

The Preferred Public Health Medicine Learning Styles among Medical Students

Fairuz Fadzilah Rahim, Siti Fatimah Kader Maideen and Abdul Rashid
RCSI and UCD Malaysia Campus (formerly Penang Medical College)
Penang, Malaysia

Surajudeen Abdulrahman
James Paget University Hospital
Norfolk, United Kingdom

Abstract. Learning styles varies from one student to another, influenced by various factors. The study aims to determine the student's preferred learning styles in the subject of Public Health Medicine and to provide input to the curriculum designers to reduce the mismatch between the learning styles and teaching methods in the subject. A cross-sectional study was conducted among undergraduate medical students at RCSI & UCD Malaysia Campus (RUMC). A structured questionnaire was used to collect data on socio-demographic factors and Index of Learning Styles (ILS) was used to measure the different learning styles preferred by students. Factors associated to the learning styles were examined by multinomial logistic regression. A total of 366 medicals students voluntarily participated in the study. The majority of them had a fairly well balanced learning style for active/reflective (59.56%), sensing/intuitive (53.28%), and sequential/global (65.03%) domains, but preferred more visual learning style (57.65%) as compared to verbal. Six factors were significantly associated with learning style preferences which include age, race, fathers' occupation, mothers' occupation, and pre-university education. Majority of the medical students were well balanced in three dimensions. Social status and educational background influenced the learning style preferences in Public Health Medicine course.

Keywords: Teaching & learning, study skills, Public Health, medical students.

1. Introduction

The concept of "learning-styles" presumes that individuals differ with regards to what mode of study or instruction works best for them, hence their preference for certain methods over others (Pashler, 2008). Different learning-style models

have been described in literature. However, the overarching consensus on the benefit of assessing and diagnosing an individual's learning style preference for purpose of tailoring instructions accordingly, is gaining increasing acceptance and popularity among educators, parents and students. Ormrod and colleagues suggested that while some students seem to learn better from information presented in words (verbal learners), others learn better when information is presented in pictures (visual learners) (Ormrod, 2008).

Assessment of learning styles is generally predicated on two important theories – “ability-based” and “personality-based” theories of learning styles (Sternberg, 2008). What is most important for teachers is to capitalize on these preferences in the diversity and flexibility of their approach to teaching. Although the objectives and learning outcomes may be almost similar in institutions but teaching methods using standard approaches, the learning styles and preferences of students may differ. These differences are not only for each student but may also be for different course. Public Health Medicine focuses on protecting and improving the health of families, communities and populations through promotion of healthy lifestyles, prevention, detection and control of infectious and non-infectious diseases. To achieve this, it is necessarily essential for implementing educational programmes, recommending policies, administering services and conducting research. Public Health teaching aims to harness and improve student's core competencies in the areas of risk assessment and analytical thinking, leadership and systems-thinking, community engagement and inter-sectoral collaboration, communication, planning and management, and policy dialogues. Because these competencies require diverse skills and mastery, some of which may draw from students intuitive, reflective, visual and global orientation in their day-to-day learning and appreciation of public health problems, it becomes imperative for public health teachers to pay particular attention to diversities in student's preference for learning styles with the aim of achieving a balanced and holistic approach.

In general, different styles of learning preferred should influence a teacher on the correct method of teaching to ensure the effectiveness of teaching and to strengthen the interaction and the efficient transfer of knowledge between educators and students. Keefe viewed learning style as “characteristic cognitive, effective, and psychological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment” (Keefe, 1979).

Numerous theories of learning style and models have been developed. There are many learning style instruments available and even more papers have been published in relation to different learning styles (Coffield, 2004; Hall, 2005). A review by Harold Pashler and colleagues found there are very few study designs capable of testing the validity of learning styles. They concluded there was no adequate evidence to support the idea of incorporating a customized learning style into education (Pashler, 2008).

Recent research evidence suggests that there remains significant value in aligning dominant learning styles of students and teaching styles of instructor for better academic performance (Kamal, 2019; Naqvi & Naqvi, 2017). Not only

does the awareness of learning styles increase flexibility of teaching styles and improve communication between instructors and students (Naqvi & Naqvi, 2017), it also enhances the teachers' capacity to help students develop strategies for adapting in differing situations (i.e different learning styles), especially when learning styles do not fit to a task (Bhagat, Vyas, & Singh, 2015; Vaughn & Baker, 2001). Indeed, the awareness of learning styles can create a better learning environment by enabling students to use appropriate strategies in different situations (Kumar & Chacko, 2010).

The Felder-Solomon's Index of Learning Styles (ILS) is most reliable in assessing an individual's learning styles. This is a questionnaire based assessment (R. M. Felder, & Silverman, L. K., 1988). Using this method of assessing the students learning styles, the individual's preferences to the learning styles are categorized into four bipolar dimensions; the ability to process information (active/reflective), the preferential type of information perceived (sensing/intuitive), the input by which the sensory channel perceives (visual/verbal), and the progression towards understanding (sequential/global). This Index of Learning Styles (ILS) is a comprehensive learning style indicator, which is modified from the expanded theories on experiential learning (Kolb, 1984) and personality type (Jung, 1990). Even though the questionnaire was purposely designed for engineering students, it has been extensively used to evaluate learning styles of different higher education students, and the reliability and validity of the tool for other sampled population particularly medical students were proven (Cook, 2005; R. M. Felder, & Spurlin, J., 2005).

This study aims to determine the preferred learning styles of medical students for Public Health Medicine and to identify the association of the demographic factors between the different learning styles of the students. The findings of this study can help to provide input to the curriculum designers and teachers in order to decrease the mismatch between the common learning styles and teaching methods in Public Health Medicine.

