

UNIMODAL & KINAESTHETIC LEARNING STYLES PREDOMINATE IN BOTH SCIENCE AND NON-SCIENCE UNIVERSITY STUDENTS IN MALAYSIA USING VARK

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Abstract

Learning styles play an imperative role in the tertiary education. Several studies have documented that multimodal is dominant in learning styles among university students. Some denote unimodal learning style trends among basic science and non-science students. Dissimilar investigation tools in previous studies complicate the comparison to reach a firm conclusion. We aim to compare the learning styles between science and non-science tertiary learning in Malaysia. This survey was conducted in May-June 2021 after ethical approval. Subjects were recruited using convenient sampling from higher education institutions. The learning styles were investigated using a validated VARK questionnaire. Informed consent was obtained from 148 university students (117 science and 31 non-sciences) before participation. Approximately 82% of the learning style are unimodal. There is no significant difference in learning styles between science and non-science students (Mann Whitney = 1505.50, $p > 0.05$). Kinaesthetic learning styles are predominant (62.8%). The unimodal findings match those observed in early studies among non-science students but do not support the previous multimodal reports among science students. This discrepancy may be attributed to the imbalanced gender proportion and composition of millennial students. The most visible finding from this study is the predominant unimodal and kinaesthetic learning style among university students in Malaysia in both science and non-science disciplines. Future research may include a more significant male sample size and multiple investigation tools of diverse learning styles classifications to have a wide-ranging understanding of learning styles to strategise pedagogy teaching.

Keywords: learning style, non-science, science, VARK, university students

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Introduction

Learning style has been a focus in teaching pedagogy research (Allen et al., 2013). A considerable amount of literature has reported that multimodal learning style was predominant to obtain information among university students (Almigbal, 2015; Balasubramaniam, 2016; Ictenbas & Eryilmaz, 2011; Marzo, 2016; McKenna et al., 2018; Muralidhara et al., 2013; Nuzhat et al., 2011; Ojeh et al., 2017; Sarabi-Asiabar et al., 2015; Sinha et al., 2013; Stirling & Alquraini, 2017; Zhu et al., 2018). The prevalence of multimodal ranges from 11.1% to 84.1%. Evidence also suggests unimodal learning style trends may dominate among students in basic science and non-science courses (Awang et al., 2017; Moayyeri, 2015). However, different investigation tools were used in previous unimodal learning and multimodal learning explorations. The assorted investigation tools complicate the comparison to draw a firm conclusion.

Various methods have been utilised to investigate the learning style (Babadogan & Budakoglu, 2012; Pashler et al., 2009). Some learning style models are complex and adopt a diverse approach in defining learning, while others can be pretty simple (Honey & Mumford, 2006; Koob & Funk, 2002; Metallidou

& Platsidou, 2008; Riechmann & Grasha, 1974). VARK is one of the simple learning style models adopted by the Malaysian Education Ministry (Othman & Amiruddin, 2010). The acronym VARK stands for Visual, Aural, Read/Write, and Kinaesthetic sensory modalities used to describe the four modalities of student learning. VARK's learning style is about the individual approach to acquiring knowledge or skills through human senses. The VARK model has been widely applied to investigate learning styles by dividing the learners into visual, auditory, kinaesthetic and linguistic types (Leite et al., 2009).

Basic human senses play a pivotal role in learning. Humans have five basic senses: touch, sight, hearing, smell and taste. The sensing organs associated with each sense send information to the brain to help us understand and perceive the world around us. A key aspect of learning is through those five basic senses. There are different ways to learn and understand new information. Among the various forms of learning, some prefer to discover by hearing, seeing, and others by doing. In the tertiary education environment, smell and taste senses are secondary except in courses that specifically require such senses. Some prefer visual learning by observing things using pictures, images, and diagrams identified. Some seem to learn best through hearing or verbal input of information. Some learners excel in linguistics and indulge in reading and writing with words. Other learners prefer to do rather than see or hear.

