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The Diversity of Learning Styles and Academic Performance of Biology Students

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Abstract

Learning style has its insightful impact on the particular dimensions of teaching and learning process. Students have their own preferred way to recognize, retain and retrieve information to perform well in academic performance. The purpose of this study is to determine the students' preference learning styles and the correlation between students' academic performance among biology students in one of public universities in Malaysia. A descriptive research design was employed using survey method to analyse the students' preference learning styles and their academic performance. The Perceptual Learning Style Preferences Questionnaire (PLSPQ) developed by Joy Reid (1984) was adopted in this study and distributed to 130 biology students. Data gathered from PLSPQ identified students' learning styles and preferences based on six domains: visual, auditory, kinaesthetic, tactile, group and individual. The findings showed most biology students were strong Visual learner and acquired commendable CGPA ranging from 3.00 to 3.49. However, the present study revealed a weak, negative and very significant correlation between academic performance and kinaesthetic (r= 0.304), visual (r= 0.260) and individual (r= 0.189) due to a weak relationship between both variables. Interestingly, gender difference were found in kinesthetic learning style only. Also, there was a statistically significant difference in Auditory learning style between students who enrolled in minor Chemistry and Mathematics. It is concluded that it was important for the lecturers to cater for the different needs of students' learning styles for science learning to be more interesting and give positive impact to their academic performance. For the future study, a large scale studies are recommended to further investigation on the relationship between learners' learning styles and lecturers' teaching style.

Keywords: Learning Styles, Academic Performance, Biology Student, Diversity, Gender.

Introduction

Science education curriculums are theoretical and application-based with the aim of instilling the knowledge of scientific theories and the skill in solving higher order thinking problems. The acquisition of conceptual and analytical skills as well as problem solving ability are the focus of science education. Science education is also content specific and is quite difficult to integrate science learning across other curriculum content. Biology is an integral part of the science curriculum that introduced to Malaysian students during their upper

secondary schools, college as well as tertiary education level (Steigerwald, 2019). Biology is taught basically to enable students to study of life and the living things in our world which are comprised of both plant and animal (Ridzal, 2022; Abidoye & Olorundare, 2020). Biology as part of science that can support the development of students' potential to understand multiple concepts related to the life of creatures on earth. Students think that biology is a rote lesson that contains abstract material with difficult scientific names, so to overcome the problems teacher role is needed. As one of important science subjects which enables learners or students to encompass more about the world, there is a need to determine effective learning styles of the students. Therefore, it is very important to recognize the personality of biology students who are able to grasp the basic concept or knowledge and understanding the principles in depth by teachers and educators.

Generally, students have their own preferred way to learn, recognize, retain and retrieve information. Students receive and process the information in different ways due to the different learning styles (Rezaeinejad et al., 2015). Some students are visual learners, while others are auditory or kinesthetic learners. Visual learners learn visually by viewing of charts, graphs and pictures. Auditory learners learn by listening to lectures and reading. Kinesthetic learners learn by doing things or physical (Vaishnav, 2013). In other words, students can learn in diversified ways either using their eyes, ears, engaging in physical movement or the sense of touch such as doing hands-on activities. Students also can learn better when they work individually rather in groups, and some are vice versa (Reid, 1987). These behaviors are known as learning style or cognitive style (Cetin & Erel, 2018). Due to this, the instructional method of teaching are also differ. Kolb (1984) and Honey and Mumford (1992) described learning style as an individual preferred or habitual ways of processing and transforming knowledge. Kolb (1984) claimed that psychological attributes resulted from individual differences, determine the particular strategies a person chooses while learning. In contrast, Keefe (1987) emphasizes learning styles as cognitive, affective, and psychological traits that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment. Some researchers thought that learning style as a set of factors, behaviors and attitudes that stimulate learning for an individual in a given situation. However, the way students learn differ in how they see, interpret, understand and conceptualize information (Kang, 1999; Teele, 2006; Zacharis, 2011). This is more serious in a context where students come from diverse educational experiences, cultural backgrounds and prior knowledge for instance related to science, arts, physical science, music and others.