2. Methods

Study Design

This analytical cross-sectional study was undertaken among 366 medical students in a private medical school in north Malaysia.

Study Location and Participants

This study was conducted in a private medical school in Malaysia which has been operational for more than 20 years. The students in this Irish owned medical school undertake their first two-and-half years of pre-clinical study in Ireland before returning to here for their clinical and Public Health training. During their final two-and-half years of training in Malaysia the students undergo clinical training in several public hospitals and health clinics in the state. During their time in Malaysia, the students also undergo six weeks of Public Health posting including field visits to District Health Offices. Public Health teaching in this medical school is divided into two, PH1 and PH2 which is done in different times of their academic year. PH1 focuses on Epidemiology,

Biostatistics, Research methods and Ethics, Public Health Concepts and training on statistical software. These are delivered during a two-week posting through PowerPoint presentations/lectures, audio-visual materials, hands-on practical exercises, field visits, tutorials and peer-learning. Assessment is conducted at the end of via written papers by means of Multiple Choice Questions (MCQ) and Short Answer Questions (SAQ). During PH2, the students undertake a four week Public Health posting focusing on Public Health principles and services as well as Epidemiology. The posting also entails 11-days supervised field attachment to one of three District Health Offices in the state. At the end of the posting, an assessment comprising of Multiple Choice Questions (MCQ), Long Answer Questions (LAQ) and Objectively-Structured Practical Assessment (OSPA) is conducted.

The medical students come from a wide range of backgrounds and experiences. They are typically top-performing students from the high school examination, majority of who hold Malaysian Government merit scholarship for the entire duration of their undergraduate study. Their unique exposure to high quality teaching and learning standards in Dublin during their preclinical years, sets the pace for further consolidation of knowledge and exposure to impeccable and innovative teaching methods. This study involved a universal sample of medical students who were in their PH1 and PH2 rotations.

These students who had completed the Public Health posting were requested for an informed consent to participate in the study. Students' participation was voluntary. The participating students completed the ILS questionnaire to assess their learning styles for Public Health course. The course under focus include Basic Biostatistics, Epidemiology, Research Ethics, and Public Health topics which covered Maternal and Child Health, Vector-borne Diseases, Non-communicable Diseases, Communicable Diseases, Occupational and Environmental Health, and Geriatric Health.

Instrument

A structured questionnaire comprising socio-demographic profiles and Index of learning style (ILS) was administered to the students. The socio-demographic information collected included age, gender, race, marital status, types of secondary school, pre-university education, and parents' occupation. The classification of occupation followed the International Standard Classification of Occupations (ISCO), the most recent classification composed by the International Labour Organization (ILO). There were 10 classifications under the ISCO and two more items were added i.e. on retirees and unemployed. The current study had further classified the occupations into three categories of professional, others occupation, and retired/not working. The professional category was those parents who worked as managers, or in professional fields, or as technicians and associate professionals. Others occupation were clerical support workers, service and sales workers, skilled agricultural, forestry and fishery workers, craft and related trades workers, plant and machine operators, and assemblers, elementary occupations, or parents in armed forces occupation.

In Malaysia, there are two main types of secondary schools - national and vernacular school. Vernacular schools include Chinese and Tamil school which follow the national curriculum but in the respective languages.

Index of learning styles (ILS) designed by Richard M Felder and Linda K Silverman was used to assess the learning preference of public health by the students of this institution (R. M. Felder, & Silverman, L. K., 1988; R. M. Felder, & Soloman, B. A.). The online version of ILS questionnaire consists of 44 questions designed by Felder RM & Soloman BM (R. M. Felder, & Soloman, B. A.) to assess preferences on four dimensions of learning styles by looking into four bipolar dimensions of learning styles; the ability to process information (active/ reflective), the preferential type of information perceived (sensing/ intuitive), the input by which the sensory channel perceive (visual/ verbal), and the progression towards understanding (sequential/ global). Each dimension consists of 11 items. Active/ reflective was assessed by question numbers 1, 5, 9, 13, 17, 21, 25, 29, 33, 37 and 41. Sensing/intuitive determined by question numbers 2, 6, 10, 14, 18, 22, 26, 30, 34, 38 and 42. Visual/verbal by question numbers 3, 7, 11, 15, 18, 23, 27, 31, 35, 39 and 43. The fourth dimension sequential/global measured by question numbers 4, 8, 12, 16, 20, 24, 28, 32, 36, 40 and 44. The four scales were summarized as follows (R.M. Felder, & Spurlin, J., 2005) :

- sensing (referring to concrete, practical, oriented toward facts and procedures) or intuitive (referring to conceptual, innovative, oriented toward theories and underlying meanings);
- visual (preference to visual representations of presented material, such as pictures, diagrams, and flow charts) or verbal (preference to written and spoken explanations);
- active (learn by trying things out, enjoy working in groups) or reflective (learn by thinking things through, prefer working alone or with one or two familiar partners);
- sequential (linear thinking process, learn in incremental steps) or global (holistic thinking process, learn in large leaps)

The ILS website link created by the North Carolina State University (R. M. Felder, & Soloman, B. A.) was applied to generate the learning styles results. Score of 1-3 indicates fairly well balanced on the two dimensions of that scale. Score of 5-7 reflects the moderate preference for one dimension and the student will learn more easily in a teaching environment which favors that dimension. Meanwhile, score of 9-11 suggests the student has very strong preference for one dimension of the scale, and the student may face difficulty learning in an environment which does not support that particular dimension.

