



## Visual, auditory, reading/writing, and kinesthetic: Which learning style predicts academic success in nursing?

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### ABSTRACT

This study focuses on how different ways of learning affect the school success of undergraduate nursing students in Saudi Arabia, especially when they had to switch to online classes because of the COVID-19 pandemic. It uses the VARK model, which identifies various learning preferences, to explore this topic. We wanted to find out what the main learning styles among these students are and how these styles relate to their grades, particularly in an online learning setting. Using a survey called the VARK questionnaire, we gathered information about the learning styles of 133 nursing students. We also collected their grades and used statistical methods to see if there's a link between the way they prefer to learn and their academic results. We found that most of the students (64.7%) liked using multiple ways of learning at once, with listening and doing activities being their top choices. However, those who preferred learning by doing or seeing struggled more with their grades when classes moved online. Online classes seem to work well for some students but not for others, depending on their preferred way of learning. This information is important for teachers so they can create lesson plans that work for all students, especially if schools have to switch to online learning unexpectedly.

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### 1. Introduction

Throughout the past decade, it has become evident that students have a variety of preferred learning styles and that effective instructors need to design courses to meet the needs of those individuals (Hallin, 2014; El-Sabagh, 2021; Wan Hussin and Mohd Matore, 2023). Numerous studies have demonstrated that achieving learning outcomes is more likely if the teaching strategies and learning styles are aligned (Hallin, 2014; Boström and Hallin, 2013). Learning style refers to a person's preferred method of absorbing, processing, comprehending, and retaining information (Costa et al., 2020).


Fleming (1995) described four popular learning styles: visual (V), auditory (A), read/write (R), and kinaesthetic (K). Visual learners tend to understand information when it is presented in the form of pictures, diagrams, and charts. Auditory learners prefer listening to information presented via lectures and group discussions. Read/write learners better understand topics through reading and writing. Finally, kinaesthetic learning involves physical experiences or hands-on approaches, such as practical work (Fleming, 1995).

An individual may have one or more learning styles based on their preferences for understanding different ideas. For a learning process to be effective, an individual needs to be aware of their learning style (Sood and Sarin, 2021). In fact, recognizing the various learning styles can help an educational organization improve its teaching strategies and focus on the preferences of specific students to achieve significant outcomes (Zain et al., 2021). The need to identify and understand learning styles also

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applies to nursing education in universities or other educational institutions worldwide, as improving the quality of learning for future nurses will improve the quality of patient care in healthcare facilities (Hallin, 2014). The COVID-19 pandemic has impacted learning processes globally, including in Saudi Arabia, causing education universities to shift to a compulsory virtual mode. Prior to the pandemic, formal education for nursing students in Saudi Arabia followed an on-campus mode. In this regard, the Saudi government pays particular attention to the quality of nursing education and the increase in the number and competency of the Saudi nursing workforce (Aljohani, 2020; Al-Dossary, 2018). For these reasons, the Saudi government is undertaking significant changes in the university education system through the Saudi Vision 2030 program, aiming to improve the quality of education and the healthcare system in the country (Al-Dossary, 2018).

According to a recent systematic review by Childs-Kean et al. (2020), several studies have been conducted to examine the association between learning styles and learning outcomes. None of these studies reported a significant relationship between the two factors. In addition, recent studies have called for researchers to examine the association between learning styles and academic performance (Zhu et al., 2018). The present study was conducted to address this gap by examining the learning style preferences of nursing students and explaining the associations between learning styles and learning outcomes, including academic performance, during the time of the COVID-19 pandemic that shifted the learning model to a mandatory virtual environment.

