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Learning Style and Academic Performance of Optometry Students

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Abstract
There has been substantial research undertaken to relate the learning style to academic performance. Several studies have documented that multimodal or kinaesthetic was dominant in learning styles among university students. The effects of ethnicity and gender on the learning style in Optometry students have also been reported. However, the impact of learning style preference on academic performance in Optometry students has yet to be understood. This study aims to explore the relationship between learning style and academic performance among Optometry students. All 141 full-time optometry students were approached to participate in an online survey. Data on the learning styles were collected using the VARK questionnaire (VARK is an acronym for visual, aural, read/write, and kinesthetic learning modalities). The academic performance was based on the academic transcript and self-reporting competency. The response rate was approximately 83%. Our findings showed that the kinaesthetic learning style was predominant. 88% of the learning style was unimodal, and only 12% bimodal. No trimodal or quadrimodal was found. A possible explanation might be due to the gender composition in our respondents, of whom 82.5% were females. Females have been reported to prefer unimodal learning. These findings can contribute to a better understanding of learning styles to assist pedagogy teaching alignment in optimizing strategic teaching planning in the Optometry program. As a result of these investigations, suggestions were identified for future research.

Keywords: Optometry, VARK, learning styles, academic performance, Optometry course

I. INTRODUCTION

Aligning the pedagogy with learning style is imperative (Allen et al., 2013). Learning styles refer to a learner's preferred way to acquire, retain and process information for knowledge acquisition. Individual learning styles depend on prior experience, cognitive, emotional and environmental factors (Romanelli et al., 2009). The learning style preference benefits the students as it helps formulate an appropriate learning strategy to enhance their learning (Allen et al., 2013; Koch et al., 2011; Vizeshfar & Torabizadeh, 2018). Awareness of learning preferences can be beneficial in learning and teaching implementation. A mismatch between the teaching and learning style remains a much-debated question in pedagogical research. Understanding students' learning style is a continuing concern within the teaching profession as students in higher education differ in their learning approaches (Almigbal, 2015). Some studies found an association between learning style preferences with age, gender, creativity, and academic performances (Koch et al., 2011; Wehrwein et al., 2007).

Despite the conventional belief that an individual prefers one learning style over the other, a growing body of literature recognises the preference of the multimodal learning style compared to other unimodal learning style preferences (Karim et al., 2019; Kim et al., 2015). More than one sense is engaged during multimodal learning. By combining these modes, the learners experience diverse learning styles to understand better and remember more.

Existing research recognises the critical role played by the learning types in academic performance. A study to relate the American Board of Surgery In-Training Examination (ABSITE) scores to learning styles among surgical residents reported that those with dominant read/write learning styles performed better on the ABSITE than those with dominant aural learning preferences (Kim et al., 2015). Students with aural and kinesthetic learning styles negatively correlated with the electronic closed book examination (Martinez & Tuesca, 2019). Evidence has suggested that the kinesthetic learning style is a dominant learning style among university students (Kim et al., 2015; Vizeshfar & Torabizadeh, 2018; Wehrwein et al., 2007). There is very little published research on the relationship between learning style and academic performance in Optometry students (Mohammed et al., 2011). What is known about learning style among Optometry students is based on a small sample size study with 35 third-year students. They used the Honey and Mumford Learning Style Survey to classify their students' learning styles into activist, theorist, pragmatist and reflector. They found that most of their students were reflectors and pragmatists while none of them were activists. They also found gender differences in learning styles where male students were dominantly pragmatists while female students were reflectors. Evidence for clinical learning style has been mixed (Martinez & Tuesca, 2019; Nurumal et al., 2019).

A range of questionnaire methods available for the identification of learning styles in health disciplines: Kolb Learning Style Inventory; Rezler and Rezmovic Learning Preference Inventory Group Embedded Figures Test; VARK (Visual-Aural-Read/Write-Kinesthetic); Felder and Solomon Learning Style Index; Grasha and Reichmann Student Learning Style Scala; Honey and Mumford Learning Style Survey; MIDAS (Multiple Intelligences Developmental Assessment Scales); Entwhistle Learning Style Inventory Marshall and Meritt Learning Style Inventory; Guglielmino Self-Directed Learning Readiness Scale (SDLRS); and Vermunt Learning Style Inventory (Babadogan & Budakoglu, 2012). VARK is a questionnaire that has been widely applied to categorise the learning styles of students. The acronym VARK stands for Visual, Aural, Read/Write, and Kinesthetic sensory modalities used to describe the four modalities of student learning (Babadogan & Budakoglu, 2012). VARK was chosen as the investigation tool for this study because we aimed to explore learning preferences for information input and output to guide students and lecturers to improve the education ecosystem.

