

Original Research Article

Handedness and learning styles: a study of its inter relationship

Vineetha Vijayan, Pallavi Panchu*, Biju Bahuleyan

Department of Physiology, Jubilee Mission Medical College and Research Institute, Thrissur, Kerala, India

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***Correspondence:**

Dr. Pallavi Panchu,

E-mail: drpallavipanchu@gmail.com

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ABSTRACT

Background: The alleged link between handedness and learning is debatable. Studies unveil that handedness has a way of influencing learning and affects the academic performance of students. Despite the researchers pointing out that handedness influences the brain organization and function, teaching strategies have largely ignored this fact. The concept of using various sensory modalities as a part of learning has not been comprehended well. The aim of the study is to find out the prevalence of handedness among our medical students and to look onto the types of learning styles amongst them and to determine the correlation between handedness with learning styles.

Methods: A cross sectional study was conducted among hundred medical students using handgrip dynamometer for handedness and VARK questionnaire (Visual, auditory, read/write, kinesthetic; a validated tool that helps one to identify the most preferred sensory modality for learning) for determining the learning preference. Data was analysed using univariate and bivariate analysis through cross tabulation and Pearson chi square test using SPSS version 20.

Results: Right handers preferred VARK with dominancy for auditory learning styles, left handers preferred VARK with dominancy for auditory and kinesthetic learning styles while ambidextrous prefer visual learning styles.

Conclusions: The awareness of the association of handedness with various learning styles and its implications on academic performance should be at the forefront of teaching strategies adopted by teachers. Hence, we conclude that to be an effective learner, the learning needs have to be understood and cater to by the trainers.

Keywords: Ambidextrous, Handedness, Handgrip dynamometer, Learning styles, Medical students, VARK

INTRODUCTION

Handedness has always been one of the researcher's favourite spheres of interest. Handedness can be defined in two ways: among the society as "preference for using right or left hand for various unimanual activities" and among the scientific community as, "consistent asymmetry in skill or preferential use between the hands which is related to lateralization within the brain."^{1,2} According to the world's population, 90% of people are right handed and the remaining constitute ambidexterity and left handed group.³⁻⁵ However the geographical distribution between ambidextrous and left handed people per se is still questionable as only a minor group of the population of every culture is found to be left handed.

The origin and mechanism of handedness has always fascinated scientists. There's plenty of ongoing debate regarding handedness. One school of thought shows that during prenatal development, embryos exhibit handedness through single arm movements between 9-10 weeks of gestation.⁶ While some have described handedness due to possibilities of hemispherical asymmetry of cortical association areas controlling the cognitive-motor skilled movements.⁷ Genes may also play a role as seen by the presence of LRRTMI within 2p12-q11 region associated with left handedness.⁸ Naturally occurring loss of axons of the corpus callosum and the size difference of corpus callosum between left and right handed individual might result in the development of hand preference.¹ As is evident, debate is

plenty and facts regarding origin of handedness remain inconclusive.

Paul Broca (a French neurosurgeon) suggested that a person's handedness was opposite from the specialized hemisphere which means that hand and brain have some association.⁹ This interconnection between handedness and brain lateralization shoots a tiny spark of thought as to its influence on learning. In addition, using a person's handedness as a marker for brain lateralization would become an easy tool for a researcher to determine the alleged link between handedness and brain asymmetry.⁹ Therefore left hemisphere is dominant for right handed people and right hemisphere for the left handers. However, 70% of left handers showed dominance of left hemisphere further adding to the body of inconclusive literature.¹⁰ Several studies have highlighted that many candidates choose their occupation or academic majors entirely on the basis of brain hemisphericity.¹¹ This indicates the existence of possible association of brain lateralization with handedness and learning potential but requires further research in these areas.

Education is essential for a bright future in India and elsewhere and learning is one of its fundamental elements towards that goal. Learning is the ability to effectively use various methods in order to perceive, process, store and recall the information that is to be learnt.¹² Transition from secondary education to tertiary education, especially medical education, is a challenging task as the students have to come up with increased volume of content in a short period of time. Tertiary education requires many learning skills such as inquiry skills, critical thinking, problem solving skills to name a few to achieve academic success. As a result, there is an increasing level of stress, depression and anxiety among students which seriously affects their academic performances.¹³

VARK questionnaire is a subjective study tool, developed by Neil Fleming which describes 4 sensory modalities namely visual, auditory, read/write and kinesthetic which each learner uses while trying to learn a particular content.¹⁴ The fact that the current education system is partial to certain learning styles which are preferred by left brain dominant learners, puts the right brain dominant learners at a distinct disadvantage, which is further emphasized by the fact that left brainers are analytical thinkers and right brainers are creative and imaginative. The latter group would supposedly do well with more visual and kinesthetic style of learning. Research has shown learners with multimodal learning strategies are known to perform the best.^{15,16}

As the education system becomes more complex and competitive, we as educators aim to provide better learning strategies to make learning process simple, stress free and effective. The objective in this study is to explore the different learning styles among students and to find the correlation of handedness with learning styles in 1st year medical students.

