

## Modelling Teaching Strategies According to Students' Preferred Learning Styles: An Experimental Study

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### ABSTRACT

Learning styles are defined as individuals' ways of perceiving, processing, and retaining new information. Researchers have proven that there is a strong relationship between identifying preferred learning styles and employing appropriate teaching styles to improve academic achievement. This research assessed the effectiveness of the Visual, Aural, Read-Write and Kinesthetic (VARK) questionnaire in determining students' preferred learning styles. The researchers adopted an experimental research design where two groups of elementary students were selected: a control and an experimental group. An experiment was designed and implemented to explore the effectiveness of the VARK questionnaire in determining the learning styles of the students. The comparison of the test results of the groups indicates that the experimental group performed better than the control group. Since the lessons in the experimental group were conducted using approaches that matched the learning preferences of the students identified through the VARK questionnaire, the results strongly indicate that the VARK questionnaire is an effective tool for identifying students' learning preferences.

**Keywords:** VARK questionnaire, Preferred Learning Styles, Experimental Research, Control & Experimental Group, Pre-test, Post-test, Teaching Approaches, Academic Achievements.

### Introduction

In the 21<sup>st</sup> century, learning has shifted focus from conventional teacher-centered to student-centered which has highlighted the need for new teaching methods that are able to support and encourage individual differences of learners (Abouzeid et al., 2021). According to Awang et al. (2017), approaches to learning have drawn a lot of attention over the past decades especially among educators who preferred alternatives to traditional teaching methods. As it has been proven, the most important components in the education system are the teaching and learning approaches. Kaushik and Joshi (2016)

question the assumption that the amount one learns is equal to the amount of what is taught by asserting that each student has his/her way of perceiving and learning things. The phrase 'learning style' is related to how a person prefers to obtain knowledge. It has been advocated that learning styles refer to the condition in the educational set up in which learning takes place in the most effective manner (Stewart & Felicitti, 1992). According to Papadatou-Pastou et al. (2021), learning styles is a phrase that emerged in the 1950s, gained popularity in the 1970s and has now become a virtual truism amongst educators. According to Fleming (2001), learning style indicates a person's characteristics and preferred methods of 'gathering, organising and thinking about information'. He went on to claim that it falls within the ambit of the instructional preference category for it deals

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with perceptual modes focused on the varied methods used for giving and receiving information. According to Al-Azawei, Parslow and Lundqvist (2017), learning and teaching styles have to be matched in order to improve the learning experience for it is assumed that the learning styles can motivate students, and enhance achievement and/or satisfaction.

In 1987, an inventory called the Visual, Aural, Read-Write and Kinesthetic (VARK) learning-style questionnaire was developed by Fleming (1987) which is one of the most frequently used inventories. VARK is a model that enables educators to identify students' learning preferences through the use of a questionnaire. This questionnaire is to help students worldwide to find out their learning preferences, and by using them, how to learn effectively. Prithishkumar and Michael (2014) concur that students have different preferences in assimilating and processing information. They added that Fleming's learning style model enables educators to identify a student's sensory modality preference in learning. Coffield et al. (2004) claim that research conducted in the past has clearly proven that motivation to learn is enhanced when there is knowledge of students' strengths and weaknesses in learning. According to Bajaj and Sharma (2018), adaptive learning systems aim to customise content and learning path of students to minimise cognitive overload problems and thus maximise learning efficiency.

Even though intelligence-typing has existed for many years, Fleming (2001) has simplified the different forms of communication and learning into Visual, Aural, Read-Write and Kinesthetic (VARK). The VARK model distinguishes learners according to their learning preferences for visual, auditory, reading and writing or kinesthetic learning. After doing the VARK questionnaire, one will identify his/her learning style, and this will help the ones with poor learning skills to improve themselves. According to Bristol (2010), the VARK questionnaire identifies learners according to their preferences in gaining and delivering information. Visual learners are learners who prefer seeing the information presented to them in a visual form rather than reading the information. Auditory learners are those who prefer listening to the information and favour the lecture mode of teaching and learning as they are good at remembering things they hear. Reading and writing learners are those who like having materials in the form of written text. Finally, kinesthetic learners are those who prefer hands-on learning strategies involving experimental practices. This learning strategy may also appeal to the other preferred styles of learning but what is evident here is that these learners learn best by touching, doing, and experiencing the entire activity