Utilising a learning-styles based teaching is valuable to customise instruction (Allen et al., 2013). Understanding students' learning styles can assist in implementing different strategies for the benefit of diverse learners. Multimodal learning style may reflect the agility of students in facing the complexity of real-world interactions (Almigbal, 2015; Balasubramaniam, 2016; Ictenbas & Eryilmaz, 2011; Marzo, 2016; McKenna et al., 2018; Muralidhara et al., 2013; Nuzhat et al., 2011; Ojeh et al., 2017; Sarabi-Asiabar et al., 2015; Sinha et al., 2013; Stirling & Alquraini, 2017; Zhu et al., 2018). Evidence for learning styles has been mixed that demand further ratification. A considerable amount of literature has been published on the learning styles of Malaysian students across several disciplines (Mansor & Ismail, 2012; Mohammed et al., 2011; Saleem et al., 2015; Tawil et al., 2012; Tee et al., 2015). To date, there has been little conclusive evidence on the learning styles between science and non-science tertiary learning in Malaysia. Extra work is required to confirm the learning styles comparison using the same investigation tool. We aim to compare the learning styles between science and non-science tertiary learning in Malaysia using the VARK questionnaire.

Methods

Ethical approval was obtained from the UiTM Research Ethics Committee [600-TNCPI (5/1/6) REC/04/2021 (UG/MR/300)]. This survey involved six higher education institutions (three private and three public universities). The data collection was conducted through an online questionnaire using the Google Forms platform. Sixteen multiple-choice questions were adopted from the VARK questionnaire to investigate learning styles (Supplementary Information 1). The VARK questionnaire has been validated and used extensively in many studies and countries (Almigbal, 2015; Ojeh et al., 2017; Zhu et al., 2018). Using the online sample size calculator (Raosoft Sample Size Calculator), which uses Cochran's Sample Size Formula with the confidence interval of 95% and margin of error of 5%, the recommended sample size was 300 respondents. Three hundred university students were approached using convenient sampling in May-June 2021. Informed consent was obtained. The inclusion criteria were local undergraduate degree students. Certificate, diploma and postgraduate students were excluded. The Statistical Package for Social Sciences (SPSS) software version 23.0 (SPSS Inc. Chicago, IL, USA) was used for data entry and descriptive analysis. Significance levels were set at p-value <0.05.

Result and Discussion

This analysis includes one hundred forty-eight university students (117 science and 31 non-sciences). Approximately 82.4% are female (122) and 17.6% are male (26). About 79% are science students (117), and 21% are non-science (31). The table below illustrates the proportion of unimodal and bimodal learning styles (Table 1). This table provides several revelations. Approximately 85.8% of the learning style is unimodal. It is apparent from this table that very few of the learning style is bimodal (about 14.2%). Interestingly, there are no trimodal or quadrimodal distributions in this table. What is striking

about the values in this table is the dominance of the unimodal kinesthetics learning style (62.8%). Science students display a learning style preference of unimodal kinaesthetic (68.4%). Non-science students also prefer unimodal learning styles (kinaesthetic - 41.9% and aural - 35.5%). There is no significant difference in learning styles between science and non-science students (Mann Whitney U Test = 1505.50, $p > 0.05$).

Table 1. Distribution of learning style preferences.

(A) All students

Learning styles	All	
	Frequency	Percentages
Unimodal (Visual)	6	4%
Unimodal (Aural)	23	15.5%
Unimodal (Read/Write)	5	3.4%
Unimodal (Kinesthetics)	93	62.8%
Bimodal (Aural + Kinesthetics)	12	8.1%
Bimodal (Visual + Kinesthetics)	7	4.7%
Bimodal (Visual + Read/Write)	1	0.7%
Bimodal (Read/Write + Kinesthetics)	1	0.7%
Total	148	100%

(B) Science students

Learning styles	Science	
	Frequency	Percentages
Unimodal (Visual)	6	5.1%
Unimodal (Aural)	12	10.2%
Unimodal (Read/Write)	3	2.6%
Unimodal (Kinesthetics)	80	68.4%
Bimodal (Aural + Kinesthetics)	9	7.7%
Bimodal (Visual + Kinesthetics)	5	4.3%
Bimodal (Visual + Read/Write)	1	0.8%
Bimodal (Read/Write + Kinesthetics)	1	0.8%
Total	117	100%