The discovery of learning style preferences among the students at many educational levels had stimulated much interest of researchers in higher institutions who believe that if students' preferred learning styles can be identified, it could help and assist significantly by providing guidance to academicians in selecting and designing appropriate instructional methods for teaching and learning options that can effectively be used. Up till now, the issues on whether students are learning in the way they prefer is still debatable and explored in many studies (Ramalingam, 2014; Fareo, 2015; Bhagat & Singh, 2015; Liew et al., 2015; Wong et al., 2017; Alkooheji & Al-Hattami, 2018). Problems occur when student learning styles cannot be adapted to the lecturers' teaching activities and styles (Entwistle, 2013). As a result, students become bored and not concentrating; causing them to fail to score high in the exam, are less interested in certain subjects and turn to give up. Study by Kurgun & Isildar (2016) concluded that one way of determining the efficiency or performance of an individual learn and acquire knowledge is to realize its learning style. Learning style can be defined as an individual's unique manner to learning based on strengths, frailty, and priority. In order to

achieve successful learners, they normally use a multiple of techniques that fit their learning styles and the nature of the task, learning conditions and their aims in certain subjects or topics. Kolb (2015) described learning styles as the method of isolated individuals find, store and reproduce information. Learning is not only related to the expansion of knowledge and recall information learned but is dominated activity and understand the concept of knowledge and further information can apply it to life (Entwistle and Ramsden, 2015).

There are many different ways of categorizing learning styles models that have been developed based on individual interests and tastes. Among a wide variety of related surveys, there are five well-known instruments examining students' learning styles namely Neil Fleming's VARK model (Fleming, 2001), Felder Silverman Learning Style Model (Felder & Silverman, 1995), The Dunn and Dunn Learning Styles Model (Dunn and Dunn,1986), Kolb's Model (Kolb, 1984) and Reid's PLSP (Reid, 1987). One particular model that has been developed and received great attention is Kolb's model. Kolb's model is particularly well-designed since it offers both a way to understand individual's different learning styles and also an explanation of a cycle of experiential learning that applies to all individuals (Healey, 2000; Smily, 2013). However, Reid's PLSP survey items were quite pertinent for this study. These instruments have been a great help in identifying visual, kinaesthetic, auditory, tactile, group and individual styles as well as many other classifications of styles in students and also exploring them with the aim of improving the learning processes. These learning styles are further classified as Major, Minor or Negligible. Major is considered the preferred learning style, Minor is one in which learners could still function well, and Negligible is the factors that hinder learning process.

There are a few studies have been conducted on learning styles among students (Omar, 2015; Magulod Jr, 2019; Maya et al., 2021; Ramirez, 2022). Previously, Razak (2008) study the learning style among the engineering students in Universiti Tun Hussein Onn Malaysia (UTHM). From his study, the result shows that the most preferred learning styles among the respondent are visual while there is no correlation between the most dominant learning styles and gender. Abu taher (2017) has constructed another study on Learning Style Preference among Quantity Surveyor Students in Universiti Teknologi Malaysia (UTM). This study shows that the most preferred learning styles among the students are kinesthetic styles which students prefer learning through touching, feeling and hands-on activities. The study was continued being conducted by (Awang et al., 2017). The study findings generally indicates that the highest domain of learning styles of student was domain kinaesthetic. These findings consistent with the findings of Vashnav & Chirayu (2013) who found out in their study on learning styles and academic achievement that the kinesthetic learners were the majority. The domain chosen may be explained by the cultural environment, students attitudes etc. According to Felder (1995), the cultural environment of the student will give an impact to the way of student receives and processes information in a teaching and learning process.

Quite recently, a number of studies have examined the factors that possibly affect learning style preferences of the students. Among the various factors, gender was found to be the most factors which contributed towards learning style preferences among the students. Urval et al (2014) also claimed that gender difference is a significant factor in terms of learning preference. Previously, study by Nuzhat (2013) indicated that females had more diverse preferences than male students. Recent study by Alkooheji & Al-Hattami (2018) reported that the preferred learning styles of female participants differed than those of male participants in several ways. However, Farid (2014) claimed that there was also no significant difference found between male and female student's learning behaviours and their academic

achievement at the university level. It was also identified that there was no correlation between learning styles and academic achievement.

