

Do learning styles influence learning outcomes in anatomy in first-year medical students?

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ABSTRACT

Background: Learning styles are a key element for teachers for any given learning environment. The Visual, Aural/Auditory, Reading/write, Kinesthetic (VARK) instrument is easy to administer and can have an impact on the quality of learning environment. The present study was done to understand the learning styles preferred by the students using VARK questionnaire and correlating learning styles with their academic performance. **Materials and Methods:** The study was conducted on 100 first-year MBBS students. Students were categorized into five groups of learners: visual, auditory, read/write, kinesthetic, and multimodal, based on their scores obtained after administering VARK questionnaire. First internal marks of theory and practicals were collected. One-way analysis of variance (ANOVA) was done in five groups of learning styles. **Results:** Out of 97, 13 were visual, 25 were auditory, 5 were read/write, 40 were kinesthetic, and 14 were multimodal type of learners. Three students were chronic absentees and were excluded from the study. The student who scored highest in theory internal assessment belonged to visual and kinesthetic type of learner, whereas who scored least was a kinesthetic learner. The student who scored highest in practical internal assessment was a multimodal learner and who scored least was a kinesthetic learner, The *P* value for theory was 0.773 and for practicals was 0.26, ANOVA for theory is 0.33 and for practicals is 0.057. **Conclusion:** There was no statistic difference in theory performance, however with respect to practicals, the ANOVA value was 5%. Hence, the aforementioned results may be suggestive of correlation between learning style and academic performance.

Keywords: Anatomy, assessment, kinesthetic learners, learning outcome, learning styles, read, VARK questionnaire, write

Introduction

Understanding a subject like anatomy is a very difficult task from student's point of view. Teaching has been defined as a building bridge from the known to the unknown. Part of the bridge is to be able to understand the learners, the learning process, and how best the information can be conveyed to the learners in a simple manner.^[1]

The important factor for determining learning style is to establish a proper teaching strategy.^[2]

Learning styles is a term used to refer to the methods of gathering, processing, interpreting, organizing, and thinking about information.^[3]

Materials and Methods

The aforementioned cross-sectional study was conducted ***

Study design

Observational study.

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In accordance with the guidelines issued by ICMR, the Institutional Ethics Committee has issued Ethical Clearance to carry on the work and also observing the confidentiality to carry on the research work.

The VARK questionnaire (Version 7.8)^[4] [Figure 1] was given to all the first-year MBBS students who were clearly explained about the questionnaire. Students were also sensitized about the importance of this study and how its results will facilitate for the future planning about the teaching and learning. In this study, the VARK Questionnaire (Version 7.8) was used to collect the required data. This questionnaire was developed by Neil. D Fleming in 1987. This questionnaire alerts both the teacher and the student about the various aspects of learning and will help to modify the teaching–learning method and help the learners who have difficulty in learning.

The VARK questionnaire (Version 7.8) comprised 16 multiple choice questions where in each question has four multiple options (a, b, c, and d). Students were advised to choose the correct answer which best explained their preference and were asked to circle the letter next to it. They were also given the freedom of circling more than one option if a single answer did not match their perception. They were further instructed to leave blank any question that they felt did not apply to them.

After giving sufficient time to the students to answer the questionnaire, scoring chart was given in the end after they have answered the questionnaire. The VARK questionnaire scoring chart was designed to find the VARK category that each of the answer corresponds to. They were instructed to circle the letters that corresponds to their answer. Later students were instructed to calculate their scores that is total number of V's circled, A's circled, R's circled, and K's circled which determines their VARK category which in turn determines their type of learning style.

Based on their VARK score, students were categorized into five groups, Visual, Auditory, Read/write, Kinesthetic, and Multimodal type of learners. First internal assessment marks of both theory and practicals were collected.

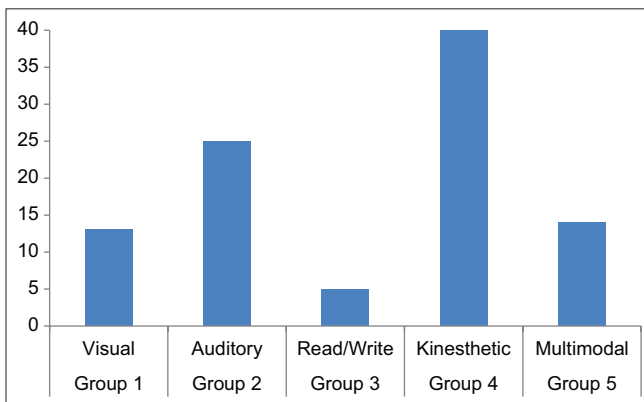


Figure 1: Total number of students belonging to various type of learning styles (As per VARK Questionnaire) and their percentage.