Most studies in learning styles using VARK have either focused on the discipline or isolated course. Research on the subject has been mostly restricted to limited comparisons of disciplines without further dissecting different course requirements within the discipline (Kim et al., 2015; Vizeshfar & Torabizadeh, 2018; Wehrwein et al., 2007). It has been reported that no significant difference was found between the learning styles of the clinical group and the semi-clinical group (Nurumal et al., 2019). Although studies have recognised the effects of learning on academic performance, research has yet to systematically investigate the difference between education programs with different professional training requirements. Up to now, there have been no attempts to examine the learning style of Optometry students from all cohorts within the same institution and then relating that to their formal academic examination transcripts. This investigation has aimed to gauge the extent to which learning style affects academic performance. Data on learning styles for this study were collected using the VARK questionnaire. The academic performance data were collected using both the self-evaluation competency 5-point Likert scale and the formal examination result transcript. The study offers some critical insights into the learning style among Optometry students.

II. METHODOLOGY

This study was approved by the institutional review board. Ethical approval was obtained from the UITM Research Ethics Committee[600-TNCPI(5/1/6)REC/04/2021 (UG/MR/309)]. This cross-sectional study adhered to the Declaration of Helsinki.

Bachelor of Optometry is a full-time four-year program. All optometry students from the Optometry Program in UiTM Puncak Alam, Selangor, were included. The 141 optometry students from the first to the final year were approached to participate. Only 26 out of 141 students were male (18%). There were 33, 29, 32 and 47 students per cohort, respectively, in years 1, 2, 3 and 4. The exclusion criteria were non-optometry students and optometry students from other universities. The data collection was conducted using an online questionnaire using the Google Form platform in May 2021.

To assess the learning preferences in this study, participants completed the VARK learning styles inventory. VARK is a 16-questions tool that gives a score for each of the four modalities and an overall learning preference. A key advantage of using VARK is its simplicity and ease of administration. Another advantage is that the VARK inventory questions have been well validated and highly reliable. The participants were asked to complete a 16 multiple-choice question survey on learning style.

Data on academic performance was collected using two approaches: formal academic transcript and self-reporting competency level. The self-reporting competency level data of every completed course was collected using the 5-point Likert scale.

Optometry courses were divided into theory, practical and clinical studies (Table 1). Descriptive data were generated for all variables. Significance levels were set at p-value <0.05.

Table 1: Summary of Optometry Courses (theory-practical-clinical)

Courses (theory)	Courses (practical)	Courses (clinical)
• Anatomy & Physiology • Genetics • Biochemistry • Microbiology • Immunology • Pathology • Ocular Diseases • Pharmacology • Psychology • Optics • Instrument Optics • Light & Colour Perception • Binocular Vision • Paediatric Optometry • Low Vision • Public Health Optometry • Biostatistics • Research Methodology • Entrepreneurship	• Ophthalmic Optics • Visual Optics • Clinical Optometry • Contact Lenses • Ophthalmic Dispensing	• Primary Optometry Clinic • Contact Lenses Clinic • Special Optometry Clinic • Clinical Dispensing • Industrial Placement

III. RESULTS

The response rate was approximately 61% (86 out of 141 students). Fifteen were male, and seventy-one were females. There were 26, 10, 21 and 29 students from years 1, 2, 3 and 4.

The table below illustrates the proportion of unimodal and bimodal learning styles (Table 2). Approximately 88% of the learning style is unimodal. It can be seen from this table that

very few of the learning styles were bimodal (12%). Interestingly, the data in the table shows no trimodal or quadri modal distributions. What is striking is the dominance of the unimodal kinesthetics learning style (67.4%).

Table 2: Distribution of learning style preferences

Learning styles	Frequency	Percentages
Unimodal (Visual)	5	5.8%
Unimodal (Aural)	10	11.6%
Unimodal (Read/Write)	3	3.5%
Unimodal (Kinesthetics)	58	67.4%
Bimodal (Aural + Kinesthetics)	6	7.0%
Bimodal (Visual + Kinesthetics)	3	3.5%
Bimodal (Read/Write + Kinesthetics)	1	1.2%
Total	**86**	**100%**

Two parameters were used to investigate the relationship between learning style and academic performance: official examination transcript and self-reporting competency level. Cumulative Grade Point Average (CGPA) data was not normally distributed (Levene Test of Homogeneity of Variance, $p>0.05$). Therefore, a non-parametric test was used to analyse the relationship between the students' learning style preferences and their academic performance. No significant statistical difference was found between the CGPA scores and the types of learning styles (Kruskal-Wallis test, $H =2.12$, $p=0.72$). The Chi-square test did not show any significant differences between the self-reporting level of competency and learning styles for theory courses (Chi-Square = 14.95, $p=0.82$), for practical courses (Chi-Square = 10.45, $p=0.97$), and clinical courses (Chi-Square = 35.12, $p=0.08$).