## 2. Methods

### 2.1. Participants

The study included undergraduate nursing students' study at Prince Sultan Military Medical City (PSMMC). Convenient sampling was used to recruit eligible participants. This research adhered to the principles of the Declaration of Helsinki and received approval from the PSMMC Institutional Review Board (IRB). All participants provided informed consent. Their submission of the completed questionnaire was considered an agreement to participate, as detailed in the information sheet and flyer distributed for the study. Participants were assured of their right to withdraw from the study at any point. To ensure privacy, anonymity, and confidentiality were strictly upheld by avoiding the use of personal identifiers and not disclosing any information that could potentially identify participants. After obtaining ethical approval from PSMMC to conduct the study, a questionnaire was sent via e-mail to each of the eligible undergraduate nursing students, who were asked to respond to the questions. A brief video was attached to the e-mail explaining the procedure for filling out the questionnaire as well as the expected benefits for

students. Assurance of autonomy in participating was also provided in the e-mail. Replying to the e-mail with a completed questionnaire was considered a confirmation of consent to participate.

### 2.2. Data collection and instruments

Data were collected from December 2020 to April 2021 via a questionnaire that was composed of two parts. The first part included demographical questions on the participant's age, gender, marital status, current nursing program level, regional location, home Internet quality, and convenience of study location, as well as the effects of virtual learning mode on student performance and satisfaction during the pandemic. The second part followed the VARK standard questionnaire developed by Fleming (1995) and consisted of 16 items to determine the participant's learning style. Each of the VARK items consisted of four categorical responses related to visual (V), auditory (A), read/write (R), or kinaesthetic (K) learning preferences (Fleming, 1995). Participants were allowed to select one or more choices based on their preferred sensory modalities when taking in new information. The authors obtained permission from the developer prior to adopting this questionnaire. Satisfactory validity and reliability levels for the VARK inventory have been reported in several studies (Breckler et al., 2009; Fitkov-Norris and Yeghiazarian, 2015; Nuzhat et al., 2011; Thepsatitporn and Pichitpornchai, 2016).

### 2.3. Data analysis

Statistical Package for Social Sciences (SPSS) version 27 was used for data cleaning, variable coding, assumption checking, and analyses. Descriptive analyses were performed to identify any potential outliers, out-of-range values, and missing data. No out-of-range values or outliers were identified; however, one participant was removed from the study, as questionnaire data was missing across all 16 VARK items.

Descriptive statistics were used to summarize the demographic characteristics of the participants. This involved analyzing the frequencies ( $F$ ) of all categorical variables and the means ( $M$ ) and standard deviations ( $SD$ ) of continuous variables. Independent sample t-tests were used to determine the effects of demographic characteristics on each of the four VARK modalities: visual, auditory, read/write, and kinaesthetic. Levene's test was used to assess the assumption of homogeneity of variance. If violated, Levene's statistics for equal variances that were not assumed were reported.

Univariate one-way analysis of variance (ANOVA) was used to determine the effects of quality of home Internet connection, convenience of location for home-based virtual learning, impact of the virtual learning process on academic performance, and overall satisfaction with the virtual learning experience on each of the four VARK modalities. Post

hoc comparisons were performed using Tukey’s test, and significant findings were obtained. Levene’s test was used to test the assumption of homogeneity of variances. If violated, Welch’s robust test of equality of means was conducted. Significant results were obtained for these two tests. Histograms and normality plots were used to assess the distribution of the dependent variables. All variables appeared to be normally distributed. Chi-squared analyses were conducted to compare categorical variables with (1) unimodal and (2) multimodal VARK learning styles.

### 3. Results

#### 3.1. Descriptive statistics

The sample comprised 133 undergraduate nursing students aged 20–32 years ( $M=22.47$  years,  $SD=2.34$  years). The frequencies and percentages of the demographic variables are shown in Table 1. The mean scores and standard deviations for each of the four VARK modalities are shown in Table 2. The nursing students’ scores were the highest for the

auditory modality, followed by the kinaesthetic modality, suggesting that the majority of the students prefer auditory learning.