themselves. Another mode of learning that has emerged is known as 'MM' which refers to a multimodal learning preference. This learning style simply means that learners who belong to this category are able to learn through many different modes or have two or more learning preferences at the same time. An applied survey, a test of VARK learning styles, applied to 218 university students from the II to the X term of the business schools of a university found that 25.5% of students have a multimodal learning style (Espinoza-Poves, Miranda-Vílchez & Chafloque-Céspedes, 2019).

The teaching and learning trends in the past few decades have shown the emergence of a number of new models which pave the way for educators to diversify their teaching practices to satisfy the demand of the transforming generation of students. However, according to McKeachie (1995), in reality most teachers do not vary their teaching approaches on the false assumption that the method being practiced by them currently is the best. Murphy et al. (2004) believe that it is crucial for educators to be made aware of the significance of the different learning styles of students that would enable them to reflect on their current practices and accommodate other learning preference modalities. It must be noted at this point that effective learning is an essential real-life skill which should be developed into a life-long strategy. However, parents and educators are constantly troubled with the deficiency of this skill among students. The reason for this can be related to students who do not know how to study in the most effective way. Some of these students may fear that they do not learn and achieve the way their peers do. They might not have developed managing skills to work within their own 'special' ways of learning. Despite researchers having established the importance for educators to know the learning styles of their students, a recent research has shown that matching learning styles and learning materials neither leads to better learning outcomes nor to a lower cognitive load (Moser & Zumbach, 2018). According to Mozaffari et al. (2020), research has shown that there are contradictory results in studies on the relationship between learning styles and academic achievement. He went on to add that some studies which investigated the relationship between learning styles and academic achievement in students of different disciplines found a significant relationship between learning style and academic achievement (Farajollahi, et al., 2013; Rashidi & Moghadami, 2017; Komarraju et al., 2011; Ruffing et al., 2015 and Li et al., 2014 cited in Mozaffari et al., 2020) while in some others, no significant relationship was reported (Almigbal, 2015 and Liew, Sidhu & Barua, 2015 cited in Mozaffari et al., 2020). As a result of the concerns and inconsistencies

evident in past research, the current research aims to investigate the effectiveness of the VARK questionnaire in identifying students' learning preferences and to evaluate whether the outcome of the questionnaire is accurate in determining the teaching strategies to enhance students' learning and academic achievement. Thus, in essence, the research attempts to prove that there is a significant relationship between learning styles and academic achievement through the use of an experimental research design.

## Literature Review

Educational researchers have suggested that every individual has a different learning style (Winn & Grantham, 2005). Over the years, educators have acknowledged that some individuals prefer certain approaches of learning compared to others and these dispositions, referred to as learning styles, outline an individual's unique learning preference and support teachers in the collaboration of small group and individualised institutions (Kemp et al., 2012). The idea that different individuals learn in different ways is accepted generally by most academicians and most likely had its derivation from the ancient Greeks (Wratcher et al., 1997). Learning styles have been given different interpretations in the past. However, the elements that are common in these definitions are that they refer to the way students gain knowledge be it to learn new ideas/concepts or also how they enhance existing knowledge. Grasha (1996) defined learning styles as individual characteristics that shape students' capability to attain information, to interact with their peers and teachers, as well as participate in learning experiences. In addition, Smith and Dalton (2005) claim that learning style is the typical and habitual approach of acquiring knowledge, skills and attitudes through study or experience. According to Keefe (1987), learning styles are the combination of the cognitive, affective, and physiological characters that act as comparatively constant indicators of how a learner perceives, interacts with and responds to the learning environment.