IV. DISCUSSION

As mentioned in the literature review, the kinesthetic learning style is a prevailing learning style among university students. Our findings are coherent with previous works, where 67% of the learning styles of our Optometry students were kinesthetic. Previous studies reported a similar trend using VARK as an investigation tool (James et al., 2011; Kim et al., 2015). Students have been indicated to be more inclined to learn best kinesthetically rather than through other styles. The kinesthetic tendency in our Optometry students is possibly due to the principles in structuring the curriculum philosophy that emphasises practical and clinical training. It fits well with kinesthetic learners who learn through doing and practical examples. Aural learners should enjoy the plus point essential in clinical training because they learn best through listening or discussing ideas.

It has been reported that students who performed well in lecture-dominated medical school environments because of their aural preferences could be disadvantaged in the more independent, reading-focused learning environments of surgical residency (Kim et al., 2015). However, there is an inconsistency with this argument. Only 11.6% of our respondents had an audio learning style. Both read/write, and visual learners may gain more in the theory learning phase through mind mapping. Read/write learners preferred things written down and tend to organise the information into categories. Visual learners preferred the explanation of concepts through the infographic approach. The combination of visual and read-write learning styles were less than 10% in our Optometry students. Being aware of learning styles can benefit both lecturers and students. By knowing the preferred learning styles, individual students can navigate their learning with the appropriate technique. The same information also helps relevant lecturers to adapt and plan their teaching and assessment strategies accordingly (Allen et al., 2013). Teaching based on the dominant learning style can enhance students' academic achievement and professional development (Vizeshfar & Torabizadeh, 2018). It has been suggested that learning preference can be a good predictor of academic performance in a more efficient student recruitment process (Koch et al., 2011).

Previous studies have highlighted the preference of multimodal learning style compared to other unimodal learning style preferences among university students (Karim et al., 2019; Kim et al., 2015). The predominant choice of quadrimodal utilising all four learning styles has been emphasised (James et al., 2011). It is somewhat surprising that no trimodal and quadrimodal learning style was found in this study. These findings were somewhat surprising given the fact that other research showed multimodal learning styles. Only 12% displayed a bimodal learning style in the present study, including the kinesthetic component in all of the bimodal modes. A possible explanation for this might be the gender composition of our respondents. In a survey of learning style preference of optometry students using the Learning Style Questionnaire by Honey and Mumford, they reported gender differences in learning styles where male students were dominantly pragmatists (Mohammed et al., 2011). In contrast, female students were reflectors (Mohammed et al., 2011). It must be noted that approximately 82.5% of our respondents were females. Females have been reported to prefer unimodal learning, whereas males prefer multimodal learning (Isman & Gundogan, 2009; Wehrwein et al., 2007). Consistent with the literature, our results further supported the idea of unimodality in females. However, with a small sample size of male students (17.5%) in our study, caution must be applied as the findings might require further confirmation with a larger male sample. A probable alternative reason for these unimodal learning styles is our sample of millennial students who are prone to the multiple usage of electronic devices at every education level. As a result, online learning may have disrupted the wide-ranging responses and physical stimuli.

The relationship between learning styles and academic performance remains inconclusive and seems to vary by discipline. Dental students with a read/write learning style have been reported to have better academic performance (Akhlaghi et al., 2018). In contrast, the read/write learning style has been negatively correlated with practical exams among preclinical medical students (Khanal et al., 2019). However, no significant relationship was found between learning styles and academic achievement among health care science students (Kamal et al., 2021). This study did not find any significant effects of learning styles on academic

performance in the theory, practical and clinical dominant courses. Our findings using VARK were consistent with previous results using Honey and Mumford's Learning Style Questionnaire. No significant difference was found between the learning styles of the clinical group and the semi-clinical group using the Honey and Mumford's Learning Style Questionnaire (Nurumal et al., 2019). It seems possible that these results may partly be explained by the high prevalence of kinesthetic learning styles. Students with a single learning style preference were reported to have a lower mean grade point average (GPA) than those with multiple (quad-modal) learning style preferences (Al-Saud, 2013; Almigbal, 2015). Students in the present study were predominantly unimodal learning styles.

The information will be of general use to enhance the efficacy of optometry education. The sample was a good representative of Optometry students, but these results may not apply to learners from other health disciplines. A limitation of this study is the unproportionate male-female sample size. Additional studies with equal gender proportion and various health disciplines compositions would be required to understand the relationship between learning styles and academic performance.

V. CONCLUSION

This study set out to assess the effects of learning style on academic performance. The most prominent finding from this study is the predominant unimodal and kinesthetic learning style among Optometry students. The prevailing kinesthetic learning style that we have identified therefore assisted in our understanding of aligning the teaching pedagogy to the students' learning style. The lack of a balanced gender ratio adds further caution regarding the generalizability of these findings. These findings contribute in several ways to our understanding of learning styles and provide a basis for further research.

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