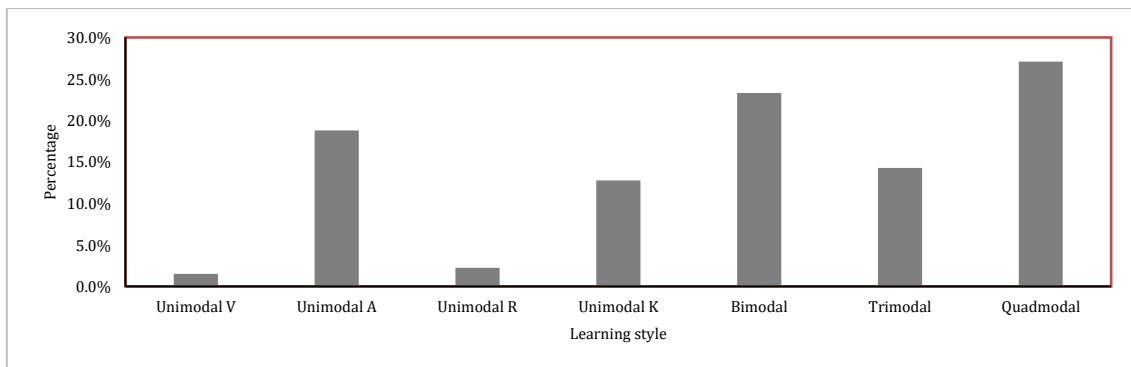
Students who predominantly selected one option when responding to the VARK items had one main learning style and were categorized in the unimodal group, whereas students who selected two or more options had two or more learning styles and were categorized as multimodal. More than half of the students (64.7%) displayed a preference for multimodal learning, while 35.3% preferred unimodal learning. Of the students in the multimodal learning group, 23.3% displayed a preference for bimodal learning, 14.3% for trimodal learning, and 27.1% for quadmodal learning, as shown in Fig. 1. Of the students in the unimodal learning group, the majority showed a preference for auditory modalities, followed by kinaesthetic learning. The means and standard deviations for each of the four VARK modalities across the demographic variables considered in this study are shown in Table 3.

**Table 1:** Demographic variables: Frequencies and percentages

Demographic Variables	Categories	N (%)
Gender	Male	81 (60.9%)
	Female	52 (39.1%)
Marital status	Married	9 (6.8%)
	Single	124 (93.2%)
Current level of nursing program	Level 1	11 (8.3%)
	Level 2	2 (1.5%)
	Level 3	23 (17.3%)
	Level 4	97 (73.0%)
Location	Urban	119 (89.5%)
	Regional	14 (10.5%)
	Good	79 (59.4%)
Quality of home internet connection	Acceptable	35 (26.3%)
	Bad	19 (14.3%)
How convenient is the place where you are doing your online learning?	Convenient	80 (60.2%)
	Uncertain	30 (22.6%)
	Inconvenient	23 (17.3%)
How does the online learning process impact your academic performance during a pandemic?	Positive	41 (30.8%)
	Uncertain	56 (42.1%)
	Negative	36 (27.1%)
How do you rate your overall satisfaction regarding your online learning experience?	Satisfied	64 (48.1%)
	Uncertain	29 (21.8%)
	Unsatisfied	40 (30.1%)

**Table 2:** Means and standard deviations of VARK scores among nursing students

VARK modalities	Mean	Standard deviation
Visual	4.13	2.71
Auditory	7.36	2.74
Read/Write	4.86	2.65
Kinaesthetic	6.66	2.93