METHODS

This cross-sectional study was carried out on 100 1st year medical students using complete sampling method at Jubilee Mission Medical College and Research Institute, Thrissur, Kerala. The subjects included 67 female subjects and 33 male subjects aged between 18-23 years. Following the approval of the Institutional Ethics Committee, the purpose of the study was explained to the students and written informed consent was obtained after the exclusion of those subjects with any motor disabilities and disinterest in participating.

Handedness: "Constant" digital handgrip dynamometer is used to measure the grip strength of the individuals, while sitting with the elbow in 90 degrees flexion and the forearm in semi-pronation, lying on arm rest. Individuals perform 3 trials for each hand with 1 min rest in between. The mean value of three trials will be recorded. Maximum value will be taken as the dominant hand. If the values are similar for both hands, then those individuals will be considered as ambidextrous handedness.¹⁷

VARK questionnaire: A printed hardcopy of VARK questionnaire (version 7.8) developed by Neil Fleming consist of 16 questions with 4 multiple choices which can identify 4 sensory modality visual (V), aural (A), read/write (R) and kinesthetic (K) learning styles was administered during their class hours. This questionnaire is available online in their official website.¹⁸ The students were allowed to choose more than one option per question or leave a question unanswered if it was not applicable to them. Each question was created in such a way that it describes the common events that take place in daily life and each option was correlated to a particular sensory modality. The questionnaires were evaluated on the basis of the scoring instructions and chart provided by the website.¹⁸ This questionnaire helps to identify the type learning style each student would prefer to use while performing a task. This questionnaire not only helps the student to identify their learning styles and make changes in their learning habits but also provides an insight to the teachers about their learning preferences which enable the teachers to upgrade their teaching skills in par with the learning preference of the student.

Statistical analysis

The results were tabulated and charted using univariate and bivariate analysis through cross tabulation and Pearson chi square test using SPSS version 20 to find the correlation and significance respectively of the learning styles with handedness.

RESULTS

Out of 100 medical students, 67 were female and 33 were male subjects. After the scoring of the VARK questionnaire, it was found that our students had different

modal learning styles and majority belonged to the quadmodal learning styles. This has been depicted in the pie chart showing the percentage of students in quadmodal (42%), unimodal (33%), bimodal (16%) and trimodal learning styles (9%) (Figure 1).

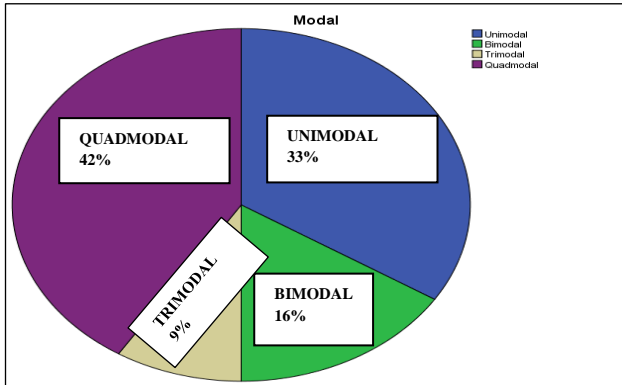


Figure 1: Distribution of unimodal, bimodal, trimodal and quadmodal learning styles in students.

Out of the 4 types of modal learning styles (quadmodal, trimodal, bimodal and unimodal); each category has been explained in detail in the table 1. A VARK profile consists of visual (V), auditory (A), kinesthetic (K) and read/write (R) modes which can exist as various combinations either as unimodal (using 1 mode at a time), bimodal (using 2 modes at a time), trimodal (using 3 modes at a time) and quadmodal (using 4 modes at a time).¹⁹ In our study we have all the 4 modes as single modality; AK, VK, RK, VA as bimodal combinations, ARK and VAK as trimodal combinations and VARK as quadmodal combinations.