Learning styles are significant for every student because it has a great influence towards their academic achievement. Unsuitable and ineffective learning styles during learning session will undoubtedly lead to lower academic achievement. The results of the study by Sanjaya (2016) show that learning styles will have an impact on academic achievement then he suggests it is appropriate if the learning style for each student is examined. Nolting (2002) emphasized that students' academic achievement positively increases if they are aware of their learning style and how they learn best. The relationship between learning styles and academic achievement in different level of education was examined by researchers. A study which evaluated the relationship between learning style and students' academic achievement was conducted by (Gokalp, 2013). The study showed that there was statistically significant differences between learning styles and students' academic achievement. Also Jilardi-Damavandi et al (2011) conducted a study to investigate the impact of learning styles on the academic achievement. The researchers found that there was a statistically significant difference in the academic achievement of the students' learning styles. However, the findings of the previous studies show inconsistent and always changed. Recently, study by Mozaffari (2020) showed no significant relationship was found between learning styles and academic achievement in the two groups of strong and weak students. The findings also in line with Almigbal (2015) who revealed that the learning style preferences were not related to GPA. Also, Gappi (2013) have showed that there was no statistically significant relationship between students' academic achievements and students' learning style preferences.

Generally speaking, the importance of learning style could help and assist academicians in selecting appropriate instructional methods and educational options (Smily, 2013). By knowing preferred learning style among students help individual to be more productive, creative, being a better decision maker and problem solver with increased achievement who is able to manage their learning more effectively. In addition, humans have a unique blend of capabilities and skills and their potential can be tied to one's preferences to learn (Gardner, 1993). Also, the awareness of educators towards the importance of students' learning styles is vital for allowing adjustment and improvement in the educators' pedagogic approaches in the classroom (Cuthbert, 2005). Studies that explored aspects of science education often examine learning in relation to students' language capacity, particularly in the learning of English; online courses and occupational health. Studies within Malaysian setting are limited and most of the review of the literature cited studies carried out in Hong Kong and United States of America. Such limitation created a gap in the literature related to the field of biology, hence creating an impetus for this study in examining the said issues. Therefore, this study was conducted to determine the students' preference learning styles and the correlation between academic performances among biology students with the following research questions:

1. What is the most preferred learning style among biology students?
2. Is there any significant difference in students' preferred learning styles and their gender?
3. Is there any significant difference in the preferred learning style among biology students and the minor courses that they were enrolled in?
4. Is there any correlation between students' preferred learning style and their academic performance?

Methodology

The discussion in this article is carried out through the utilization of a survey method, specifically through the use of questionnaires as the main instrument. The Perceptual Learning Style Preferences Questionnaire (PLSPQ) developed by Reid (1984) was employed in this study and distributed to 130 biology students in one of public university in Malaysia. The questionnaire consisted of two sections. The first section (three items) attempted to gather the respondents' demographic information. The second section, with 58 items, was developed to investigate learning style dimension (Visual, Auditory, Kinesthetic, Tactile, Group and Individual. Five-point Likert scale was employed ranging from '1' (never) to '5' (always)'. The Statistical Package for the Social Sciences (SPSS) program version 25 was utilized in the data analysis. Descriptive analysis was employed in determining the distribution of demographic data and the mean score for each respondents' learning styles. The mean score for each learning styles preference was divided into three categories; major, minor, and negligible learning styles as shown in Table 1. To analyze the variance in learning styles between gender and minor courses opted by Biology students, independent sample t-test were conducted. Pearson Correlation analysis was also carried out to probe the relationship between the learning styles and academic performance.

Table 1
Classification of Learning Styles (Reid, 1987)

Classification of Learning Style	Mean (M)
Major	38-50
Minor	25-37
Negligible	0-24

Findings and Discussion

Table 2
Distribution of Samples based on Gender, Minor courses and CGPA

Profile	Variables	Frequency (F)	Percentage (%)
Gender	Male	41	31.5
	Female*	89	68.5
Minor	Chemistry*	81	62.3
	Mathematics	49	37.7
CGPA	Excellent (3.50-4.00)	20	15.4
	Good (3.00-3.49)*	78	60.0
	Moderate (2.50-2.99)	17	13.1
	Low (2.00-2.49)	15	11.5

As can be seen from Table 2, majority of the respondents participated were female, N=89 (68.5%) and most N=81 (62.3%) were enrolled in minor chemistry. A survey conducted by the Malaysian Ministry of Higher Education (MOHE, 2012) showed that students' enrolments in the public universities until 2012 were dominated by female. This explains the unequal distribution of male and female respondent groups in this study in which there are more female respondents than the male respondents especially in biology field. As for academic achievement, majority of the respondents N= 78 (60.0 %) managed to score a good CGPA of (3.00 – 3.49).