Statistical analysis

One-way ANOVA was done to look for differences between groups based on their learning styles.

Results

A total of 100 students belonging to first-year MBBS Batch 2014–2015 participated in the study. Among them, 44 were boys and remaining 56 were girls. Among the total of 100 students, three students were chronic absentees and were excluded from the study. Out of remaining 97 students who participated in the study, 13.4% belonged to Visual learners, 25.7% belonged to Auditory learners, 5.1% were Read/write type of learners, 41.2% belonged to Kinesthetic type of learners, and remaining 14.3% were categorized as multimodal type of learners which included more than one type of learning styles in a combination of two or more. As per their learning styles, all the students were categorized into five groups as visual, auditory, read/write, kinesthetic, and multimodal type of learners [Table 1 and Figure 1].

The internal assessment marks of the whole batch both theory and practicals were collected. If the confidence interval is more in the group, then the test is less authentic. For example, the students belonging to group C which included read/write learners in both theory as well as practicals [Table 2 and Figure 2].

Levene’s test of homogeneity of variances was done. The *P* value for theory was 0.773 and that for practicals was 0.26. After doing this, now the groups can be compared [Table 3].

One-way ANOVA was done to look for differences between groups based on their learning styles. According to our results, the *P* value for theory was 0.330 and that for practicals was 0.184 [Table 4].

After applying ANOVA and comparing the various groups, it was found that with respect to theory performance there was no statistic difference. However, with respect to practicals, when comparing Group 1 with Group 3, *P* value was 0.057 which is near to 5% and statistically significant. So, the hypothesis is if we have a greater number of students in Group 1 and 3, we may have significance with respect to practicals. In the present study, Group 1 is performing better than Group 3 [Table 5].

In the present study, students who performed best in theory were kinesthetic and visual learners, and who performed least were also kinesthetic learners. The students who performed best in practicals were kinesthetic, visual, auditory as well as multimodal learners whereas who performed least were kinesthetic learners. However, the limitations of this study are less sample size and confined only to anatomy.

Discussion

Students have different learning styles which show up in the classroom in the different ways that they acquire information.

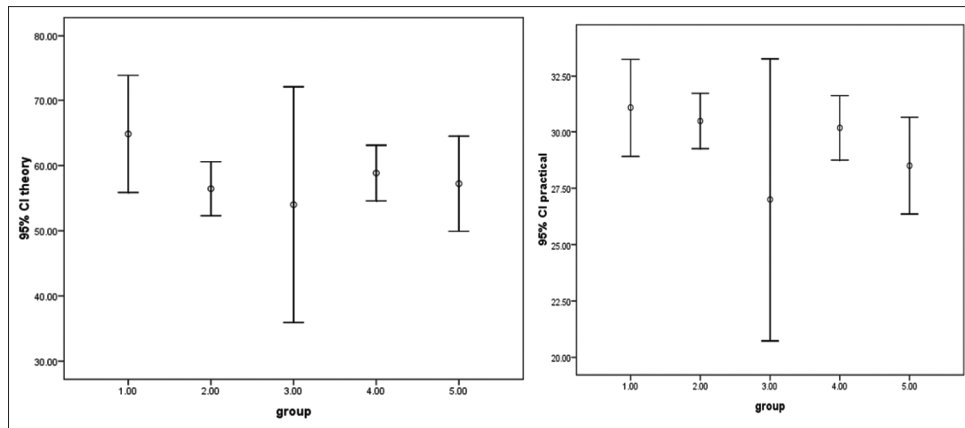


Figure 2: Confidence Interval for mean for both theory and practicals. The VARK questionnaire (version 7.8) to determine learning style devised by Neil D Fleming. <http://vark-learn.com/the-vark-questionnaire/>

Table 1: Confidence interval for mean for both theory and practicals

	n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
				Lower Bound	Upper Bound		
Theory							
1	13	64.8462	14.85960	55.8666	73.8257	32.00	82.00
2	25	56.4400	10.04191	52.2949	60.5851	37.00	76.00
3	5	54.0000	14.56022	35.9211	72.0789	36.00	73.00
4	40	58.8500	13.33503	54.5852	63.1148	24.00	82.00
5	14	57.2143	12.62585	49.9243	64.5042	35.00	80.00
Total	97	58.5464	12.78184	55.9703	61.1225	24.00	82.00
Practical							
1	13	31.0769	3.59308	28.9056	33.2482	24.00	36.00
2	25	30.4800	2.97377	29.2525	31.7075	23.00	36.00
3	5	27.0000	5.04975	20.7299	33.2701	23.00	33.00
4	40	30.1750	4.46575	28.7468	31.6032	17.00	36.00
5	14	28.5000	3.71587	26.3545	30.6455	23.00	36.00
Total	97	29.9691	3.98553	29.1658	30.7723	17.00	36.00