Data Analysis

Data analysis was done by using STATA (version 13) statistical software. Data was analyzed and presented descriptively and analytically. Descriptive statistics of mean and standard deviation was reported for numerical variable, while frequency and percentage for categorical variables.

There were four separate analyses for the univariable and multivariable methods according to the four learning style dimensions. Multinomial logistic regression was utilized for these purposes. Each of the dimension was categorized into three groups, example; active, fairly well balanced, and reflective; Sensing, fairly well balanced, and Intuitive; and so on. The fairly well balanced group was identified as the reference group for the assessment of the Relative Risk Ratio (RRR) for each of the subdimension scale. Univariable analysis examined association of individual demographic factor with the learning style dimension. Following the univariable examination of the factors that could potentially influence the preference to the learning styles, the potential variables were entered into multivariable logistic regression. The multivariable regression was used to model the effect of the different demographic factors of medical students on the preference to the each dimension of the learning style. A p -value of less than 0.05 was considered as statistically significant.

3. Results

Study Characteristics of Medical Students

A total of 366 out of 409 students completed the survey, giving a response rate of 89.5%. The socio-demographic profile of the participating students is presented in Table 1. This study consisted of predominantly female Malay students aged 22-23 years old, majority of whom had a fairly well balanced learning style for active/reflective, sensing/intuitive and sequential/global domains, but preferred visual learning style. Majority of them were from National type secondary school followed by Chinese vernacular type with one third of the students were from a local pre-university education system and the rest from the international system. Most of the students' fathers were classified under the category of other occupations, while more than half of the mothers were either retired or not working.

Index of Learning Styles for Public Health Medicine

The learning style preferences for Public Health Medicine are shown in Table 2. Majority of the students had a fairly well balanced learning style for active/reflective, sensing/intuitive and sequential/global domains. Meanwhile for visual/verbal, majority preferred visual learning style (Figure 1).

Univariable Analysis for Four Bipolar Dimensions

Malay and 'others' race students with those who had attended National type secondary school significantly preferred active learning style, while younger students and those whose fathers' occupation were of the professional and employed in category of 'others' occupation preferred reflective learning style (Table 3a). Students whose mothers' occupation was of the 'others' category were more likely to prefer intuitive learning style (Table 3b). Chinese and 'others' race students were significantly more inclined to fairly well balanced relative to visual learning style. Whereas younger students and those who

attended international pre-university education preferred verbal learning style (Table 3c). Malay students appeared to be significantly more inclined to fairly well balanced relative to sequential learning style. In the same vein, Malay students were also preferred fairly well balanced in relative to global learning style. Chinese students similarly observed favoring fairly well balanced (Table 3d).

Multivariable Analysis for Four Bipolar Dimensions

Following univariable analysis, the effects of the variables were adjusted accordingly in four separate multinomial logistic regression models. Table 4 shows the results of the analysis. There were six demographic factors significantly associated with the Index of Learning Style for Public Health Medicine.

Race was significantly associated with most of the domains. the active, visual, sequential and global learners relative to fairly well balanced. Malays students significantly preferred active, visual, fairly well balanced (in relative to sequential and global) learning styles. Chinese students favored fairly well balanced (relative to active, visual and global) learning styles. 'Others' race students preferred active and fairly well balanced (relative to visual) learning styles.

Students whose fathers' occupations were of Professionals category preferred reflective learning style. Students whose fathers' occupation of 'others' category favored reflective and fairly well balanced (relative to intuitive) learning styles. Students with retired or not working fathers preferred fairly well balanced (relative to reflective) and intuitive learning style.

Those mothers' occupation of 'others' category significantly preferred intuitive learning style, while younger students and those who attended international pre-university education preferred verbal learning style.

4. Discussion

A structured educational setting involves reception and processing of information (R. M. Felder, & Silverman, L. K., 1988). At the reception stage, students observe the external information through senses and incline to internal information introspectively. The students were selective on the material they processed which involves inductive or deductive reasoning, reflection or action, and introspection or interaction with others. Research on individual learning preferences and how instructional methods can be tailored to cater to the different styles has demonstrated significant progress in the last decade or so (Baykan & Nacar, 2007; Dobson, 2009; Kamal, 2019; Rajendra Kumar, Voralu, Pani, & K Raman, 2009, 2011).

More than half of the students in this study had fairly well balanced learning styles for active/reflective, sensing/intuitive and sequential/global. Similar findings was observed in another study by Jiraporncharoen and colleagues in Thailand whereby majority of the undergraduate medical students had well balanced learning styles in the active/reflective and sensing/ intuitive domains

(Jiraporncharoen, 2015). The study found out that those students in the pre-clinical years preferred reflective learning while the students in the clinical years preferred active learning style which could be influenced by the different lecture contents, teaching methods and assessments. Similar findings to the present study was also observed among first year medical student studying Physiology in Tamil Naidu whereby majority of the students were fairly well balanced in the sequential/global, active/reflective and sensing/intuitive domains (D'cruz, 2013). In a study done among undergraduate nutrition and dietetic students showed that the students preferred intuitive learning style (Williams, 2012). The information on learning styles is important for lecturers to as it would help them to understand how students understand and adapt with different teaching methods during various learning activities in varsities.

Parents' background contributes to the schooling system which a student enrolls to. It has been reported that socioeconomic factors such as family income, education, and occupation play an important role in the achievement of learners. Good financial support and positive home environment will enrich the learning process in the form of educational resources (Arshad, 2012). Richer parents are able to provide better environment for their children. The environment has great influence on learners and molds the preference to learning style (Gelade, 2004). Reid and colleagues defined learning style as an individual's natural, habitual, and preferred ways of absorbing, processing, and retaining new information and skills which also influenced by the culture or environment (Reid, 1995).