Table 1: Distribution of modal preference in students (includes single and combined learning styles).

Modal dominance	Frequency	Percent
V	3	3.0
A	23	23.0
R	1	1.0
K	6	6.0
VA	1	1.0
VK	5	5.0
AK	9	9.0
RK	1	1.0
ARK	3	3.0
VAK	6	6.0
VARK	42	42.0
Total	100	100.0

V-visual, A-auditory, R-read/write, K-kinesthetic, VA-visual and auditory, VK-visual and kinaesthetic, AK-auditory and kinesthetic, RK-read/write and kinesthetic and ARK-auditory, Read/write and kinesthetic, VAK-visual, auditory and kinesthetic, VARK-visual, auditory, Read/write and kinesthetic

The table describes that out of 100 students 42% prefer VARK (quadmodal) with auditory learning mode in

unimodal category (23%), AK in bimodal category (9%) and VAK in trimodal category (6%) (Table 1).

The Table 2 describes the cross tabulation between handedness and modal preferences among 100 first year medical students. The table shows that out of 73 right handed students, preferred VARK (43.8%) with a dominance of auditory learning mode (27.4%) and AK (8.2%) in bimodal category. 28.6% left handed students (n=14) prefer VARK with a dominance of auditory (14.3%) and kinesthetic (14.3%) learning mode and AK in bimodal category (21.4%). 46.2% ambidextrous students (n=13) preferred VARK with dominance for visual learning mode (7.7%).

The Table showed a significance of $p=0.013 < 0.05$. From this table it indicates that the different types of handedness showed VARK (quadmodal) as the preferred learning style with specific dominance for either a single sensory mode or bimodal mode.

From present study, out of 42 number of quadmodal (VARK) preferred students (described in Table 1 and Figure 1), 47.6% are VARK type 2 followed by 26.2% in VARK type 1 and VARK transition, shown in the pie chart (Figure 2). VARK profile of a student can be categorized into VARK type 1, VARK type 2 and VARK transition based on the score they obtain from the VARK questionnaire. VARK type 1 group involves those who have to use all 4-learning mode but one mode at a time ("context specific"), VARK type 2 involves those have to use all 4-learning mode at the same time to achieve their specific goal ("context blind") and VARK transition involves those who lie in between VARK type 1 and VARK type 2 (Figure 2).¹⁹

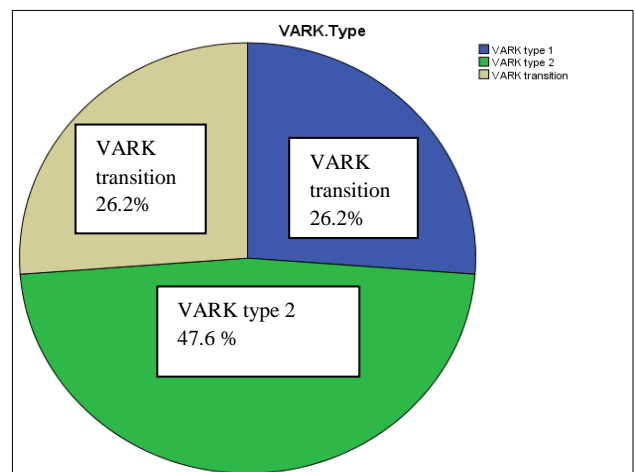


Figure 2: Distribution of different types of VARK modalities.

Table 3 describes the cross tabulation between VARK type and gender. Out of 42 quadmodal preferred students, they have been further studied based on gender differences. Out of 11 students who showed VARK type

1 profile, 9 were females and 2 were males. 20 students showed VARK type 2 profile, out of which 15 were females and 5 were males. 11 students showed VARK

transition profile, out of which 6 were females and 5 were males. Count percentage within gender and VARK type has been done.

Table 2: Handedness Vs Model preference cross tabulation.

Modal dominance (n=100)		Handedness			Total	P value
		Right	Left	Ambidextrous		
Visual (V)	Count	1	1	1	3	0.013*
	%	1.4	7.1	7.7	3.0	
Auditory (A)	Count	20	2	1	23	
	%	27.4	14.3	7.7	23.0	
Read/write (R)	Count	0	1	0	1	
	%	0.0	7.1	0.0	1.0	
Kinesthetic (K)	Count	4	2	0	6	
	%	5.5	14.3	0.0	6.0	
VA	Count	1	0	0	1	
	%	1.4	0.0	0.0	1.0	
VK	Count	5	0	0	5	
	%	6.8	0.0	0.0	5.0	
AK	Count	6	3	0	9	
	%	8.2	21.4	0.0	9.0	
RK	Count	0	0	1	1	
	%	0.0	0.0	7.7	1.0	
ARK	Count	1	1	1	3	
	%	1.4	7.1	7.7	3.0	
VAK	Count	3	0	3	6	
	%	4.1	0.0	23.1	6.0	
VARK	Count	32	4	6	42	
	%	43.8	28.6	46.2	42.0	
Total	Count	73	14	13	100	
	%	100	100	100.0	100	

Table 3: VARK type vs gender cross tabulation.

