

Relationship between the learning style preferences of medical students and academic achievement

Turky H. Almigbal, MBBS, SBFM.

ABSTRACT

الأهداف: دراسة العلاقة بين أساليب التعلم لدى طلاب الطب السعوديين وتحصيلهم العلمي.

الطريقة: أجريت دراسة مستعرضة على 600 طالب طب في جامعة الملك سعود، الرياض، المملكة العربية السعودية في الفترة من أكتوبر 2012م إلى يوليو 2013م. وقد تم الاعتماد على استبيان (VARK) لتحديد أساليب التعلم. تم استخدام أسلوب الوصف والتحليل لمعرفة ارتباط أساليب التعلم لدى طلاب الطب والتحصيل الأكاديمي أو الجنس أو الحالة الاجتماعية أو مكان الإقامة أو مصدر المعلومات الدراسية.

النتائج: أظهرت النتائج بأن 261 (43%) من طلاب كلية الطب يفضلون التعلم بأساليب (VARK) مجتمعة. كان هناك اختلاف وأهمية إحصائية بين جنس الطالب وأسلوب التعلم المفضل ($p=0.028$). أيضا كان هناك اختلاف وأهمية إحصائية بين أساليب التعلم لدى طلاب الطب وبين طريقة تدريس المناهج المتبعة ($p=0.047$). لم يكن هناك أي علاقة بين أساليب التعلم المفضلة والتحصيل الأكاديمي أو الحالة الزوجية أو الإقامة أو مصادر المعلومات الدراسية. أيضا بعد الأخذ في الاعتبار العوامل الأخرى، لم نجد علاقة بين أساليب التعلم والتحصيل الأكاديمي.

الخلاصة: النتائج التي وصلنا لها مفيدة لتحسين جودة التعليم لطلابنا، الطلاب سيستفيدون من فهم من يدرسه لهم للعوامل التي قد تكون متعلقة بأساليب التعلم.

Objectives: To investigate the relationship between the learning style preferences of Saudi medical students and their academic achievements.

Methods: A cross-sectional study was conducted among 600 medical students at King Saud University in Riyadh, Kingdom of Saudi Arabia from October 2012 to July 2013. The Visual, Aural, Read/Write, and Kinesthetic questionnaire (VARK) questionnaire was used to categorize learning style preferences. Descriptive and analytical statistics were used to identify the learning style preferences of

medical students and their relationship to academic achievement, gender, marital status, residency, different teaching curricula, and study resources (for example, teachers' PowerPoint slides, textbooks, and journals).

Results: The results indicated that 261 students (43%) preferred to learn using all VARK modalities. There was a significant difference in learning style preferences between genders ($p=0.028$). The relationship between learning style preferences and students in different teaching curricula was also statistically significant ($p=0.047$). However, learning style preferences are not related to a student's academic achievements, marital status, residency, or study resources (for example, teachers' PowerPoint slides, textbooks, and journals). Also, after being adjusted to other studies' variables, the learning style preferences were not related to GPA.

Conclusion: Our findings can be used to improve the quality of teaching in Saudi Arabia; students would be advantaged if teachers understood the factors that can be related to students' learning styles.

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From the Department of Family and Community Medicine, Medical College, King Saud University, Riyadh, Kingdom of Saudi Arabia.

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Address correspondence and re-print request to: Dr. Turkey H. Almigbal, Teaching Assistant and Senior Registrar, Department of Family and Community Medicine, College of Medicine, King Saud University, PO Box 28054, Riyadh 11437, Kingdom of Saudi Arabia.
E-mail: almogbal@yahoo.com

Learning processes vary from person to person due to differences in cognitive processing.¹ While acquiring a huge amount of knowledge in medical college, medical students experience a different learning environment in their educational setting than non-medical students. Studies have shown that each student typically adapts his, or her learning preferences