Based on the findings of this study, majority of the students were fairly well balanced to both learning styles and only 20% preferred active and reflective learning style. The classification of active/reflective category was on how the students preferred to process the public health services information during their District Health posting and lectures in the classroom. Since active learners prefer actively participating in discussion or physical activities, they are unlikely to learn much in passive situation like lectures. However, reflective learners would not learn much during lectures unless given a chance to think about or examine the perceived information, at times Public Health Services lectures hardly give them this chance. However, the lecturers would be able to help both active and reflective learners simultaneously by using brainstorming sessions or providing a few minutes for the students to think about what is being taught in the lecture. A study found that the learning styles differ according to the year of study where final year dietetics and nutrition students preferred reflective learning. The reason behind this was due to the different learning context in final year that incorporates internship, problem-based learnings and research in other health sciences field (Williams, 2012).

The second dimension of sensing or intuitive also had similar pattern with active/reflective learning style whereby majority of the students were fairly well balanced. However, the preference to sensing was higher as compared to intuitive. The division into sensing/intuitive learners is based on whether the students preferentially perceive "practice-to-theory" type (sensing) or "theory-to-practice type" (intuitive). According to the nature of Public Health Medicine subject and its curriculum, it is a reasonable finding that sensing learners would

be more than the intuitive learners in the study. However, teaching of Public Health Medicine involves both explanations of concepts in the classroom and learning the Public Health services provided in the community, generally caters both sensing and intuitive learners.

Similar to the findings of current study, a study which was done among a group of health sciences students showed that, in the dimension of sensing-intuitive, the students preferred sensing learning style as compared to intuitive. In the same study, it was found that students that preferred active/reflective and sensing-intuitive learning styles predicted the attitudes towards e-learning (Brown, 2009).

The visual or verbal dimension deals with the sensory channel through which information is processed. Visual information consists of diagrams, plots, animation, etc. whereas verbal information not only includes spoken words but also written words as cognitive scientists have proven that the brain converts written words into their spoken equivalents and then processes them like spoken words. Interestingly visual learners were the highest compared to verbal learning style. Teaching the Public Health course involves both verbal and visual presentations. Since majority of the students in this study are visual learners, potential for a teaching/learning style mismatch may exist. The application of more pictures, flow charts, graphs, animations, videos and even live demonstrations in the teaching/learning activities can help prevent the possible mismatch. A study done among medical students in Romania showed that majority of students that preferred single learning styles preferred visual learning style as it is much easier for them to retain information while studying (Busan, 2014).

The final learning style dimension which is the sequential or global had the most majority of fairly well balanced learners (65.03%). This dimension categorizes students based on how they progress towards understanding the Public Health in step by step manner (sequential) or in large jumps, holistically (global). However, the sequential learners were slightly higher than the global learners. As already being done, the lecturers should always present in orderly and logical approach in explaining the public health strategies and activities. In this context, the students would eventually possess the ability of processing information both sequentially and global which would be invaluable when they practice medicine. As contrast to the findings of current study, in the dimension of sequential/global, medical students in Thailand preferred sequential learning styles as compared to global. It was also showed that sequential learning style was significantly associated with high academic achievements (Jiraporncharoen, 2015).

This study found the association of demographic factors with the preference of learning style for Public Health Medicine subject. After adjusting of other independent factors, race and the fathers' occupation were significant for active/reflective learning style. The findings confirm the relationship of culture with the development effect of active learners. Malaysia is a multiracial country where every race practiced their own unique culture which influenced the quality of their learning (Caldwell, 1996). It was also reported that

active/reflective learning associated with students' achievement (Mahmoud, 2019). On the other hand, the working fathers seem to build up the reflective learners. This study shows the effect of a good socioeconomic status on how the learners perceived information. The socioeconomic status found to be a significant factor in learners' cognitive development and academic achievement (Bornstein, 2002; Milne, 2006).

This study did not find any association with sensing learning style, however fathers' and mothers' occupation were found to be associated with intuitive learning style. Fathers and mothers who are not in professional occupation were also associated with the intuitive learning style (Bornstein, 2002; Milne, 2006). The intuitive learners need to understand the theory behind the concept before practicing it. These students learnt most of the theories during their preclinical studies. Students were able to choose to which university they want for the preclinical studies for their twinning programmes. The universities provides extensive education and training for both Irish and international students. The universities offer training, research, innovation, and community engagement.

Race, age, and pre-university education were associated with the visual/verbal dimension. Students exposed to international pre-university education were associated with verbal learning style. The study confirms that the different education system will have an influence to the learning style (R. M. Felder, & Silverman, L. K., 1988). Last but not least for the sequential/global dimension, only race factor was associated with the learning style.

5. Strengths and limitations

This study had several strengths and limitations that worth mentioning. The strength of this study is the use of validated questionnaire, namely the Index of Learning Styles (ILS) and considerable large number of sample size that would have increase the power of the study. Whereas the limitations of this study were it only includes medical students who were posted under Public Health Medicine Department in a private medical school in one state in Malaysia, which is not representative of all medical students in different years of the current medical school and other medical colleges or universities in Malaysia. Due to the nature of the cross-sectional study, temporal relation cannot be ascertained. Also, since there are more components of learning than just the learning styles (for example, the learning approaches of the students, their levels of intellectual development, motivation, etc.) addressing learning styles alone as a solution to all learning problems cannot be assumed.