Quadmodal preferred group N=42			Gender		Total	P value
			Male	Female		
VARK type	VARK type 1	Count	2	9	11	0.326
		% within VARK type	18.2	81.8	100.0	
		% within gender	16.7	30.0	26.2	
	VARK type 2	Count	5	15	20	
		% within VARK type	25.0	75.0	100.0	
		% within gender	41.7	50.0	47.6	
	VARK transition	Count	5	6	11	
		% within VARK type	45.5	54.5	100.0	
		% within gender	41.7	20.0	26.2	
Total	Count	12	30	42		
	% within VARK type	28.6	71.4	100.0		
	% within gender	100.0	100.0	100.0		

Categorical measurements are presented in number (%). significance is assessed at 5% level of significance

As per the table 3, the females belong to VARK type 1, VARK type 2 and VARK transition groups. But due to the discrepancy in the female to male ratio, marked changes are not observed between male and female

students. However, males tend to belong to the transition group and females belong to the VARK type 2 group more than VARK type 1 and VARK transition groups

when observed in particular within the gender count (Table 3).

DISCUSSION

We as educators try to incorporate new teaching strategies to make the learning process, simple yet informative and effective. Keeping students engaged and motivated is a challenging task and trainers face dual responsibilities in terms of identifying the preferred learning approach of the learner and the task of providing it. In India, left handedness is considered a social and cultural taboo. From a very young age the child is forced, coaxed and cajoled into using his right hand, with little thought being given to his brain development. As handedness is thought to have a correlation with learning abilities of a student, we decided to explore the different kinds of handedness prevalent in our population and look into its relationship with learning styles.

Figure 1 describes the 4 types of modal preferences (unimodal, bimodal, trimodal and quadmodal). 42% of students preferred quadmodal learning styles which forms the major group, followed by 33% in unimodal, 16% in bimodal and 9% in trimodal group. Studies have shown that students who had quadmodal learning habits performed better than those who had unimodal learning habits.¹⁵ We are awaiting the results of examination to further pursue this line of thought. Furthermore, lecture class that lasts 1 hour, the attention span of a student may be limited to 10-15 minutes and this could be enhanced if the teaching format and teaching skills of the lecturers suited the learning preference of the student in order to create enthusiasm in learning.²⁰

Table 1 represents the distribution of dominance of sensory modalities opted by our students. Out of 100 students, 67% showed multimodal preference and 33% showed unimodal preference of which quadmodal style (42%) is most preferred followed by auditory learning styles (23%), by kinesthetic (6%) and then others. Visual learning doesn't only mean watching videos or seeing pictures.

It includes flowcharts, graphs, symbols, posters and slides using different formats, fonts and highlighters emphasising the important points as well as underlining the important sentences and using textbooks with pictures and diagrams.

Auditory learning style includes attending classes, discussions and tutorials, using tape recorder, explain new ideas and topics with teachers and friends and read out loud the topics that have been learnt. Read/write learning style encompasses reading content silently again and again, making list or flow diagrams or arranging the content in points and practicing with multiple choice questions. Creating a learning package by using all the senses that is hearing, taste, smell, touch and sight into experiences and things that are real, forms the

kinesthetic learning style. In addition, field trips, laboratories, lectures including real life examples and application of the same and exhibiting samples and photographs of the content to be learnt forms a part of this category.^{12,14,15}

Table 2 addresses the cross tabulation of handedness with learning styles. Most of the studies have used handgrip questionnaire to obtain the hand preference.^{1,9} It being purely subjective in nature, we have used handgrip dynamometer as an objective tool in our study that tells us the exact strength of each handgrip following the 10% rule that dominant hand possesses a 10 % greater grip strength than the non-dominant hand.²¹

The results show that out of 73% right handed students, the unimodal modality exhibited by them is auditory (27.4%) with bimodal modality AK (8.2%), trimodal modality VAK (4.1%) and quadmodal modality (43.8%). Out of 14% left handed students, the unimodal modality showed by them is auditory and kinesthetic (14.3% each), bimodal modality as AK (21.4%), in trimodal modality as ARK (7.1%) and quadmodal modality (28.6%). Out of 13% ambidextrous handed students, in unimodal modality showed by them is auditory and visual (7.7% each) with trimodal modality VAK (23.1%) and quadmodal modality (46.2%). The findings obtained through this analysis are statistically significant. From this it's clear that these 3 groups of handedness showed highest preference for auditory in single mode category and the least for read/write learning style.