Kolb (2014) has highlighted that a learner's achievement in the class is not only determined by the intellectual capacity and inherent skills but is also affected by students' learning styles. Reiff (1992) suggested that a better understanding of the learning style would help instructors and the learners. In line with this, Nolting (2002) has also asserted that students who understand their learning styles can enhance their learning effectiveness in and outside of the classroom. This is further supported by Ojeh et al. (2017) who claim that educators need to be

aware of the different learning styles to effectively tailor instructional strategies and methods to cater to students' learning needs and create a conducive learning environment. Rollins and Yoder (1993) claim that there are a number of past research which have proven that learners' achievement is closely related to students' preferences of learning styles in conjunction with the focus given by educators to ensure this is taken into consideration in their teaching methods. According to Shih and Gamon (2001), knowledge of learning styles enables educators to comprehend how their students differentiate and process information using varied approaches. Further, Felder and Spurlin (2005) state that some learners prefer to work with concrete information such as facts and experimental data compared to others who are more comfortable with abstractions like theories, symbolic information, and mathematical model. There are also learners who are partial to visual presentation of information like pictures, schematics, diagrams, flowcharts while others prefer to get more from verbal explanations. Some prefer to learn by trying things out, observing, and analysing what happens around them while others would rather reflect on things they plan to do and understand as much as they can about them before actually trying them out. Dembo and Howard (2007) highlight that learning styles are vital variables in processing cognitive information. According to some researchers, learning that takes place according to students' preferred learning styles benefit them in a number of ways such as increased retention, better marks, increased self-confidence, and lowered anxiety experienced in the classroom (Rasmussen & Davidson-Shivers, 1998; Davidson, 1990). In addition to research on teaching using preferred learning styles, research has also been conducted on the design of courses using learning styles and its impact on learners. For example, the research conducted by El-Bishouty et al. (2019) found that a course designed with certain learning styles in mind can improve learning of the students with those specific learning styles.

In order to create a conducive environment that enables students to learn according to their learning preferences, Suskie (2003) suggests that the teaching approaches of educators should be modified to cater to the students' different learning styles. As an educator, identifying and knowing the learning style of the students is a valuable skill in education as it helps educators to identify and solve learning problems among students and help them to become more effective learners (Baykan & Nacar, 2007). Further, Acharya (2002) claims that awareness about learning styles would assist educators to understand the differences of students in their classroom and pave a way to systematically match learning experiences with their

students' learning preferences to ensure the learning outcomes of their lessons are achieved. Thus, information about learning styles can facilitate academics to become more aware of the differences that students bring to the classroom which can also serve as a guide in thoughtful and systematic designing of learning experiences that match or mismatch students' learning preferences, depending on what the educators want their students to accomplish at the end of the day (Jaleel & Thomas, 2019). Foley (1999) also states that the concept of learning styles is helpful for finding and understanding the internal and external distinctions of how individuals learn and develop information and in helping to enhance their interaction within the educational environment. Additionally, Hilgersom-Volk (1987) claims that learning styles have a real effect on the achievement of students where if learning styles are neglected, this may impede their educational enhancement. Price, Dunn and Sanders (1981) also emphasise on the significance of educators having an awareness of their learners' learning styles stating:

As we learn more and more about the scope and complexity of individual differences and how they affect academic progress, we become increasingly convinced that many individuals who do not read well do not because the instructional method used to teach them does not complement their learning styles' characteristics (p.226).

Understanding learning styles could be considered as a key component of managing classroom teaching strategies (Jaeger, Whalen & Freeman, 2007). Even though traditional learning approaches like lectures, textbooks, discussions, and others are important and should be practiced in teaching sessions, teachers should vary their teaching styles to facilitate each distinctive students' learning styles (Becker, Kehoe & Tennent, 2007). Teachers should also mix different pedagogical strategies in every aspect of their teaching to cater to different learners' needs. To do this, Alias, Tahar and Majzub (2005) highlight that student diversity is an aspect that needs to be taken into consideration by teachers throughout the learning process. Before planning and delivering the teaching process and assessment in the classroom, teachers should identify their learners' needs in advance so that a variety of learning experience structures are assigned to all students. However, a research that was carried out by Fleming and Baume (2006) show that there are some learning style critics who assert that knowing students' individual learning styles cannot actually help to enhance learning. They responded to those criticisms by affirming that information on individual learning style benefits when educators take further action in their teaching approaches rather than just considering how and when

the students learn. However, Fleming and Mills (1992) claim that it is less realistic to expect teachers to plan and deliver lessons that can cater to the diverse learning styles of each individual student. They suggest that the most realistic approach is to encourage students to adapt their learning habits to the learning context and gain knowledge or information in accordance with their own distinctive learning styles. According to Miller (2001), the reason why students' learning styles become unproductive is due to teachers who do not attain the skills in learning theory and do not understand students' learning styles. He further adds that students will be more motivated to learn when their learning styles are compatible with the teachers' teaching styles and will thus be able to increase their academic performance.