6. Conclusion

The majority of the students in this study was visual learners and was well balanced in active/reflective, the sensing/intuitive and the sequential/global dimensions with no gender differences in the preference of learning styles. The finding of this study is more of informative nature. The awareness on different learning styles is essential to the students as they would be able to adjust with various teaching and learning activities for progressing well in their academic. It is worth to note that the identification of different learning styles is not to

teach each student according to their preference but rather to help the teachers to adopt a balanced style between student's preferences and the needs of learning activities. With the knowledge of these dimensions and the current findings, the lecturers and the curriculum developers from Public Health Medicine can adopt balanced teaching styles to reach all the students, help them to learn better using different dimensions of ILS instead of just focusing on sensory modality preference alone.

It is an unsurmountable task to cater for each student's style of learning because students have myriad ways of learning and taking up information. The compromise is to use various teaching strategies to engage the students and to be flexible in the teaching strategies according to the students' needs. Selecting the most appropriate strategy will help to ensure effective teaching and boost the students' performance in examination.

7. List of abbreviation

ILS: Index of Learning Styles

ISCO: International Standard Classification of Occupations

ILO: International Labour Organization

RRR: Relative Risk Ratio

CI: Confidence interval

8. Declarations

Competing interests

The authors declare that they have no competing interests.

Ethics approval and consent to participate

All work was conducted in accordance with the Declaration of Helsinki (1964). The anonymity of the students is assured. Students were required to provide a signed informed consent after reading the participant's information sheet which clearly specified that the student may withdraw from the study at any moment. The study had received the approval from the institutional ethics committee prior to the commencement of the study. The Joint Penang Independent Ethics Committee (JPEC) had offered a waiver from ethical approval for this study after an expedited review (JPEC 05-14-0119).

Consent to publish

The study had obtained written informed consent for publication.

Availability of data and materials

The data that support the findings are not publicly available due to confidentiality reason. Data are however available from the corresponding author upon reasonable request and with permission of RCSI and UCD Malaysia Campus (RUMC).

Funding

There was no declaration of interest as this study was not supported by any type of research funding.

9. Acknowledgements

A special thanks and gratitude to amazing people who contributed to the completion of this study: Dr Kyaw Ko Latt, Dr Harith Alaa Abdulhadi, Dr Saw Maung, and Mrs. Siti Nur Afiqah Zahari.

References

- Arshad, M., Attari Z.H., & Elahi, E. (2012). Impact of Parents' Profession on their Children's Learning English in Pakistan. *International Journal of Learning & Development*, 2(1). doi:10.5296/ijld.v2i1.1384
- Baykan, Z., & Nacar, M. (2007). Learning styles of first-year medical students attending Erciyes University in Kayseri, Turkey. *Adv Physiol Educ*, 31(2), 158-160. doi:10.1152/advan.00043.2006
- Bhagat, A., Vyas, R., & Singh, T. (2015). Students awareness of learning styles and their perceptions to a mixed method approach for learning. *Int J Appl Basic Med Res*, 5(Suppl 1), S58-65. doi:10.4103/2229-516x.162281
- Bornstein, M. H., & Bradley, R.H. (2002). *Socioeconomic status, parenting, and child development*. In (pp. 13-27). doi:10.4324/9781410607027
- Brown, T., Zoghi, M., Williams, B., Jaberzadeh, S., Roller, L., Palermo, C., ... Holt, T.-A. (2009). Are learning style preferences of health science students predictive of their attitudes towards e-learning? . *Australasian Journal of Educational Technology*, 25(4), 524-543. doi:10.14742/ajet.1127
- Busan, A. M. (2014). Learning styles of medical students - implications in education. *Curr Health Sci J*, 40(2), 104-110. doi:10.12865/chsj.40.02.04
- Caldwell, G. P., & Ginther, D. W. (1996). Differences in learning styles of low socio-economic status for low and high performers. *Education*, 117(1), 141-147.
- Coffield, F., D. Moseley, E. Hall, and K. Ecclestone. (2004). Learning Styles and Pedagogy in Post-16 Education: A Systematic and Critical Review. *The Learning and Skills Research Centre, London*.
- Cook, D. A. (2005). Reliability and validity of scores from the Index of learning styles. *Academic medicine*, 80 (10), S97-S101. doi:10.1097/00001888-200510001-00026
- D'cruz, S. M., Rajaratnam, N., & Chandrasekhar, M. (2013). Learning styles of first year medical students studying physiology in Tamil Nadu. *International Journal of Medical Research & Health Sciences*, 2(3), 321. doi:10.5958/j.2319-5886.2.3.111
- Dobson, J. L. (2009). Learning style preferences and course performance in an undergraduate physiology class. *Adv Physiol Educ*, 33(4), 308-314. doi:10.1152/advan.00048.2009
- Felder, R. M., & Silverman, L. K. (1988). Learning and Teaching Styles in Engineering Education. *Engineering Education*, 78(7), 674-681.
- Felder, R. M., & Soloman, B. A. Index of Learning Styles Questionnaires. Retrieved from <https://www.webtools.ncsu.edu/learningstyles/>
- Felder, R. M., & Spurlin, J. (2005). Applications, reliability and validity of the Index of Learning Styles. *Intl. Journal of Engineering Education*, Vol. 21, 103-112.
- Felder, R. M., & Spurlin, J. (2005). Reliability and Validity of the Index of Learning Styles: A Meta-analysis. *International Journal of Engineering Education*, 21(1), 103-112.
- Gelade, S., & Stehlik, T. (2004). *Exploring locality: The impact of context on indigenous vocational education and training aspirations and outcomes*. . Adelaide., Australia: National Centre for Vocational Education Research.