to their learning environment.² The concept of learning styles has undergone extensive analysis in empirical literature in an attempt to understand the dynamic processes of learning.³ Keefe⁴ defined a learning style as “the composite of cognitive, affective and physiological characteristics that serve as relatively stable indicators of how a learner perceives, interacts and responds to [a] learning environment.”⁴ Understanding students’ learning styles is essential for instructors, because each learning style requires different educational materials.⁵ When students’ learning styles and instructors’ teaching styles are aligned, it results in students improving their understanding of the course content.⁶ Many models and tools for assessing learning styles have been described in the literature.⁷ Fleming and Miles⁸ designed a questionnaire, the Visual, Aural, Read/Write, and Kinesthetic questionnaire (VARK), to determine a preferred method of learning. The VARK questionnaire provides greater understanding about information processing preferences, including a learner’s ability to simultaneously use more than one learning mode.⁹ The authors suggested that these 4 categories reflect the way students learn new material. The VARK questionnaire consists of 16 questions that focus on content delivery and communication with others.¹⁰ Some learners prefer one of these learning modalities. Others prefer to learn with a combination of 2 (bimodal) or 3 modes (trimodal). Multimodal learners do not have a dominant preference for any single method; instead, they use all the 4 modes.¹¹ Fleming and Miles’¹² VARK assessment questionnaire is a recognized, well tested, and validated tool used to assess students’ learning styles.¹²

There have been many attempts to enhance students’ academic achievements. Students’ academic achievements can be measured using many methods, including their problem solving abilities, clinical performances in fieldwork, grade point average (GPA), and the completion of an academic course.¹³ Students’ learning styles have received increasing attention in higher education. Matching students’ learning styles with a learning framework has resulted in improved test scores, whereas a mismatch between learning styles and curriculum has led to low levels of academic achievement.¹⁴ To become effective teachers, teaching staff should understand a learner’s characteristics and

their learning style.¹⁵ However, there are still a number of important issues that have yet to be established, including the relationship between learning styles and academic achievement.¹⁶ The literature concerning the relationship between learning style preferences and academic achievement contains conflicting results. Urval et al¹¹ did not find a relationship between learning styles and academic grades in a study of undergraduate medical students in India. Gurpinar et al⁵ also did not find a difference in the academic achievements of students in their first year of medicine when they were compared based on learning styles. Conversely, Alkhasawneh et al¹⁷ identified a significant relationship between VARK preferences and course grades. However, little is known about the relationship between learning style preferences and academic achievement in Saudi Arabia.

For instance, a descriptive study about the learning style preferences of medical students in one medical college in Saudi Arabia found that the vast majority of students preferred to learn through multiple sensory modalities, but the relationship between learning styles and academic achievements was not investigated.²

This study was initiated to investigate the relationship between academic achievement and learning style preferences of medical students at King Saud University in Riyadh, Kingdom of Saudi Arabia (KSA). In addition to our main objective, the study will also explore the relationship between learning style preferences and students’ gender, marital status, residency, study resources, and method of teaching received in the medical college at King Saud University.

Methods. *Setting and participants.* We conducted this cross-sectional study from October 2012 to July 2013. Participants in this study consisted of students from the medical college at King Saud University in Riyadh, KSA who were studying in their second, third, fourth, and fifth year. A new problem-based learning method was used in the second-, third-, and fourth-year classes, whereas an older (traditional) lecture-based learning method was used in fifth-year classes.

Instrument. The latest English version of the VARK questionnaire was used in this study: VARK 7.1. The VARK questionnaire was selected because it is reliable, concise, and easy to complete. It has also been used extensively among medical students in many studies and countries.^{2,9,10,13,18} It consists of 16 questions with 4 options each. Students were allowed to choose multiple answers per item to adequately describe their preferred response(s) to the situation. We used a research algorithm to analyze the results and to determine the

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medical students' learning style preferences. The research algorithm was developed by a VARK designer in 2009, and has a more statistical rationale than other methods of determining learning style preferences.¹⁹ Using factor analysis techniques, the reliability and validity of the VARK questionnaire was confirmed to be satisfactory.¹²

Procedure. In January 2013, a hard-copy of the VARK questionnaire, which was downloaded from VARK's official website, was distributed to medical students in their second, third, fourth, and fifth year during regular classes.¹⁹ We did not include first-year medical students, because they had not yet attained a GPA from the medical college. There were 1181 medical students in total in these 4 years. Eight hundred questionnaires were distributed to all medical students who were available at the time of the study. Six hundred questionnaires were completed and collected. Students were informed that the VARK questionnaire was designed to measure the learning style preferences of students, participation was voluntary, and the study findings would only be used for research purposes. Academic achievement was measured by asking students to report their GPA. This GPA was an end-of-year score created by multiplying each course grade by the number of credit hours for that course and then dividing this sum by the total number of credit hours for that student. The resulting averages were converted to a common 5.0 scale.²⁰ The study was approved by the Institutional Review Board of King Saud University, Riyadh, Saudi Arabia.