In order to ensure learning takes place effectively, educators should vary their teaching styles that complement their students' learning styles. Fleming and Baume (2006) claim that teachers' teaching approaches would reflect the inclination of their own learning styles compared to the students' learning styles. Another study conducted by Thomas et al. (2002) revealed that learning styles are significant in increasing the understanding and achievement of the students. Fleming (2001) developed the VARK inventory in an attempt to enhance students' learning and to help them become better learners. He also stated that VARK is not theoretically a learning style as it provides feedback only on one's preferred modes of communicating. Bristol (2010) also highlights that learning preferences can be matched with learning strategies and that the learning strategies then can be aligned with the teaching modes. Nolting (2002) also emphasises that students' academic achievement positively increases if they are aware of their learning styles and how they learn best. Murphy et al. (2004) state that learning based on VARK provides a medium for self-knowledge, exploring opportunities in classrooms and creates a more productive and enjoyable learning experience for students. Similarly, Piping (2005) has also proven that VARK can improve students' understanding and increase learning motivation and interest among students.

Bachok et al. (2004 cited in Othman & Amiruddin, 2010) concur that students have different learning styles in which unsuitable lessons and teaching styles can affect the students' learning and quality of behaviour in class. Further, Pritchard (2017) claims that good learning does not only depend on identifying the students' learning styles but also depends on the teaching materials used. Thus, production of teaching materials requires to be profoundly based on students' learning styles. Nevertheless, there is also a belief that teaching methods which are

used by educators are fundamental to attract students' interests. Yahaya (2007) states that educators have to exploit more proactive and responsive teaching methods for target groups. As such, educators should be able to provide opportunities and experiences to students with different backgrounds of learning styles through different teaching approaches.

According to Fleming (2006), students have the strengths and distinctive inclinations in accepting learning. Nevertheless, teachers are unable to prepare suitable instructional materials according to the different needs of students' learning styles because of time factor. Virleen (2010) states that the characteristics in VARK can be used to help develop teaching materials which are also suitable and intrigue students to create an effective learning process. Further, according to Zhang (2002), the effectiveness and students' acceptance to learning that applies in the teaching and learning process depends highly on students' learning style. Byrne (2002) also agrees with Zhang that students' achievement depends on students' learning styles. The foregoing discussion shows that adopting teaching methods that cater to students' individual learning styles ensures that effective learning takes place during the learning process.

## Materials and Methods

This study bases its methodology on quantitative research method. The reason for this choice was based on the nature of the research itself. Since the research aims to analyse the effectiveness of the VARK questionnaire in determining learning strategies to enhance students learning and academic achievement, using a quantitative method is considered to be more reliable. A post hoc dataset using data collected from the 16 questions in the "VARK" questionnaire was used. The researchers used the VARK questionnaire because they agree with Fleming's view that this tool benefits teachers by reminding them that each student is an individual and learns in a different way. By understanding the different ways through which learning occurs, teachers can reach more students and help foster stronger teacher-student relationships. Further, despite several tools to study learning styles of students, past research has proven that the visual-aural-read/write-kinesthetic (VARK) questionnaire is a simple, freely available and an easy to administer tool that encourages students to describe their behavior in a manner they can identify and accept (Urval et al., 2014).

In this research, the samples used are students from two Grade 3 classes in an international school in Malaysia.

One class was the control group and the other was the experimental group. The experimental group students went through the treatment where the classes were taught by one of the researchers using teaching strategies that catered to the preferred learning styles as identified from the administered VARK questionnaire. The control group was taught by the regular class teacher using teaching strategies with no knowledge of students' preferred learning styles. The first step in the research process was to administer the VARK questionnaire which consists of 16 questions designed based on Fleming's questionnaire version 8.1 (VARK-Learn Limited, 2019). Further, a pre-test and post-test was administered to both groups and the results were analysed using the Statistical Package for the Social Sciences (SPSS).