The most preferred learning style among biology students

Table 3

The Mean Score of Learning Style

Learning styles	(M)	Standard Deviation (SD)
Visual*	37.515	4.182
Auditory	30.262	4.482
Kinesthetic	33.369	5.154
Tactile*	34.369	4.999
Group	34.123	5.763
Individual*	35.808	6.805

Based on the Table 3, it can be clearly seen that the learning styles most preferred by Biology students were visual (M = 37.515, SD= 4.182), individual (M= 35.808, SD= 6.805), tactile (M = 34.369, SD=4.999); followed by kinaesthetic (M = 33.369, SD=5.154) and Group (M = 34.123, SD=5.763) styles of learning. Biology students in this study expressed the least preference for the auditory learning style (M = 30.262, SD=4.482). The calculated mean scores in the present study are closer to major learning styles, M = 38.00 as served in Table 1 and it can be deduced that visual is the most preferred learning style among respondents. The remaining of four learning styles (Tactile, Kinesthetic, Group and Auditory) were categorized as minor learning styles. Yet, none of the respondents was found to demonstrate Neglected learning style.

This finding is similar to another studies by Nigerian senior secondary students (Abidoye & Olorundare, 2020), economics education students in Indonesia (Syofyan & Siwi, 2018), computer science students in Spain (Alfonseca et al., 2006), as well as medical school students in Barbados, West Indies (Ojeh et al., 2017) who also reported the most students are visual learners. Students with visual learning style understand better when information is received in the forms of visual aids, such as picture, image, diagram, and demonstration (Hawk & Shah, 2007). Likewise, Stanley (2007) stated the same conclusion that visual learning had long been identified as an integral process in educating biology undergraduates, particularly in developing specific visual skills and the acquisition of knowledge relevant in performing well in biology contents as a whole. A way to improve the design of field experience in biology is through the considerations of the kinds of visual tasks that are needed for student learning. This is in line with the nature of knowledge in the field of biology that requires students to memorize and understand a huge amount of scientific facts. This fact can be possibly caused by the previous conditions which led the students to be comfortable with visual learning activities such as describing pictures, drawing structures, and so on. Thus, it was not surprising observation result if visual was the most voted learning style chosen by biology students.

Comparison between students' preferred learning styles and gender

Table 4

Comparison of Learning styles between Gender

Learning Style	Gender	(M)	(SD)	t	p-value
Visual	Male	37.024	3.102	-.908	.366
	Female	37.742	4.594		
Auditory	Male	29.439	3.218	-1.426	.156
	Female	30.640	4.927		
Kinesthetic*	Male*	34.034	5.197	-2.262	.026*
	Female	31.927	4.808		
Tactile	Male	33.951	3.924	-.646	.520
	Female	34.562	5.433		
Group	Male	33.976	4.077	-.197	.844
	Female	34.191	6.412		
Individual	Male	38.829	5.928	-1.114	.268
	Female	36.258	7.160		

To dig more feature about learning styles, this study conducted the analysis on students' learning styles based on their gender. To provide further insights into the gender influence on respondents' preferred learning styles, an independent t-test analysis was performed to confirm the findings as obtained in Table 4. Independent sample t-test was performed to examine the differences between male and female respondents in the mean values for each of the learning styles. As can be observed from the Table, obviously shows that there are no significant differences between male and female respondents with respect to all dimensions Reid's learning styles, either visual $t(128) = -0.908$, $p = 0.366$), auditory $t(128) = -1.426$, $p = 0.156$, tactile $t(128) = -0.646$, $p = 0.520$, group $t(128) = -0.197$, $p = 0.844$ or individual $t(128) = -1.114$, $p = 0.268$ learning styles. However, kinaesthetic learning style shows a statistically significant different between gender with $t(128) = -2.262$, $p = 0.026$. From the results, majority of learning styles tended to be chosen by female students compared to the male. Only kinaesthetic and individual learning styles were highly voted by male students than the female. Auditory is the least preferred style both in male and female. The respondents' preferences on each of the learning style dimensions may be said to be equally distributed irrespective to their gender.