- Hall, E., & Moseley, D. (2005). Is There a Role for Learning Styles in Personalised Education and Training? *International Journal of Lifelong Learning*, 24(3), 243-255. doi:10.1080/02601370500134933
- Jiraporncharoen, W., Angkurawaranon, C., Chockjamsai, M., Deesomchok, A., & Euathrongchit, J. (2015). Learning styles and academic achievement among undergraduate medical students in Thailand. *J Educ Eval Health Prof*, 12, 38. doi:10.3352/jeehp.2015.12.38
- Jung, C. G. (1990). *Psychological Types* (3 ed. Vol. 6). New York, NY: Princeton University Press.
- Kamal, A., & Radhakrishnan, S. (2019). Individual learning preferences based on personality traits in an E-learning scenario. *Educ Inf Technol*, 24(1), 407 - 435. doi:10.1007/s10639-018-9777-4
- Keefe, J. W. (1979). *Student learning styles: Diagnosing and prescribing programs*. Reston, VA: National Association of Secondary School Principals.
- Kolb, D. A. (1984). *Experiential Learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.
- Kumar, L. R., & Chacko, T. V. (2010). Using appreciative inquiry on learning styles to facilitate student learning. *Med Educ*, 44(11), 1121-1122. doi:10.1111/j.1365-2923.2010.03842.x
- Mahmoud, H., Ahmed, K., Ibrahim, E. . (2019). Learning Styles and Learning Approaches of Bachelor Nursing Students and its Relation to Their Achievement. *International Journal of Nursing Didactics*, 9(03), 11 - 20. doi:10.15520/ijnd.v9i03.2465
- Milne, A., & Plourde, L. A. (2006). Factors of a Low-SES Household: What Aids Academic Achievement? *Journal of Instructional Psychology*, 33(3), 183-193.
- Naqvi, A., & Naqvi, F. (2017). A Study on Learning Styles, Gender and Academic Performance of Post Graduate Management Students in India. *Int J Econ Manag Sci*, 6, 398. doi:10.4172/2162-6359.1000398
- Ormrod, J. E. (2008). *Educational psychology: Developing learners* (6 ed.). Upper Saddle River, NJ: Pearson.
- Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning Styles: Concepts and Evidence. *Psychological science in the public interest*, 9(3), 105-119. doi:10.1111/j.1539-6053.2009.01038.x
- Rajendra Kumar, L., Voralu, K., Pani, S. P., & K Raman, S. (2009). *Predominant Learning styles adopted by AIMST University students in Malaysia* (Vol. 3).
- Rajendra Kumar, L., Voralu, K., Pani, S. P., & K Raman, S. (2011). *Association of Kinesthetic and Read-Write Learner with Deep Approach Learning and Academic Achievement*.
- Reid, J. M. (1995). *Learning Styles in the ESL/EFL Classroom*. Boston, MA: Heinle & Heinle.
- Sternberg, R. J., Grigorenko, E. L., & Zhang, L. F. (2008). Styles of learning and thinking matter in instruction and assessment. *Perspectives on Psychological Science*, 3(6), 486-506. doi:10.1111/j.1745-6924.2008.00095.x
- Vaughn, L., & Baker, R. (2001). Teaching in the medical setting: balancing teaching styles, learning styles and teaching methods. *Med Teach*, 23(6), 610-612. doi:10.1080/01421590120091000
- Williams, B., Brown, T., & Etherington, J. (2012). Learning styles of undergraduate nutrition and dietetics students. *Journal of Allied Health*, 41(4), 170-176.

Table 1: Socio-demographic profile of the students (N=366).

Factors	n (%)
Age (years old)*	23.13 (0.83)
Age category	
22-23	282 (77.05)
24-27	84 (22.95)
Gender	
Male	146 (39.89)
Female	220 (60.11)
Race	
Malay	220 (60.11)
Chinese	98 (26.78)
Indian	29 (7.92)
Others	19 (5.19)
Marital status	
Single	358 (97.81)
Married	8 (2.19)
Secondary school	
National type	314 (85.79)
Chinese vernacular school	31 (8.47)
Others	21 (5.74)
Pre-university Education	
Local	299 (81.69)
International	67 (18.31)
Fathers' Occupation	
Retired/ Not-working	92 (25.14)
Professionals	133 (36.34)
Others	141 (38.52)
Mothers' Occupation	
Retired/ Not-working	196 (53.55)
Professionals	105 (28.69)
Others	65 (17.76)

* Mean (SD)

Table 2: The Index of Learning Styles for Public Health Medicine (N=366)

Learning styles preference	Frequency (%)
<i>Active or Reflective</i>	
Preference for active	72 (19.67)
Fairly well balanced	218 (59.56)
Preference for reflective	76 (20.77)
<i>Sensing or Intuitive</i>	
Preference for sensing	126 (34.43)
Fairly well balanced	195 (53.28)
Preference for intuitive	45 (12.30)
<i>Visual or Verbal</i>	
Preference for visual	211 (57.65)
Fairly well balanced	138 (37.70)
Preference for verbal	17 (4.64)
<i>Sequential or Global</i>	
Preference for sequential	72 (19.67)
Fairly well balanced	238 (65.03)
Preference for global	56 (15.30)

Table 3a: Univariable multinomial logistic regression of learning styles preferences for active and reflective dimension