Table 2: Test of homogeneity of variances

	Levene Statistics	df1	df2	Sig
Theory	0.449	4	92	0.773
Practical	1.344	4	92	0.260

Table 3: The details of ANOVA

	Sum of squares	df	Mean square	F	Sig
Theory	758.732	4	189.683	1.169	0.330
Between groups	14925.309	92	162.232		
Within groups	15684.041	86			
Total					
Practicals	98.469	4	24.617	1.588	0.184
Between groups	1426.438	92	15.505		
Within groups	1524.907	86			
Total					

Learning styles is defined as ‘the composite of characteristic cognitive, affective and physiological characters that serve as relatively stable indicators of how a learner perceives, interacts with and responds to the learning environment’.^[3]

Learning style inventory like VARK (VARK is an acronym for visual, aural/auditory, read/write and kinesthetic learning modalities) is one such tool which helps the teacher to understand what type of learner the student belongs to and definitely helps the teacher to modify their style of teaching to reach the needs of the student.

Malcolm Knowles widely accepted theory about adult learning is based on principle that learning should be ‘Learner-centered’.^[1]

As adults learn, it’s moving on from dependent state to self-directed learning. Recognizing that adults have an ocean of life experiences, Knowles stated that newly acquired information is integrated into these past experiences and serves as the driving force in the learner’s desire to learn.^[5]

The VARK instrument devised by Fleming and Mills comprised 16 multiple choice questions with four items each corresponding to four sensory modalities, Visual (V), Aural (A), Reading/write (R), and Kinesthetic (K). Fleming stated that the questionnaire could alert teachers and students to various

Table 4: The details of ANOVA by comparing Group 1 with other groups for practicals

	Multiple Comparisons				
	Mean difference	Std Error	Sig	95% Confidence Interval	
				Upper bound	Lower bound
Group 2	0.59692	1.3643	0.659	-2.0772	3.2710
Group 3	4.07692	2.07211	0.052	-0.0385	8.1923
Group 4	0.90182	1.25710	0.475	-1.5948	3.3986
Group 5	2.57692	1.31663	0.093	-0.4352	5.5891

Table 5: Table showing the details of ANOVA by comparing Group 1 with other groups for practicals.

	Multiple Comparisons				
	Mean difference	Std Error	Sig	95% Confidence Interval	
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Group 2	0.59692	1.3643	0.659	-2.0772	3.2710
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Group 5	2.57692	1.31663	0.093	-0.4352	5.5891

approaches of learning, it also supports the students who have difficulties in learning.^[6]

Evaluation of the learning process, is essential to see how the results are achieved. For the designer of the course, the main purpose is to identify those parts of the course that could be improved in the future. For the administrator of the course, purpose could be to evaluate the manner in which the staff members are approaching certain instructional tasks in practice. The students should also be involved in the evaluation of the teaching/learning process, and should be invited to give their views on the methods which are being used. This feedback will definitely have an impact on the way the course is planned or carried out throughout the year.^[7]

The present study is basically done to understand the learning style preferred by students using VARK questionnaire and correlating their learning styles with their academic performance in the internal assessment which is a formative type of assessment. So that we can improve teaching–learning methods and can improve the student’s learning which in turn will improve their academic performance in their summative assessments which is usually conducted toward the end of the first year of MBBS by the affiliated university.

Learning is an active process going on inside the student’s and the teacher’s mind, main function is to facilitate this learning process. Learning usually needs examples from psychomotor, affective, and cognitive domains before it is fully understood.^[8]

Learning is understood in terms of psycho-physiological process, that is to discover, to commit to memory and to become efficient.^[9]

In a passive lecture format, all students are assumed to be auditory learners. Students remember only 20% of what they read, 30%

of what they hear, 40% of what they see, 50% of what they say, and 60% of what they do. This average increases to 90% for information they say, hear, see, and do.^[3]

Learning styles (LS) have dominated educational practice since their popularization in the 1970s. The rate of acceptance is more than 90% of teachers worldwide.^[10]

The learning style of faculty members may influence student learning and levels of their interaction during classroom instruction, experiential teaching activities, and problem-based learning.^[11]

It would be valuable to determine students’ learning styles as early as in the first year of their MBBS and to assess their progress through the classroom as well as experiential portions of the curriculum.^[12]

Learning style is a habitual manner of gaining knowledge, skills, or attitudes and considered as a stable characteristic feature in individuals across different learning contexts and intra-individual variation is possible with the changing contexts.^[13]

Learning and personality styles of health professions students and practitioners have been assessed using a variety of instruments including Productivity Environmental Preference Survey, Kolb Learning Style Inventory, Myers–Briggs Type Indicator, Gregorc Style Delineator, LSQ [Learning style questionnaire], Canfield Learning style inventory, Cognitive Style Analyzer, and the VARK Inventory.^[14-17]

