on only three questions from VARK questionnaire to give insight into their learning styles. Table 2 shows the related questions and the learning styles based on the answers.

Table 2. Questions for learning styles evaluation

No.	Question	Answer	Learning style
1	A website has a video showing how to make a special graph or chart. There is a person speaking, some lists and words describing what to do and some diagrams. I would learn most from:	seeing the diagrams.	Visual
		listening.	Auditory
		reading the words.	Reading/Writing
		watching the actions.	Kinesthetic
2	When I am learning I:	I like to talk things through.	Auditory
		see patterns in things.	Visual
		use examples and applications.	Kinesthetic
		read books, articles and handouts.	Reading/Writing
3	I prefer a presenter or a teacher who uses:	demonstrations, models or practical sessions.	Kinesthetic
		question and answer, talk, group discussion, or guest speakers.	Auditory
		handouts, books, or readings.	Reading/Writing
		diagrams, charts, maps or graphs.	Visual

Findings and Discussion

Preliminary findings suggest that a majority of students display multimodal learning preferences, with combinations of visual and kinesthetic being most common Table 3. Students who identified strongly as visual learners demonstrated better performance in geometry and graph-related problems, while auditory learners performed well in collaborative tutorials. Reading/writing learners excelled in algebraic manipulations and theoretical proofs, whereas kinesthetic learners showed strength in applied mathematics and modeling tasks. The results support the argument that understanding and accommodating VARK preferences can reduce learning barriers in mathematics and promote more effective engagement Figure 1 to 3.

Table 3. Result from questions based on learning style in percentage

Question	Visual	Auditory	Reading/Writing	Kinesthetic
1	25%	0	8.3%	66.7%
2	12.5%	4.2%	0	83.3%
3	8.3%	25%	8.4%	58.3%

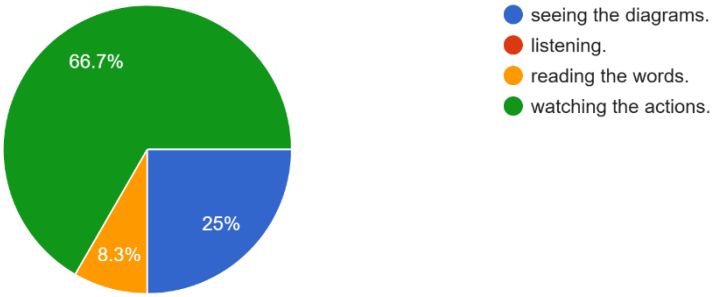

Figure 1. Result from question 1

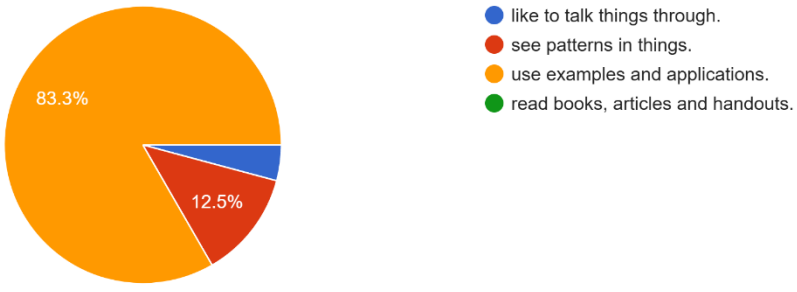

Figure 2. Result from question 2

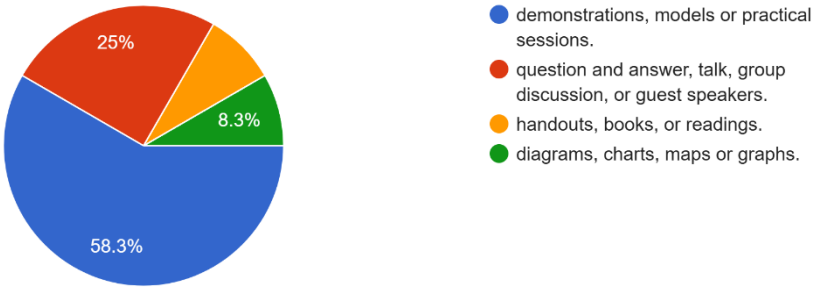

Figure 3. Result from question 3

Conclusion

The VARK model provides valuable insight into how university students learn mathematics. Recognizing and accommodating learning preferences can help educators design more inclusive and effective teaching methods. While students may have dominant learning styles, most benefit from multimodal approaches that combine Visual, Auditory, Reading/Writing, and Kinesthetic elements. By applying VARK-informed strategies, mathematics educators can enhance students' conceptual understanding, performance, and lifelong learning skills.

References

Fleming, N. D., & Mills, C. (1992). Not another inventory, rather a catalyst for reflection. To improve the academy, 11(1), 137-155.

Zapalska, A. M., & Dabb, H. (2002). Learning styles. Journal of Teaching in International Business, 13(3-4), 77-97.

Ahmed, J., Shah, K., & Shenoy, N. (2013). How different are students and their learning styles. *International Journal of Research in Medical Sciences*, *1*(3), 212-215.

El-Saftawy, E., Latif, A. A. A., ShamsEldeen, A. M., Alghamdi, M. A., Mahfoz, A. M., & Aboulhoda, B. E. (2024). Influence of applying VARK learning styles on enhancing teaching skills: application of learning theories. *BMC medical education*, *24*(1), 1034.

Hawk, T. F., & Shah, A. J. (2007). Using learning style instruments to enhance student learning. Decision Sciences Journal of Innovative Education, 5(1), 1-19.

Leite, W. L., Svinicki, M., & Shi, Y. (2010). Attempted validation of the scores of the VARK: Learning styles inventory with multitrait–multimethod confirmatory factor analysis models. Educational and psychological measurement, 70(2), 323-339.

Surjono, H. D. (2015). The effects of multimedia and learning style on student achievement in online electronics course. Turkish Online Journal of Educational Technology-TOJET, 14(1), 116-122.

Fleming, N., & Baume, D. (2006). Learning Styles Again: VARKing up the right tree!. *Educational developments*, *7*(4), 4.