In this study, the researchers chose students from the elementary level of class Y and class Z (two classes) to carry out the research. To achieve the objective of this research, an experimental plan was carried out to integrate learning strategies to cater to learning preferences identified in the VARK questionnaire in a science class into the chosen topic "Communication through Signs and Symbols". A total of 10 students ( $n=10$ ) from the experimental group underwent the teaching approaches catering to the learning preferences of the students using textbooks and supplementary materials. However, the control group which has the same number of students ( $n=10$ ) was taught using the traditional teaching approaches and the textbook. The experimental group had a total of 10 ½ hours of experimental teaching over 7 days (1 ½ hours per day). Table 1 shows the lessons that the experimental group went through over the 7 days.

The lessons conducted during the 7 days were designed to cater to the learning preferences of the 10 students in the experimental group. Table 2 shows the learning preferences of the students which were identified through the VARK questionnaire which was implemented a month before the classes were conducted.

As shown in Table 2, there are two students; Students E and G who had visual learning preferences while Students A, C, D and H preferred learning through kinesthetic activities. However, Student I and J learnt best through reading and writing compared to Student B and F who learned best through aural activities. As discussed, learners with aural preference in learning prefer to hear and discuss information rather than read as they learn best when they have a chance to discuss the information with their peers. They also love to listen to information as well as use words efficiently to express themselves in the form of speaking.

**Table 1:** Activities carried out in the Experimental Class

Lesson	Activities	Vark Learning Preference
1	Students were taken around the school with strict instructions to observe and draw the signs and symbols found in the school. Then, they were requested to define the signs and symbols and discuss in groups and as a class.	Kinesthetic Aural Visual
2	Students were asked to list down the names of 5 symbols that can be found in public places and identify their purpose	Kinesthetic Read/Write
3	Students were asked to draw and present a sign that is useful and can be implemented in the school.	Aural
4	Students were given 3 cue cards with single alphabets and were asked to design a symbol for the three alphabets which comprises a secret code. Subsequently, the other students were asked to guess the code.	Kinesthetic Aural
5	Students were asked to design a flag and define the meaning of the colours and symbols on the flag.	Kinesthetic Aural
6	Students were divided into groups, and they were asked to design and colour a symbol of their choice and then to do an oral presentation on why they chose that symbol.	Kinesthetic Aural
7	Students were asked to listen to a new song and then to sing the song accompanied by body language such as combining hand shapes, orientation and movements of the hands, arms, or body to convey the meaning of the song.	Read / write Kinesthetic

**Table 2:** Results of the Experimental Group Students' VARK Questionnaire

	Visual	Aural	Read/write	Kinesthetic
EG Student A	6	2	0	8
EG Student B	5	6	1	4
EG Student C	1	5	3	7
EG Student D	5	2	3	6
EG Student E	6	2	3	5
EG Student F	3	8	3	2
EG Student G	6	1	5	4
EG Student H	2	1	2	11
EG Student I	1	1	5	2
EG Student J	0	5	6	5

As one of the key development areas is to develop team spirit among the students, hence students who belong to these learning preferences were put into groups for discussion so they could learn how to cooperate with each other and were also given an opportunity to do an oral presentation of their findings on their favorite symbol. Learners with visual learning preference give emphasis to space and dimension perception. These students preferred to see the whole picture and were interested in the colours and design, which clearly indicated their preferences to drawing and designing instead of talking, reading, and writing. These students learn best and enjoy the lesson when teachers use gestures, descriptive language as well as logos, videos, posters, slide shows, diagrams or any other tools that have pictures. Therefore, these students were asked to observe and