The VARK inventory categorizes four different sensory modalities with an extra category for multimodal students. The “V” in VARK stands for visual, the learners belonging to this type, learn best if they can see, like flowcharts, graphs, pictures, diagrams are helpful for them. The “A” in VARK stands for auditory and learners belonging to this type would like to hear the information. This type of learners processes the information best by listening to lectures, using tape recorders to playback learning sessions and attending tutorials. The “R” in VARK stands for read/write and the learners belonging to this type like to see the written words. They like to read texts, take notes verbatim and reread these over and over again. Finally, the “K” in VARK stands for kinesthetic and these types of learners acquire information by practice and experience and prefer to learn which has got a connection to reality. Multimodal category includes the students who fall into more than one sensory modality of any combination.^[18]

The results of present study showed that majority of learners belonged to kinesthetic type (Group 4 – 41.2%). This also substantiates that anatomy can be best learnt by doing dissections, whatever technology with 3D images, the best learning by touching the cadaver cannot be replaced. Further kinesthetic learners have performed very well in both theory as well as practicals.

In the study of James *et al.*,^[13] mean score was highest for kinesthetic learning. This emphasizes the need for teaching style that is more hands on with demonstrations, extensive laboratory work, role plays involving all their senses of learning and interactive simulations.

Visual learners like to draw maps of their learning sequence or create patterns of information. Aural learners an attachment to the questionnaire provides a set of strategies for 'learning by ear'. Read/write learners reveal preference for accessing information from printed words as they prefer reading and writing as their first preference in learning. Kinesthetic learners who like to experience their learning by using all their senses, like taste, touch, smell, sight, and hearing. They can easily learn abstract material and concepts with suitable examples, real-life experiences, and metaphors.^[19]

One study was conducted to know the relationship between learning styles and academic performance in TURKISH physiotherapy students in 2018 which showed significant increase in academic performance with respect to students with participant learning styles.^[20]

Formative assessments play a key role, in identifying the loopholes and correcting them. Researchers feel that increasing formative assessments helps in consolidating knowledge and prior skills, providing corrective feedback.^[21]

"There is a body of firm evidence that formative assessment is an essential component of classroom work and that its development can raise standards of achievement. We know of no other way of raising standards for which such a strong prima facie case can be made".^[22]

One study conducted by Sabo *et al.*^[23] in 2012 using the VARK questionnaire on health professional students showed majority were multimodal type of learners.

In our study, 14.3% belonged to multimodal type of learners. No student is restricted to only one mode of learning, but it is noteworthy that there are some dominant preferences and some voids among different students. Students exhibit strong preference for one particular mode and a relative weakness for some other mode. A few other prefer information to arrive in a variety of modes and such category of students belong to multimodal type of learners.^[19]

One more study which was conducted by Pungente *et al.*^[24] in the year 2002, showed that convergers had strong preference for activities and divergers had least preference. Whereas accommodators and assimilators showed positive responses to activities.

The classification of learners as convergers, divergers, assimilators, and accommodators were classified as per Kolb's learning style inventory.^[25]

Residents are different from faculty preceptors in their secondary learning style, with accommodators and divergers being more common among residents than among faculty preceptors. More participants had "passive" and "watching" learning styles than did nursing residents, medical students, and most other health professions trainees, who exhibit more "active" and "doing" learning styles such as convergers and accommodator.^[26]

Results should be interpreted in consideration of study design and limitations. The scope of this study was to provide insight on differences in learning styles among medical students. One limitation of the study was the low number of students and confined to one subject only that is anatomy. Further the comparison was done only to formative assessments and not the summative assessments.

Given the variability in learning styles that may exist in a classroom, some authors suggested that students should adapt their learning styles to coincide with a given instruction style.^[27]

Conclusions

No matter what student's individual learning style preference is, it is the responsibility of the educators to keep the students active in their learning process. Questionnaire does not attempt to be diagnostic, in fact it acts as a catalyst for both teachers and learners to reflect upon their own preferences. Teacher has a role to play as a facilitator to improve learning. This can only be achieved by fully knowing the concerns of students and their learning. Medical education thrives on perseverance of students and teachers both.

Majority of the students in the present study belonged to kinesthetic type of learners. Kinesthetic group of learners have performed well in both theory and practicals in the first internal assessment. The *P* value is near to 5% between Group 1 and Group 3 which is statistically significant, the study has its own limitations as the sample size is very less and is confined only to anatomy.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient/student consent forms. In the form, the patient(s)/ student(s) has/have given his/her/their consent for his/her/ their images and other clinical information to be reported in the journal. The patients/students understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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