Almost similar results of left handers being auditory and kinesthetic procured from our group was also found in another study whereas other studies have reported left handers being visual learners.^{4,9,22} However right handers being auditory learners in our cohort goes against many studies where they are found to be visual learners and kinesthetic learners.^{4,22,23} From primary education all the students are trained to listen and learn facts through talks which is the traditional approach to teaching; primarily in India, and hence the cause for the prominent auditory preference in India. Previously, studies have shown learners with ambidexterity performed the worse in nearly all measures of development.²⁴

However recent studies point out that ambidextrous individuals have the qualities of being a leader, creating innovative strategies and learning.²⁵ Our population comprises of intelligent medical students. The gateway into a medical college is through a common entrance exam in India that rules out the learning and cognitive difficulties. However academic performance compared to handedness in our students is still awaited. Quadmodal learners are better academic performers.^{15,16}

In our student population ambidextrous students prefer quadmodal learning teachings more compared to others. Is this due to social and environmental factors that led to ambidexterity or is it the evolution of adaptability of

humans to the progressing competitiveness of the world? Lastly, the figure 2 and table 3 describes the type of VARK profiling of the quadmodal group into VARK 1, VARK 2 and VARK transition. Those who use all 4 learning styles but prefer to use one mode at a time suiting that occasion and switching to another mode till they achieve their goal belongs to VARK type 1. Students using VARK type 2 are those who have to use all 4 learning styles at the same time to understand a concept. Those belonging to VARK Transition lie in between the two types of VARK.

In the present study, between males and females, the females showed a preference for all the 3 groups but mainly belong to VARK type 2 category (50.0%) within the gender count. Due to the imbalance between males and female's ratio (12:30), a significance was not obtained in this analysis, however the males belonged to VARK transition group (41.7%) when gender count is considered.

Students belonging in the VARK type 2 needs to spend a large amount of time to understand a concept but will be able to retain the information much better than those who belong in the VARK type 1. According to Neil Fleming, students in VARK type 2 will have a deeper and broader thinking.¹⁹ That means female students do fairly better in academics than male students.

In addition, basic human nature stems from social comparison. Every student is diverse in the manner of learning and each has their own style to acquire it. To summarize, polishing the existing skills and nourishing it by inculcating different learning strategies for a successful academic performance is the need of the hour.

Today's teachers were trained in the past. A paradigm shift in the teaching methodology has been noticed. The culture of teaching in the past was to provide monotonous lectures which involved a lot of reading and writing skills and the use of black boards to visually represent information. But the present teaching system has remarkably changed from the past which used pedagogical teaching with power point presentations which have now been replaced by virtual classrooms. The age-old methods of lectures with the use of visual representation of graphs and flow charts on white boards which used to develop 'read and write' skills are practically extinct today. However, the least inculcated teaching skills is the kinesthetic type.

While progress in the field of technology is inevitable, the traditional methods should not be erased completely, rather an ideal mix should be created.

There are still many trainers who use uninspiring methods of teaching and many colleges do not have the technology to provide a virtual classroom. Since learning is a trained experience, but modifiable, it would be

prudent to develop kinesthetic teaching skills by the facilitator to provide a holistic learning experience.

CONCLUSION

Learning is an act of acquiring, modifying and reinforcing the existing knowledge, skills or behaviour that influences the diversity of learning experiences by the learners. A balance must be maintained between the quality and quantity of learning content and its application in real life through a high level of interaction and collaboration, possible only in an active learning process. Whatever be the handedness, all 4 learning styles have to be incorporated in our learning habits to have a holistic learning experience. Teachers must appreciate the varied learning habits of students and provide instructions according to the students learning preferences and styles. Introduction of curriculum consisting of problem solving and decision-making skills that include simulated clinical experiences, study trips/tours, practical classes etc can enhance and improve the learning techniques.

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