then to design a few signs that benefit public places such as banks, hospitals, cinemas, and others. They were also instructed to colour the signs according to their respective colours. This helped them to develop awareness of signs and symbols in their daily lives. The kinesthetic learners want to experience the 'information' in order to understand them and love ideas that are practical, real, and relevant to them. They learn best when they are allowed to use their senses and hands-on activities and appreciate teachers who use real life examples to help them to apply what they are learning. For this activity, the kinesthetic students were asked to listen to a song and later use body language to convey the meaning of the song which involved simultaneous combination of hand shapes, orientation and movements of the hands, arms, or body to sinuously express the lyrics of the song. This was an attempt to develop the students' sensitivity to music and ability to express rhythm through signs and symbols. Kinesthetic learners enjoy this kind of activity very much since it emphasizes on physical movements as well as stimulates the students' imagination on physical movements. It must be noted at this point that the findings from the VARK questionnaire as indicated in Table 2 show that the students despite having dominant preferred learning styles, also showed some inclination to other learning styles but to a lesser proportion. In a research conducted by Urval et al. (2014), majority of the students in their study had multiple learning preferences (68.7%). They supported their findings by citing other authors who indicated similar results from different geographic locations (Baykan & Nacar, 2007; Lujan & DiCarlo, 2006; Nuzhat et al., 2011). For the purpose of this research, the researchers designed teaching methods

that catered to the dominant learning styles projected by the students in the VARK questionnaire administered.

### Results and Discussion

The researchers carried out a pre-test on the students in the control group and experimental group during the first week when the research. Next, the researchers also conducted a post-test on the students in the control group and experimental group in the last week to observe if the students were affected by the teaching approaches adopted by the respective teachers. Then, the researchers compared the differences between the pre-test and post-test results taken by students in the experimental group and control group. The results show that the students from the experimental group performed better in the post-test compared to the control group. This shows that the students in the experimental group did benefit from the teaching approaches designed specifically to fit the learning preferences identified in the VARK questionnaire which were used in the 7 lessons. There were 7 questions in the pre and post-tests. Each question was marked over 4, totaling up to 28 marks. The tests were marked by the three researchers with the help of an interrater (who was not part of this research). The final marks awarded for the answers provided by the students in the pre and post-tests were based on the discussion between the three markers and the interrater. This was done to remove biases and subjectivity and to ensure reliability of the findings. The results of the students were classified into 4 categories to ease data analysis. The categories were 0-7 marks (Level 1), 8-14 marks (Level 2), 15-21 marks (Level 3) and 22-28 marks (Level 4). The results of the pre and post-tests of the control group are shown in Figure 1.

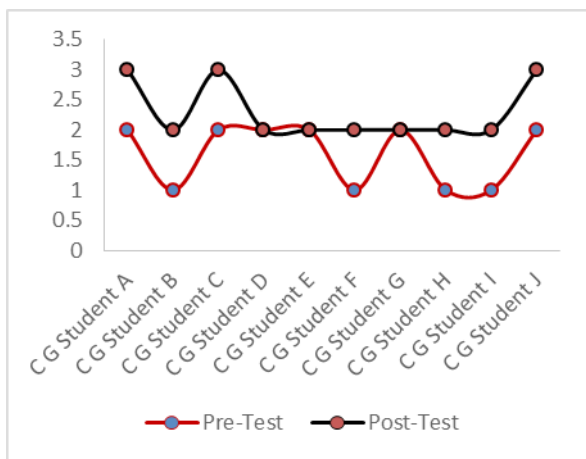


Figure 1: Pre and Post-test Results of Control Group

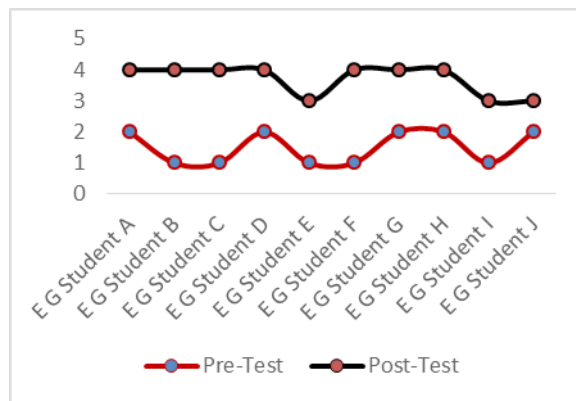


Figure 2: Pre and Post-test Results of Experimental Group

The findings from the pre and post-tests of the control group show that the achievement level for the pre-test ranged from 1 to 2 while for the post-test, most students achieved level 2 while only 3 students were able to achieve level 3 and nobody achieved level 4. Figure 2 shows the results of the pre and post-tests of the experimental group.