Gender is considered as one of an effective factor in learning style preferences among students. Based on the findings in this study, obviously there was no significant difference in learning styles between gender. This mean that male and female students have similar learning style preferences. The findings are in agreement with Dobson (2010) who claimed that there was no difference between learning preferences and gender. This finding has similar result with previous study by Farid (2014) which are also found that there was no significant difference in learning style preferences between male and female and their academic achievement at the university level. The absent of significant differences in students' preference in learning styles based on their gender difference is making sense. There are several factors identified responsible in determining gender inequity in their choices (i.e. sex, parental, peer influences, social and cultural stereotyping) (Osagie & Alutu, 2016). Thus, the phenomenon of gender equity can be naturally occurred as the proper treatment given by their surroundings to the both genders as well as their needs are well accommodated (Reddy, 2017).

Interestingly, present study also found out that there was a statistically significant difference in kinaesthetic learning styles between male and female students. According to the results, male students preferred to use the kinaesthetic and individual learning style more than females, while, female students preferred the visual, auditory, tactile and group learning style. This mean that male Biology students are more prefer the hands on approach to learning, or learn by doing. They like to move and using touch sensation for acquiring information especially in conducting science experimental. Several studies showed that there is a difference between learning style preferences in relation to gender. In general, individuals differ by gender. Learning style differs between males and females. Males tend to be more kinesthetic, and visual, and need more mobility in a more informal environment than females. Males tend to learn less by listening. Females more than males tend to be auditory, sit at classroom desks and chairs. Females also tend to be more silent during learning (Tatarintseva, 2002). Porter (2007) stated that most students in science laboratory situations prefer hands-on kinesthetic and visual learning styles. The National Science Teachers Association in the United States (NSTA, 2004) is the largest organization of science teachers worldwide also emphasized that the learning science standards should focus more on kinaesthetic styles which encourage science students to engage in a "hands on" activity. It is suggested that kinaesthetic learning styles are very important style for science students because there are a lots of opportunities for students to discover concepts and build physical relationships as they move about and manipulate materials.

Comparison between preferred learning style and minor courses opted by Biology students.

Table 5

Analysis between preferred learning style and minor courses

Learning Styles	Minor	(M)	SD	t	p-value
Visual	Chemistry	37.358	4.246	-.550	.583
	Mathematic	37.776	4.104		
Auditory*	Chemistry	29.568	4.272	-2.261	.026*
	Mathematic*	31.408	4.627		
Kinaesthetic	Chemistry	32.605	4.880	-2.153	.064
	Mathematic	34.633	5.391		
Tactile	Chemistry	34.025	4.957	-1.010	.314
	Mathematic	34.939	5.068		
Group	Chemistry	34.358	5.068	.596	.552
	Mathematic	33.735	6.797		
Individual	Chemistry	35.148	6.516	-1.426	.156
	Mathematic	36.898	7.194		

Table 5 shows the finding of t-test between preferred learning style and minor courses opted by biology students. As can be seen in the table, there is a statistically significant difference in Auditory learning style between students who enrolled in minor chemistry and mathematics, t (128) = -2.261, p = 0.026. This mean that students in Biology who opted in minor Mathematics mostly preferred auditory meanwhile students in minor Chemistry had deeper interest in visual learning style for their learning. The nature of Mathematics and Chemistry are somewhat distinctive from each other as Mathematics is a subject that deals with formulae, quantities, numbers and a rigorous amount of calculations. As comparison, Chemistry involves a lot of scientific facts which require students' comprehension and the

application of concepts at macroscopic, microscopic and symbolic level. Previously, Shahril et al (2013) who study on low and high achievers in Mathematics in Brunei, which found that the high achievers made use of an auditory learning style significantly more than did the low achievers. Therefore, it can be deduced that learning styles play an important role across all the subjects. Due to the fact, it is vital for teachers to be aware and acknowledge the usefulness of recognizing and knowing the domains of learning styles preferred by students (Al-Hebaishi, 2012). The remaining learning styles pointed out there is no significant difference between respondents who enrolled in minor chemistry and mathematics on the learning style preference.