Statistical analysis. Data were analyzed using the IBM SPSS Statistics for Windows, (Version 21.0) (IBM Corp., Armonk, NY, USA).²¹ The distribution of VARK preferences was calculated using the research spreadsheet that was created by Neil Fleming, the VARK designer.¹⁹ The number of students who preferred each mode of learning style was divided by the total number to calculate the percentage of students in each category. An ANOVA test was used to investigate the differences in GPA and students' learning style preferences. A chi square test was performed to compare the different distributions of learning style preferences by gender, study resources, residency, marital status, and different curricula, including a traditional model and a hybrid system that uses a problem-based learning (PBL) curriculum model. Fisher's exact test was used when the chi square test was not suitable. Multiple linear regression was used to examine the relationship between GPA as a dependent variable and learning style preferences, after they were adjusted to other studies' variables. Significance was considered present at p -value <0.05.

Results. Out of the 800 questionnaires distributed, 600 completed questionnaires were returned. The response rate was 75%. Among the participants, 317 were female (52.8%), and 283 were male (47.2%); only 21 students (3.5%) were married. Almost all students were living with their families (538 students, [89.7%]). The main study resource for students was the teachers' presentations in the form of power point slides (442, [73.7%]) (Table 1).

Table 2 illustrates that 261 students preferred to learn using all VARK modalities. Only 17 students (2.7%) preferred to learn using only bimodal sensory modalities (Table 2).

Table 3 indicates the differences in learning style preferences between the subgroups of each of the following variables: gender, study resources, residency, and marital status. There is no statistical difference concerning study resources, residency, and marital status. We found a statistical difference between male and female students ($p=0.028$) concerning their learning styles: female students scored higher than males for visual only, aural only, read and write only, bimodal, and

Table 1 - Participants' socio-demographic characteristics and study resource types (N=600).

Demographic	n (%)
<i>Gender</i>	
Female	317 (52.8)
Male	283 (47.2)
<i>Marital Status</i>	
Single	579 (96.5)
Married	21 (3.5)
<i>Residency</i>	
Alone	62 (10.3)
With family	538 (89.7)
<i>Study resources</i>	
Teachers' powerpoint slides	442 (73.7)
Students' notes	199 (33.2)
Text books	195 (32.5)
Multiple choice questions	140 (23.3)
Multiple choice questions books	35 (5.8)
Guidelines and medical journals	35 (5.8)

Table 2 - Learning styles among medical students.

Learning style	n (%)
All VARK	261 (43.5)
Only aural	127 (21.2)
Only visual	97 (16.2)
Only kinesthetic	64 (10.7)
Only read and write	34 (5.7)
Only bi-modal	17 (2.7)
Total	600 (100)
VARK - Visual, aural, read/write, and kinesthetic questionnaire	

Table 3 - The relationship between learning style preferences and gender, marital status, residency, and study resources.

Characteristics	Learning styles						P-value
	Only visual	Only aural	Only kinesthetic	Only read and write	Only bimodal	All VARK	
	n (%)						
<i>Gender</i>							0.028
Female	57 (17.9)	58 (18.3)	26 (8.2)	20 (6.4)	13 (4.2)	143 (45.0)	
Male	40 (14.1)	69 (24.4)	38 (13.4)	14 (5)	4 (1.5)	118 (41.6)	
<i>Marital status</i>							0.209
Single	95 (16.4)	123 (21.2)	64 (11.0)	34 (5.9)	16 (2.8)	247 (42.7)	
Married	2 (9.5)	4 (19.0)	0 0	0 0	1 (4.8)	14 (66.7)	
<i>Residency</i>							0.499
Alone	13 (21.0)	15 (24.2)	9 (14.5)	2 (3.2)	1 (1.6)	22 (35.5)	
With family	84 (15.6)	112 (20.8)	55 (10.2)	32 (6.0)	16 (3.0)	239 (44.4)	
<i>Study resources</i>							0.509
Teachers' powerpoint slides	75 (17.0)	94 (21.3)	44 (10.0)	29 (6.6)	12 (2.7)	188 (42.4)	
Students' hand notes	35 (17.6)	40 (20.1)	20 (10.0)	7 (3.5)	9 (4.5)	88 (44.3)	
Previous MCQs	23 (16.4)	35 (25.0)	11 (7.9)	5 (3.6)	7 (5.0)	59 (42.1)	
MCQs books	7 (20.0)	6 (17.1)	5 (14.3)	6 (17.1)	4 (11.5)	7 (20.0)	
Text books	34 (17.4)	31 (15.9)	20 (10.3)	13 (6.7)	2 (1.0)	95 (48.7)	
Journals and guidelines	5 (14.3)	6 (17.1)	5 (14.3)	6 (17.1)	2 (5.8)	11 (31.4)	