Factors	Learning style preference			
	Active (n=72)		Reflective (n=76)	
	RRR (95% CI)	<i>p</i> value	RRR (95% CI)	<i>p</i> value
Age (years old)	1.27 (0.93, 1.74)	0.128	0.64 (0.45, 0.91)	0.014
Age category (years old)				
22-23 years old	0.69 (0.38, 1.25)	0.226	1.80 (0.89, 3.68)	0.104
24-27 years old	1		1	
Gender				
Male	1.43 (0.83, 2.45)	0.192	1.23 (0.72, 2.09)	0.445
Female	1		1	
Race				
Malay	3.79 (1.63, 8.81)	0.002	0.73 (0.41, 1.29)	0.282
Others	3.72 (1.32, 10.44)		0.54 (0.21, 1.39)	
Chinese	1		1	
Secondary school				
National type	3.14 (1.07, 9.18)	0.036	0.82 (0.41, 1.62)	0.567
Others	1		1	
Pre-university Education				
International	1.14 (0.58, 2.23)	0.700	1.16 (0.60, 2.26)	0.653
Local	1		1	
Fathers' Occupation				
Professionals	1.66 (0.84, 3.30)	0.146	3.20 (1.46, 7.00)	0.004
Others	1.14 (0.57, 2.28)	0.716	2.48 (1.13, 5.40)	0.023
Retired/ Not-working	1		1	
Mothers' Occupation				
Professionals	0.99 (0.53, 1.85)	0.978	1.18 (0.66, 2.12)	0.583
Others	0.92 (0.45, 1.89)	0.822	0.67 (0.31, 1.46)	0.318
Retired/ Not-working	1		1	

Table 3b: Univariable multinomial logistic regression of learning styles preferences for sensory and intuitive

Factors	Learning style preference			
	Sensory (n= 126)		Intuitive (n= 45)	
	RRR (95% CI)	<i>p</i> value	RRR (95% CI)	<i>p</i> value
Age (years old)	0.96 (0.73, 1.27)	0.790	1.07 (0.73, 1.58)	0.718
Age category (years old)				
22-23	0.94 (0.54, 1.61)	0.811	1.39 (0.67, 2.88)	0.370
24-27	1		1	
Gender				
Boy	0.90 (0.57, 1.43)	0.657	1.79 (0.93, 3.44)	0.080
Girl	1		1	
Race				
Malay	0.92 (0.46, 1.83)	0.806	0.54 (0.21, 1.35)	0.186
Chinese	0.73 (0.34, 1.57)	0.418	0.80 (0.30, 2.14)	0.655
Others	1		1	

Secondary school National type Others	0.92 (0.48, 1.76) 1	0.443	0.71 (0.30, 1.70) 1	0.443
Pre-university Education International Local	0.88 (0.49, 1.60) 1	0.681	1.26 (0.57, 2.78) 1	0.564
Fathers' Occupation Professionals Others Retired/ Not-working	1.05 (0.58, 1.88) 0.86 (0.48, 1.54) 1	0.877 0.613	0.49 (0.22, 1.12) 0.77 (0.35, 1.69) 1	0.509 0.093
Mothers' Occupation Professionals Others Retired/ Not-working	1.66 (1.00, 2.78) 1.53 (0.82, 2.88) 1	0.052 0.183	1.39 (0.63, 3.06) 2.60 (1.16, 5.83) 1	0.411 0.020

Table 3c: Univariable multinomial logistic regression of learning styles preferences for visual and verbal dimension

Factors	Learning style preference			
	Visual (n= 211)		Verbal (n= 17)	
	RRR (95% CI)	<i>p</i> value	RRR (95% CI)	<i>p</i> value
Age (years old)	1.10 (0.84, 1.43)	0.492	0.52 (0.27, 0.99)	0.047
Age category (years old) 22-23 years old 24-27 years old	0.89 (0.53, 1.47) 1	0.640	4.64 (0.59, 36.35) 1	0.144
Gender Male Female	1.18 (0.76, 1.84) 1	0.453	0.90 (0.31, 2.58) 1	0.848
Race Chinese Others Malay	0.58 (0.35, 0.95) 0.40 (0.21, 0.76) 1	0.031 0.006	0.90 (0.28, 2.88) 0.93 (0.23, 3.73) 1	0.865 0.922
Secondary school National type Others	1.29 (0.70, 2.38) 1	0.409	0.89 (0.23, 3.34) 1	0.857
Pre-university Education International Local	0.94 (0.53, 1.67) 1	0.845	4.22 (1.48, 12.06) 1	0.007
Fathers' Occupation Professionals Others Retired/ Not-working	1.07 (0.61, 1.86) 1.11 (0.65, 1.92) 1	0.814 0.697	3.40 (0.69, 16.67) 2.13 (0.41, 11.17) 1	0.132 0.369
Mothers' Occupation Professionals Others Retired/ Not-working	0.68 (0.41, 1.11) 0.91 (0.50, 1.64) 1	0.123 0.755	1.53 (0.50, 4.67) 1.23 (0.29, 5.15) 1	0.452 0.775

Table 3d: Univariable multinomial logistic regression of learning styles preferences for sequential and global