**Fig. 1:** Learning style preference among undergraduate nursing students

**Table 3:** Means and standard deviations of VARK scores by demographic variables

Demographic variables	Categories	Visual <i>M (SD)</i>	Auditory <i>M (SD)</i>	Read/write <i>M (SD)</i>	Kinaesthetic <i>M (SD)</i>
Gender	Male	4.14 (2.97)	7.65 (2.99)	5.07 (2.79)	6.86 (3.15)
	Female	4.12 (2.28)	6.90 (2.24)	4.52 (2.40)	6.35 (2.53)
Marital status	Single	4.11 (2.75)	7.46 (2.76)	4.93 (2.67)	6.69 (2.98)
	Married	4.33 (2.18)	6.00 (2.12)	3.89 (2.15)	6.22 (2.11)
Current level of nursing program	Level 1	3.27 (1.42)	8.27 (2.28)	5.72 (2.28)	7.00 (2.53)
	Level 2	2.00 (0.00)	5.00 (0.00)	7.00 (0.00)	8.00 (0.00)
	Level 3	3.78 (2.30)	6.30 (2.55)	3.43 (1.90)*	6.78 (2.24)
	Level 4	4.25 (2.90)	7.56 (2.78)	5.05 (2.75)*	6.57 (3.15)
Location	Urban	4.16 (2.72)	7.41 (2.70)	4.80 (2.60)	6.69 (2.88)
	Regional	3.86 (2.68)	6.93 (3.12)	5.36 (3.05)	6.43 (3.41)
Quality of home internet connection	Bad	4.05 (1.81)	6.53 (2.99)	3.84 (3.04)	8.05 (1.99)
	Acceptable	3.77 (2.02)	6.77 (2.59)	4.66 (2.07)	6.23 (2.94)
How convenient is the place where you are doing your online learning?	Good	4.30 (2.02)	7.82 (2.67)	5.19 (2.73)	6.52 (3.04)
	Inconvenient	3.91 (1.90)	7.09 (3.41)	4.09 (2.25)	7.96 (2.67)
How does the online learning process impact your academic performance during a pandemic?	Uncertain	4.80 (2.51)	7.00 (2.78)	5.23 (3.04)	6.43 (2.90)
	Convenient	3.94 (2.96)	7.58 (2.51)	4.94 (2.58)	6.38 (2.94)
How do you rate your overall satisfaction regarding your online learning experience?	Negative	4.78 (3.38)*	7.64 (3.49)	4.97 (3.13)	7.69 (2.89)*
	Uncertain	4.34 (2.51)	7.13 (2.38)	4.75 (2.52)	6.14 (2.82)*
How do you rate your overall satisfaction regarding your online learning experience?	Positive	3.27 (2.10)*	7.44 (2.47)	4.90 (2.40)	6.46 (2.93)
	Unsatisfied	3.83 (1.75)	7.08 (2.26)	4.30 (2.57)	7.28 (2.68)
	Uncertain	5.21 (3.68)	8.10 (2.90)	5.34 (2.82)	6.52 (3.28)
	Satisfied	3.83 (2.61)	7.20 (2.25)	4.98 (2.59)	6.34 (2.89)

Note: \*  $p < .05$ 

### 3.2. Impact of virtual learning processes on academic performance

Statistically significant differences were found between student's visual ( $F(2,130)=3.39, p=0.037$ ) and kinaesthetic ( $F(2,130)=3.33, p=0.039$ ) modality scores and student's perceptions of the impact of virtual learning processes on academic performance. The post hoc comparisons revealed that the visual modality scores of students who perceived the virtual learning process to have negatively impacted their academic performance during the pandemic ( $M=4.78, SD=3.38$ ) were higher than the scores of students who viewed the virtual learning process to have positively impacted their academic performance ( $M=3.27, SD=2.10$ ; *mean difference*=1.51,  $p=0.038$ ). Additionally, the kinaesthetic modality scores of students who perceived that the virtual learning process negatively impacted their academic performance ( $M=7.69, SD=2.89$ ) were higher than those of students who were uncertain about how the virtual learning process impacted their academic performance ( $M=6.14, SD=2.82$ ; *mean difference*=1.51,  $p=0.034$ ).

### 3.3. Nursing levels

Statistically significant differences were found between the students' reading modality scores and nursing levels ( $F(3,129)=3.40, p=0.020$ ). The post hoc comparisons showed that the reading modality scores of Level 4 nursing students were higher ( $M=5.05, SD=2.75$ ) than those of Level 3 nursing students ( $M=3.43, SD=1.09$ ; *mean difference*=1.62,  $p=0.038$ ).