MCQ - Multiple choice questions, VARK - visual, aural, read/write, and kinesthetic questionnaire

Table 4 - The relationship between learning style preferences and academic achievement (GPA).

Characteristics	Only visual	Only aural	Only kinesthetic	Only read and write	Only bimodal	All VARK	F-test	P-value
n	97	127	64	34	17	261	2.226	0.050
Mean (GPA)	3.9	3.83	3.85	4.07	4.16	3.88		
SD	0.51	0.54	0.56	0.32	0.29	0.50		

GPA - grade point average, SD - standard deviation

Table 5 - The relationship between learning style preferences and different teaching methods at the medical college of King Saud University, Riyadh, Saudi Arabia.

Mode of teaching	Learning styles						Chi-square	P-value
	Only visual	Only a aural	Only kinesthetic	Only read and write	Only bimodal	All VARK		
PBL group	69 (16.5)	85 (20.3)	39 (9.3)	30 (7.2)	15 (3.7)	180 (41.8)	11.239	0.047
Traditional model of teaching group	28 (15.4)	42 (23.1)	25 (13.7)	4 (2.2)	2 (1.1)	81 (44.5)		

PBL - problem-based learning, VARK - visual, aural, read/write, and kinesthetic questionnaire

all VARK methods. Male students used kinesthetic only more than female students. Table 4 shows that there was no relationship between learning style preferences and academic achievement (F-test= 2.2, $p=0.05$).

Table 5 indicates that learning styles were different between PBL groups and traditional teaching groups ($p=0.047$). The PBL group used more than the traditional model of teaching group for visual only, read and write only, and bimodal methods. The traditional model of teaching group scored higher than the PBL group for aural only, kinesthetic only, and all VARK.

Table 6 illustrates that after being adjusted to other studies' variables, the learning style preferences were not related to GPA.

Discussion. This study investigated the relationship between learning style preferences among medical students and their academic achievements at King Saud University in Riyadh, KSA. A secondary purpose was to demonstrate the relationship between students' preferred learning styles and gender, marital status, residency, study resources, and different teaching curricula at the medical college. It is important for educators to

Table 6 - The relationship between learning style preferences and academic achievement after adjustments have been made using other studies' variables.

Variable	Unadjusted			Adjusted		
	Beta coefficient	P-value	95% CI	Beta coefficient	P-value	95% CI
Gender: male	-0.173	<0.001	-0.253 to -0.093	-0.204	<0.001	-0.278 to -0.129
Marital status: married	-0.261	0.020	-0.480 to -0.041	-0.062	0.548	-0.267 to 0.142
Residency: with family	0.183	0.007	-0.050 to 0.315	-0.004	0.953	-0.127 to 0.120
<i>Learning style (ref: visual):</i>						
Only aural	-0.067	0.349	-0.197 to 0.070	-0.016	0.792	-0.135 to 0.103
Only kinesthetic	-0.045	0.577	-0.204 to 0.114	0.040	0.583	-0.102 to 0.182
Only read and write	0.172	0.087	-0.025 to 0.369	0.088	0.323	-0.087 to 0.263
Bi-modal	0.260	0.050	0.000 to 0.520	0.144	0.223	0.087 to 0.375
All VARK	-0.015	0.806	-0.132 to 0.103	0.006	0.908	-0.099 to 0.111
Teaching method: traditional	-0.479	<0.001	-0.559 to 0.400	-0.483	<0.001	-0.565 to -0.402

VARK - visual, aural, read/write, and kinesthetic questionnaire, 95% CI - 95% confidence intervals

gain a clear understanding of the relationship between learning styles and these factors, especially in the field of medicine where students need to acquire extensive, in-depth knowledge, and high-level skills.²² This study seeks to contribute to the development of medical education in our country.