Factors	Learning style preference			
	Sequential (n= 72)		Global (n= 56)	
	RRR (95% CI)	<i>p</i> value	RRR (95% CI)	<i>p</i> value
Age (years old)	1.13 (0.82, 1.55)	0.449	1.13 (0.80, 1.60)	0.502
Age category (years old)				
22-23 years old	0.88 (0.47, 1.64)	0.695	0.68 (0.35, 1.32)	0.253
24-27 years old	1		1	
Gender				
Male	0.83 (0.48, 1.44)	0.505	1.56 (0.87, 2.80)	0.137
Female	1		1	
Race				
Malay	0.30 (0.10, 0.95)	0.040	0.23 (0.07, 0.74)	0.013
Chinese	0.40 (0.12, 1.31)	0.129	0.28 (0.08, 0.96)	0.043
Indian	0.39 (0.09, 1.62)	0.195	0.32 (0.07, 1.41)	0.134
Others	1		1	
Secondary school				
National type	1.17 (0.53, 2.56)	0.701	0.87 (0.39, 1.94)	0.734
Others	1		1	
Pre-university Education				
International	1.06 (0.53, 2.11)	0.871	1.45 (0.72, 2.94)	0.300
Local	1		1	
Fathers' Occupation				
Professionals	1.15 (0.59, 2.25)	0.687	1.01 (0.45, 2.26)	0.982
Others	0.97 (0.49, 1.92)	0.925	1.57 (0.74, 3.33)	0.242
Retired/ Not-working	1		1	
Mothers' Occupation				
Professionals	1.02 (0.55, 1.87)	0.961	0.73 (0.36, 1.47)	0.376
Others	1.20 (0.59, 2.44)	0.613	1.09 (0.50, 2.36)	0.824
Retired/ Not-working	1		1	

Table 4: Adjusted relative risk ratio for learning style preference of Public Health Medicine (N = 366)

Factors	Learning style preference Sub-dimension 1		Learning style preference Sub-dimension 2	
	Active (n=72)	Reflective (n=76)	Sensory (n=126)	Intuitive (n=45)
	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)
Age (years)				
Race				
Malay	3.74 (1.61, 8.72)	0.72 (0.41, 1.29)		
Chinese	1	1		
Indian	-	-		
Others	3.46 (1.22, 9.76)	0.48 (0.19, 1.25)		
Fathers' Occupation				
Professionals	1.60 (0.80, 3.22)	3.35 (1.53, 7.38)	0.87 (0.46, 1.62)	0.71 (0.30, 1.67)
Others	1.16 (0.57, 2.34)	2.47 (1.13, 5.41)	0.79 (0.44, 1.44)	0.36 (0.15, 0.87)
Retired/Not-working	1	1	1	1
Pre-university Education				
International				
Local				
Mothers' Occupation				
Professionals			1.67 (0.96, 2.93)	1.32 (0.56, 3.11)
Others			1.62 (0.85, 3.10)	3.43 (1.45, 8.08)
Retired/Not-working			1	

Factors	Learning style preference Sub-dimension 3		Learning style preference Sub-dimension 4	
	Visual (n=211)	Verbal (n=17)	Sequential (n=72)	Global (n=56)
	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)
Age (years)	1.03 (0.79, 1.36)	0.52 (0.28, 0.98)		
Race				
Malay	1	1	0.30 (0.10, 0.95)	0.23 (0.07, 0.74)
Chinese	0.58 (0.35, 0.96)	0.90 (0.27, 3.03)	0.40 (0.12, 1.31)	0.28 (0.08, 0.96)
Indian	-	-	0.39 (0.09, 1.62)	0.32 (0.07, 1.41)
Others	0.40 (0.21, 0.77)	0.69 (0.16, 3.01)	1	1
Fathers' Occupation				
Professionals				
Others				
Retired/Not-working				
Pre-university Education				
International	0.92 (0.51, 1.65)	4.48 (1.52, 13.22)		
Local	1	1		
Mothers' Occupation				
Professionals				
Others				
Retired/Not-working				

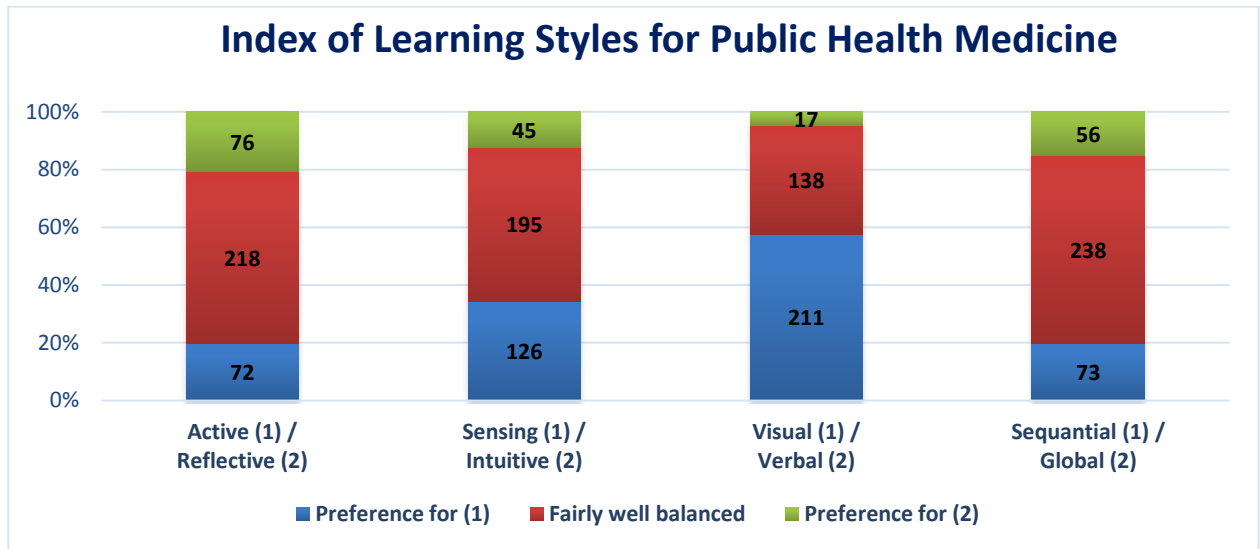


Figure 1: Index of Learning Styles for Public Health Medicine (N=366)