Relationship between students' preferred learning style and their academic performance

Table 6

Pearson Correlations between Learning Style and Academic Achievement

Learning Styles		Visual	Auditory	Kinaesthetic	Tactile	Group	Individual	CGPA
Visual	r	1	.025	.446**	.334**	-.185**	.457**	-.260**
	Sig.		.778	.000	.000	.035	.000	.003
	N	130	130	130	130	130	130	130
Auditory	r	.025	1	.103	.083	.083	.015	-.136
	Sig.	.778		.246	.349	.349	.864	.124
	N	130	130	130	130	130	130	130
Kinaesthetic	r	.446**	.103	1	.460**	.028	.349**	-.304**
	Sig.	.000	.246		.000	.752	.000	.000
	N	130	130	130	130	130	130	130
Tactile	r	.334**	.083	.460**	1	.005	.381**	-.138
	Sig.	.000	.349	.000		.959	.000	.117
	N	130	130	130	130	130	130	130
Group	r	-.185**	.083	.028	.005	1	-.486**	.108
	Sig.	.035	.349	.752	.959		.000	.221
	N	130	130	130	130	130	130	130
Individual	r	.457**	.015	.349**	.381**	-.486**	1	-.189**
	Sig.	.000	.864	.000	.000	.000		.031
	N	130	130	130	130	130	130	130
CGPA	r	-.260**	-.136	-.304**	-.138	.108	-.189**	1
	Sig.	.003	.124	.000	.117	.221	.031	
	N	130	130	130	130	130	130	130

**. Correlation Is Significant At The 0.05 Level (2-Tailed).

Pearson correlation analysis in Table 6 has been conducted to analyze the relationship between students' preferred learning styles and academic performance among Biology students. From the table, it can be seen that there was a weak, negative and very significant correlation between students' kinaesthetic learning styles and their academic performance (r = 0.304), likewise with the visual (r = 0.260, and individual (r = 0.189) learning style. A negative correlation between students' preferred learning styles and their academic performance due to a weak relationship between both variables. Students could managed to score a good CGPA even though without visual or attending physical class learning particularly during pandemic

(Ramirez, 2022). It means that the types of learnings styles do not contribute directly to the students' academic performance. This might be due to different students may use different ways to learn in their academic field (Isa et al., 2021). In fact, there are many other variables which possibly affect students' performance besides learning styles. The previous study conducted by Rogowsky et al (2020) indicated that providing instruction based on students' learning styles does not improve their learning achievement. Mozaffari (2020) also stated that there was no statistically significant relationship was found between learning styles and academic achievement in the two groups of strong and weak students. The fact that there were no significant difference of students' performance based on their learning styles become more interesting to be discussed as there are many research findings which proved the opposite results.

Conclusion

In conclusion, the findings derived in this study could potentially assist the educators in considering appropriate instructional strategies in order to facilitate for a more conducive environment for learning. The appropriate match between teaching styles to learning styles can significantly enhance academic achievement, students' attitudes, aptitude and behaviors, hence, leading to a more meaningful learning. Understanding learning styles is crucial for educators especially in developing teaching techniques and curriculum design. Thus, lessons that employ the 'one-size-fit-all' approach of teaching and learning is no longer practical. Teaching styles and learning styles which are inconsistent from each other would impact students' academic performance negatively. Students tend to be inattentive and uninterested in class, perform poorly in tests, become discouraged about the course and thus may eventually see themselves as low achieving students (Kadir, 2013). Conflicts would arise in educational settings resulting in negative consequences for both parties; the learners and educators. One of the conflicts suggested is due to the unaligned educator's teaching styles with the learner's learning styles (Jhaish, 2010).

Future work in this field should be extended in a way that covers wider sample size, through the use of multiple methodologies in data collection given the dearth of studies that look at the same area and perspective. Other factors should also be investigated such as students' motivations, social economic status, parenting styles, school types, etc. Also, a mixed-methodology should be adopted in order to obtain a more rounded and comprehensive view on this particular research area.

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