(C) Non-Science students

Learning styles	Non-science	
	Frequency	Percentages
Unimodal (Visual)	0	0%
Unimodal (Aural)	11	35.5%
Unimodal (Read/Write)	2	6.5%
Unimodal (Kinesthetics)	13	41.9%
Bimodal (Aural + Kinesthetics)	3	9.7%
Bimodal (Visual + Kinesthetics)	2	6.5%
Bimodal (Visual + Read/Write)	0	0%
Bimodal (Read/Write + Kinesthetics)	0	0%
Total	31	100%

Learning preference to gain information is unique to every university student. Most highlighted the preference for multimodal learning style in comparison to other unimodal learning style preferences (Alkhasawneh et al., 2008; Ictenbas & Eryilmaz, 2011; Karim et al., 2019; Kim et al., 2013; Nuzhat et al., 2011). It is somewhat surprising that no trimodal and quadrimodal learning style was found in this study. The preference for quadrimodal utilising all four learning styles has been emphasised (James et al., 2011). Our findings are somewhat surprising because previous studies revealed multimodal learning styles. Nearly 86% of the learning style in our subjects are unimodal. Only 14% of subjects display bimodal learning styles.

In terms of the science and non-science comparison, science disciplines have been reported to favour multimodal learning styles in obtaining information (Almigbal, 2015; Balasubramaniam & K, 2016;

Marzo, 2016; McKenna et al., 2018; Muralidhara et al., 2013; Nuzhat et al., 2011; Ojeh et al., 2017; Sarabi-Asiabar et al., 2015; Sinha et al., 2013; Stirling & Alquraini, 2017; Zhu et al., 2018). The prevalence of multimodal ranged from 11% to 84.1% (Almigbal, 2015; Balasubramaniam & K, 2016; Ictenbas & Eryilmaz, 2011; Marzo, 2016; McKenna et al., 2018; Muralidhara et al., 2013; Nuzhat et al., 2011; Ojeh et al., 2017; Sarabi-Asiabar et al., 2015; Sinha et al., 2013; Stirling & Alquraini, 2017; Zhu et al., 2018). Contradictorily, multimodal is uncommon among our science students. The most visible finding from our study is the predominant unimodal and kinaesthetic learning style among university students in Malaysia in both science and non-science disciplines. A predominance of unimodal and bimodal learning styles prevail in our study. Consistent with the literature, non-science students' findings broadly support the work of previous studies that have described non-science courses preferred unimodal learning style more than the multimodal learning style (Awang et al., 2017; Moayyeri, 2015).

One possible explanation is the gender factor, where most of our sample are female, who prefer unimodal learning while males prefer multimodal learning as indicated in previous studies (Isman & Gundogan, 2009; Wehrwein et al., 2007). There has been disagreement on the relationship between gender and learning styles in Malaysian students. Bidabadi & Yamat reported negligible gender effect (Bidabadi & Yamat, 2010). Other studies concluded otherwise (Bidabadi & Yamat, 2010; Halili et al., 2015; Halili et al., 2014; Mohammed et al., 2011; Piaw, 2014). Female students are believed to favour independent, competitive, dependent, participative and collaborative learning styles, whereas male students are prone to be avoidant learners (Halili et al., 2015). The male students are described as more creative but less able to pay attention to learning stimuli than female students (Piaw, 2014). Consistent with the literature, our results further support the idea of unimodal among females.