The results of the pre and post-tests of the experimental group indicate that the achievement level for the pre-test is almost the same as the control group where the range was from 1 to 2. However, there was a significant improvement in the post-test. A total of 3 students were able to achieve level 3 and the rest of them were able to achieve level 4. This clearly proves that teaching using strategies that cater to the learning preferences of the students as indicated in the VARK questionnaire do enhance academic achievement of students. This finding is supported in a recent study where the researchers find that there is significant difference between the control group and the experimental group which determined that students in experimental group were more successful (Sintia, Rusnayati & Samsudin, 2019). Kaur (2017) too asserted that teachers should adopt a variety of teaching approaches that are capable of accommodating the different abilities and learning preferences of students. This is consistent with the findings of Joshi (2012) who asserts that students usually learn more effectively when they learn through their own initiatives. Additionally, when students’ learning styles are matched with appropriate teaching styles, their motivation and achievement increase and are enhanced. The significant improvement between the pre and post-tests of the experimental group compared to the control group proves that adopting teaching strategies that cater to the learning preferences of the students identified through the implementation of the VARK questionnaire enhances the academic achievement of the students compared to using

strategies without knowledge of students learning preferences as done in the control group.

## Conclusion

The research concludes that the VARK questionnaire is effective in identifying students' learning preferences. This is proven by the levels of achievement obtained by the students of the experimental group in their post-test after having gone through 10 ½ hours of lessons taught using strategies that catered to the students learning preferences identified through the VARK questionnaire that was administered. Despite the positive outcome of this study, it must be noted that designing lessons based on students learning preferences is not an easy task for it requires a lot of time and effort. In order to cater to all the students' needs, the teacher should plan in detail the integration of all the learning preferences of his/her students into the activities but still be able to achieve the same objectives. In the researchers' opinion, this is something future research should take into consideration. It is recommended that educators should administer the VARK questionnaire to their students and identify their learning preferences which should then be followed by adopting strategies that meet these preferences to ensure learning becomes more effective. In addition, the researchers are of the opinion that the VARK questionnaire can be applied to anybody regardless of age and gender. For this reason, it is recommended that future research should consider applying the VARK questionnaire in other age groups as the application of this method in teaching can help teachers to identify and utilize their students' dominant learning preferences in their teaching. In a recent study, it was found that age has a significant association with learning styles (Espinoza-Poves, Miranda-Vílchez & Chafloque-Céspedes, 2019). As such, future researchers should investigate this further. The findings of this study which has similarities with other research such as Singh, Govil and Rani (2015) are important not only in shaping teaching practices but also in highlighting issues that will help policy makers, administrators, curriculum framers, parents, and faculty members to think more deeply about their role in facilitating student learning. However, a recent research by Husmann and O'Loughlin (2019) has proven that the alignment of study strategies with VARK results had no correlation with anatomy course outcomes and they went on to advocate that the conventional wisdom about learning styles should be rejected by educators and students alike. In addition, a study conducted by Kamal et al. (2021) indicated that there was no significant relationship between learning styles and academic achievement

using Pearson's Chi-square test ( $p > 0.05$ ). Although, the findings in this study showed a significant relationship between learning styles and academic achievement, the sample size is small, and it cannot be generalised. As such, future researchers are recommended to study this issue using a larger sample. Adding to this controversy, a recent study advocates for teachers to use learning styles only for choosing teaching materials that are as diverse as possible, rather than matching the style and materials (Huang, 2019). Since the controversies on the effectiveness of modelling teaching practices according to students' learning preferences with VARK results are still ongoing, it is recommended that larger samples are used from different geographical locations as well as different levels of education to confirm on the effectiveness. Further, it is advocated that future research should also adopt classroom observation and interview of students to identify the strengths and weaknesses of adopting strategies that accommodate the learning preferences of the students.

## Competing Interest Statement

All authors have read and approved the manuscript and take full responsibility for its contents. No potential conflict of interest was reported by the author(s).

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