In the current research project, most medical students preferred to learn using all VARK modalities. Also, the preferred learning styles were related to gender and different teaching curricula at the medical college. There was no relationship between learning style preferences and academic achievement.

The response rate of the study, which was a 75% response from the distributed questionnaires, was acceptable. We found that a large portion of the medical students who participated in our study preferred to learn using all VARK modalities (43.5%). The second highest group was students who preferred to learn through the use of aural modalities (21.2%). A study carried out by Fleming,¹⁹ found that 40% of participants who completed the questionnaire online preferred to learn using all VARK modes, which is comparable with our findings. However, he found that the second most prominent style after all VARK modalities was the read/write method (14.7%). A study conducted by Nuzhat et al² examined the learning style preferences of undergraduate medical students in Riyadh, Saudi Arabia. It demonstrated that 22.6% of students preferred to learn using all VARK modalities. Among the single learning modalities, researchers found that 11.6% of these students preferred learning using the aural mode, which is consistent with the present study's results. In addition, the results of the current study regarding dominant learning style were consistent with other studies. For example, Zeraati found multimodality to be the preferred learning style

amongst 35.5% of medical and midwifery students and the aural mode to be the highest single modality (30.8%).¹⁰ When we compare the current results with those findings, there are distinct similarities. Differences arise in the percentage of students in each group as a result of our use of the research algorithm to determine the learning style preferences of medical students, an approach developed by the VARK designer in 2009. This approach involves a more statistical rationale in analyzing the results as compared with other studies that used the standard method of results analyses. In using the research algorithm, we did not find any students who preferred the trimodal learning style and very few students preferred the bimodal learning style. These findings are similar to Fleming's results.¹⁹ Based on our results and Nuzhat et al's study,² most Saudi medical students who preferred a single modality, preferred the aural mode.² This may be due to the teacher-centered and lecture-based (listening) approach traditionally used in Saudi Arabian high schools, which may affect the type of student who is successful in a traditional Saudi Arabian educational setting.

One of the main findings of our study was that learning styles differ between male and female students. If we compare our results with other studies, we find inconsistent results regarding the relationship between learning styles and gender. Dobson²³ demonstrated significant differences between learning styles and gender among students in physiological classes. Choudhary et al¹⁵ also found the same results among first-year medical students. However, Alkhasawneh et al¹⁷ did not find any differences between gender and learning styles, nor did Dobson¹⁶ in another study. This difference may be due to the large sample size in our study compared with their sample sizes, which were comprised of 64 and 92 students.

Another important finding in our study is that there was no relationship between learning style preference and academic achievement, although the results were near the significant level. There are few studies that compared medical students' learning preferences with academic achievement using the VARK inventory. For instance, a study conducted in India¹¹ among undergraduate medical students found no statistical association between learning style preferences and academic performance based on grades. Similar results in another 2 studies concerning students in physiology classes also found no association between learning styles, and course scores.^{23,16} Only one study found that students with multimodal sensory preferences performed better in a nursing course.¹⁷

Finally, a statistically significant association between students' learning styles and the different teaching methods was found in the medical college at King Saud University. This is a unique finding, not found to be previously reported on literature review.

This study has some limitations. First, the sample was from a single institution and may be biased and not representative of the population of medical students in Saudi Arabia. A larger study from multiple sites is needed. Second, a research algorithm was employed to determine the learning style preferences of medical students. This is a new approach with limited use in studies, thereby limiting the research that can be compared with the current results. Finally, we used a cross-sectional method as a study design, which is not ideal for determining relationships between variables.

In conclusion, this study demonstrated that many medical students at this single medical institution prefer to learn using all VARK modalities. Additionally, male and female students differ from each other in their learning style preferences. The students' learning styles were also associated with the different teaching curricula. This information is very useful for improving the quality of teaching and may impact how educators deliver information to students in the future. However, more studies need to be conducted among medical students regarding their learning style preferences and the factors that can impact educational achievements, especially in our region, as there are few studies in this area.

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