Another possibility is our sample of millennial students. Early exposure to electronic devices usages may have disrupted the learning adaptation capability. Technology has progressed at a staggering rate for the past few decades. Younger generations are more likely to experience electronic device exposures as these devices become more common at all educational system levels (Hopkins & Reynolds, 2001; Mpungose, 2020; Raghupathi & Raghupathi, 2020; Rodrigues et al., 2019). Increased exposure to electronic devices is likely to occur. The learning environment has shifted from face-to-face, blended learning to open and distance learning alongside electronic technologies. From traditional to digitalisation in education, this evolution showed a shift from hardcopy to electronic type-based learning. Students nowadays search articles via an online platform such as PubMed, online library or Google Scholar instead of searching hardcopy books or journals from the physical library. Online education may limit holistic feedback and physical stimulation. To date, there has been little agreement on the relationship between learning styles and the level of acceptance of online learning (Mahazir et al., 2013; Mansor & Ismail, 2012). Learning style and student performance have been tested to link with personality (Cletus et al., 2019). Learning style has been claimed to be not the main factor in enhancing students' achievement among Malaysian undergraduates (Omar et al., 2015). Students' learning styles have more influence than personalities on social media engagement for learning (Balakrishnan & Gan, 2016). Students with participatory and independent learning styles tend to use social media during their learning activities (Balakrishnan & Gan, 2016). Students with the collaborative learning style prefer working with their teammates (Balakrishnan & Gan, 2016). Is unimodal a new trend of learning style among millennium students? This is an important issue for future research.

Our findings were consistent with previous works where 62.8% of learning styles were kinaesthetic. Previous studies reported similar trends among students from science disciplines using the VARK as an investigation tool (Asiry, 2016; Chimmalgi, 2018; James et al., 2011; Johnston et al., 2015; Kim & Gilbert, 2015; Klement, 2014; McKenna et al., 2018; Meehan-Andrews, 2009; Pashler et al., 2009; Stirling & Alquraini, 2017). Students from science disciplines were more prone to learn best kinaesthetically than through other styles. Learning styles have been linked to various knowledge acquiring abilities such as creativity, critical thinking, technology competency, and so on (Kassim, 2013; Nordin et al., 2013; Piaw, 2014; Yee et al., 2015).

The debate continues with match and mismatch of learning and teaching styles (Naimie et al., 2010; Nasir & Masek, 2015). Some question the empirical evidence and argue that the trivialisation of learning that is not beneficial (Franklin, 2006; Sharp et al., 2008). Others adopted a broader and positive perspective on learning styles. (Nancekivell et al., 2019; Newton & Miah, 2017; Rogowsky et al., 2015; Spoon & Schell, 1998). Expert, facilitator and delegator teaching styles have been narrated as dominant among lecturers, while students are more prevailing in collaborative and competitive learning styles (Amir & Jelas, 2010). Adult learners in Malaysia display both behaviours of learner-centred and teacher-centred styles (Ismail & Azman, 2010). The reflector learning style is most preferred by the Malaysian generation 'Y' under-graduates (Nurumal et al., 2019).

The relationship between various learning styles has been investigated (Khanal et al., 2019; Movchun et al., 2021). A correlation was observed between auditory and visual learning styles among dental students (Movchun et al., 2021). Students with highly developed auditory learning tend to have less effective visual memorisation (Movchun et al., 2021). Visual learning was correlated with kinesthetics and read/write learning styles among preclinical medical students (Khanal et al., 2019). Students have improved their academic performance by adopting new sensing learning techniques among medical students (Hernández-Torrano et al., 2017). Teaching can be improved by modifying and adapting more appropriate teaching approaches (Hernández-Torrano et al., 2017).

Teaching based on a dominant learning style can enhance learning (Stirling & Alquraini, 2017; Vizeshfar & Torabizadeh, 2018). Knowing the students' preferred learning styles allows individual students to navigate their learning with the appropriate technique. The same information also helps relevant educators to adopt and plan their teaching and assessment strategies accordingly (Allen et al., 2013; Dickinson et al., 2021).

Conclusion

This study sets out to examine the learning styles of university students in Malaysia. The most prominent finding from this study was unimodal, kinaesthetic predominant learning style. These findings can contribute to a better understanding of learning styles to assist the pedagogy teaching alignment in optimising the learning environment. Future research can include a more significant male sample size and multiple investigation tools on learning styles.