## 4. Discussion

In this research, a significant portion of nursing students, approximately 64.7%, showed a preference

for learning through multiple methods, particularly through listening and engaging in physical activities. This learning preference notably influenced their academic performance, especially when they had to transition to online learning due to the COVID-19 pandemic. Meanwhile, a different study from China indicated that while the inclination towards learning through various methods was common among nursing students there as well, there was a notable difference in preferences between students pursuing bachelor's degrees (58.49%) and those enrolled in associate degree programs (45.77%). This difference highlights the variability in learning style preferences among nursing students based on their level of education (Zhu et al., 2018). Kinaesthetic learning was predominant in both groups, but the Chinese study also noted the read-write modality as the least preferred among their participants. Furthermore, several studies have found that the majority of nursing students prefer two or more learning styles (Alkhasawneh et al., 2008; Sinaga et al., 2018; Samarakoon et al., 2013). This can be attributed to multimodal learners being more flexible in their absorption of information than learners with a single preference.

Additionally, the predominant preference among the nursing students in this study was for the auditory modality, closely followed by the kinaesthetic modality. This contrasts with findings in various global contexts, where the kinaesthetic modality often emerges as the most favored among nursing students, with auditory preferences typically ranking second, as noted in studies by Alkhasawneh (2013) and Stirling and Alquraini (2017). This discrepancy highlights the variability in learning style preferences across different educational and cultural environments. However, the present study's result is consistent with that of a study by Alipour et al. (2013), who found that the most preferred learning style is auditory, followed by kinaesthetic. The mixed results can be attributed to the



kinaesthetic and auditory modalities being equally significant in nursing education based on students' preferences. Both learning styles obtained the highest results in most studies. However, a qualitative study is needed for an in-depth exploration of this research area and to determine the reasons for nursing students' learning style preferences.

The visual modality scores of students who reported that the virtual learning process negatively impacted their academic performance were higher than those of students who viewed the virtual learning process as having positively impacted their academic performance. Additionally, the kinaesthetic modality scores of students who perceived the virtual learning process to negatively impact their academic performance were higher than those of other students. This may be because kinaesthetic learning approaches need to involve practical work and hospital placements to be effective, which cannot be offered via a virtual learning platform (Redmond et al., 2016). Likewise, visual learning is effective in face-to-face sessions where educators may use visual aids to improve the level of understanding among students; visual learning methods and visual aids are most used in theoretical, clinical, seminar-based, and laboratory learning (Stirling, 2017). Therefore, nursing students perceived virtual learning mode as having negatively impacted their learning performance during the pandemic.

Finally, statistically significant differences were found between the students' reading modality scores and nursing levels. The reading modality scores of Level 4 nursing students were higher than those of the lower-level nursing students. This result is not surprising since Level 4 students would have an advanced understanding of reading materials as well as advanced writing skills. The development of reading and writing skills is often associated with reading and writing practice, which occurs in the final year of nursing studies. Therefore, Level 4 students' reading and writing skills tend to be better than students of other nursing levels (Mahama, 2010).

## 5. Conclusion

The study provides insightful revelations into the learning preferences of nursing students in a Saudi Arabian context, particularly during the transition to virtual learning due to the COVID-19 pandemic. The findings underscore a predominant preference for multimodal learning styles, with auditory and kinaesthetic modalities being the most favored. This preference has significant implications for academic performance, especially under the constraints of virtual learning environments. The study highlights the challenges faced by students with specific learning preferences, such as visual and kinaesthetic, in adapting to online education. The correlation between learning modalities and various demographic factors, including the level of nursing

education, offers a nuanced understanding of how different students engage with learning materials. These insights are crucial for educators and institutions in tailoring their teaching methodologies and resources to accommodate diverse learning styles, thereby enhancing the educational experience and academic success of nursing students. The study's findings contribute to the broader discourse on the adaptability of educational practices in times of crisis and the importance of understanding student learning preferences in the effective delivery of education.

## 6. Limitations

This study was conducted in a single educational facility and only considered undergraduate nursing students. Therefore, these findings may not be generalizable to other settings and professions. In addition, convenience sampling was used in this study, which may also limit the generalisability of the findings. Furthermore, the use of a cross-sectional study design has the major limitation of not establishing a causal relationship between independent and dependent variables.

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## Compliance with ethical standards

### Ethical considerations

This research was approved by the PSMCM Scientific Research Center and Institutional Review Board (IRB) in Saudi Arabia (Approval No. HP-01-R079).

### Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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