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Supplementary Information 1

VARK Questionnaire

1. You are helping someone who wants to go to your airport, town centre or railway station. You would:
 - A. go with her.
 - B. tell her the directions.
 - C. write down the directions.
 - D. draw, or give her a map.

2. You are not sure whether a word should be spelled 'dependent' or 'dependant'. You would:
 - A. see the words in your mind and choose by the way they look.
 - B. think about how each word sounds and choose one.
 - C. find it in a dictionary.
 - D. write both words on paper and choose one.

3. You are planning a holiday for a group. You want some feedback from them about the plan. You would:
 - A. describe some of the highlights.
 - B. use a map or website to show them the places.
 - C. give them a copy of the printed itinerary.
 - D. phone, text or email them.

4. You are going to cook something as a special treat for your family. You would:
 - A. cook something you know without the need for instructions.
 - B. ask friends for suggestions.
 - C. look through the cookbook for ideas from the pictures.
 - D. use a cookbook where you know there is a good recipe.

5. A group of tourists want to learn about the parks or nature reserves in your area. You would:
 - A. talk about, or arrange a talk for them about parks or nature reserves.
 - B. show them internet pictures, photographs or picture books.
 - C. take them to a park or nature reserve and walk with them.
 - D. give them a book or pamphlets about the parks or nature reserves.

6. You are about to purchase a digital camera or mobile phone. Other than price, what would most influence your decision?
 - A. Trying or testing it.
 - B. Reading the details about its features.
 - C. It is a modern design and looks good.
 - D. The salesperson telling me about its features.

7. Remember a time when you learned how to do something new. Try to avoid choosing a physical skill, e.g. riding a bike. You learned best by:
 - A. watching a demonstration.
 - B. listening to somebody explaining it and asking questions.
 - C. diagrams and charts - visual clues.
 - D. written instructions – e.g. a manual or textbook.

8. You have a problem with your knee. You would prefer that the doctor:
 - A. gave you a web address or something to read about it.
 - B. used a plastic model of a knee to show what was wrong.
 - C. described what was wrong.
 - D. showed you a diagram of what was wrong.

9. You want to learn a new programme, skill or game on a computer. You would:
 - A. read the written instructions that came with the programme.
 - B. talk with people who know about the programme.

- C. use the controls or keyboard.
 - D. follow the diagrams in the book that came with it.
10. I like websites that have:
- A. things I can click on, shift or try.
 - B. interesting design and visual features.
 - C. interesting written descriptions, lists and explanations.
 - D. audio channels where I can hear music, radio programmes or interviews.
11. Other than price, what would most influence your decision to buy a new non-fiction book?
- A. The way it looks is appealing.
 - B. Quickly reading parts of it.
 - C. A friend talks about it and recommends it.
 - D. It has real-life stories, experiences and examples.
12. You are using a book, DVD or website to learn how to take photos with your new digital camera. You would like to have
- A. a chance to ask questions and talk about the camera and its features.
 - B. clear written instructions with lists and bullet points about what to do.
 - C. diagrams showing the camera and what each part does.
 - D. many examples of good and poor photos and how to improve them.
13. Do you prefer a trainer or a presenter who uses:
- A. demonstrations, models or practical sessions.
 - B. question and answer, talk, group discussion, or guest speakers.
 - C. handouts, books, or readings.
 - D. diagrams, charts or graphs.
14. You have finished a competition or test and would like some feedback. You would like to have feedback:
- A. using examples from what you have done.
 - B. using a written description of your results.
 - C. from somebody who talks it through with you.
 - D. using graphs showing what you had achieved.
15. You are going to choose food at a restaurant or cafe. You would:
- A. choose something that you have had there before.
 - B. listen to the waiter or ask friends to recommend choices.
 - C. choose from the descriptions in the menu.
 - D. look at what others are eating or look at pictures of each dish.
16. You have to make an important speech at a special occasion. You would:
- A. make diagrams or get graphs to help explain things.
 - B. write a few key words and practice saying your speech over and over.
 - C. write out your speech and learn from reading it over several times.
 - D. gather many examples and stories to make the talk real and practical.