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Alignment of Teaching Style to Learning Preferences: Impact on Student Learning

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ABSTRACT

The learning outcome can be effective if the students practice study habits according to their learning styles. Students can also learn best when teaching methods match their learning style. The present study tries to unearth the possibility of relationship between the teaching style and learning preferences of the students through the application of VARK inventory and is also interested in finding out whether the students carry out study habits as per their learning preferences. The study relies on the VARK inventory to assess learning styles. Many a times there is no alignment between the teaching style of the teachers and the learning preferences of the students due to which the learning will hardly be effective. Also, students will not know their true learning styles and study in a manner their peers are studying which actually may not bring out productive performance from them. There is less correlation between the learning style of the students identified through VARK and learning style identified by self. Though there is no relationship between learning style of the students and the study habits with the performance of the students in the three examinations, namely SSLC, PUC and University exams. No learning style is superior as it hardly plays a role in influencing the performance of the students. This study reiterates that understanding one's learning style makes the learning effective and meaningful.

Keywords: Visual, Auditory, Kinesthetic, Uni-modal, Multimodal, Teaching style, Learning preference

INTRODUCTION

Educational scientists postulate that each individual has a unique learning style. Students learn best when teaching methods match their learning style. The learning outcome can be even more effective if the students practice study habits according to their learning styles. Thus, on the one side of the balance, the teaching style and on the other side study habits enable the students to learn better. Educational researchers have come up with dual finding that learning style could or could not impact student performance. The present study tries to unearth the possibility of relationship between the teaching style and learning preferences of the students through the application of VARK inventory and is also interested in finding out whether the students carry out study habits as per their learning preferences.

Learning styles are a popular concept in psychology. Education is supposed to identify how people learn best. In this respect, the concept of learning styles remains extremely popular. There are many different ways of categorizing learning styles including Kolb's model and the Jungian learning styles. Kolb's model of learning styles is one of the best-known and widely used learning style theories. He believed that our individual learning styles emerge due to our genetics, life experiences and the demands of our current environment in addition to describing four different learning styles Kolb (1981). Kolb (1984) also developed a theory of experiential learning and a learning style inventory. Smith (2001) argued that Kolb's model is supported only by weak empirical evidence and that the learning process is actually far more complex than the theory suggests. He also noted that the theory fails to fully acknowledge how different experiences and cultures may impact the learning process. Another learning style theory is based

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on the work of analytical psychologist Carl Jung, who developed a theory of psychological types designed to categorize people in terms of various personality patterns. Jung's theory focuses on four basic psychological functions: extraversion versus introversion; sensation versus intuition; thinking versus feeling; and judging versus perceiving (Cherry, 2010). This theory later led to the development of the now-famous Myers-Briggs Type Indicator. In addition to influencing personality assessment, Jung's dimensions can also be used to assess and describe various learning styles. While each dimension represents a unique aspect of a learning style, it is important to remember that one's own individual learning style may include a combination of these dimensions. For instance, one's learning style might include elements of extroverted, sensing, feeling and perceiving learning styles. Neil Fleming's VARK model is one of the most popular representations. In 1987, Fleming developed an inventory designed to help students and others learn more about their individual learning preferences (Fleming and Mills, 1992a, b).

LITERATURE REVIEW

Learning style 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 (Baykan and Nacar, 2007). Educational researchers postulate that each individual has a unique learning style (Murphy *et al.*, 2004). Students learn best when teaching methods match their learning style. Researchers in other fields have studied the impact of learning styles on student performance in introductory courses (see, for example, Boatman *et al.,* 2008). Their results are mixed; some conclude that learning style can impact student success, while others found no significant relationship. Charkins *et al.* (1985) searched for a link between teaching styles and learning styles, and tried to identify any impact of such a link on student learning. These authors use a questionnaire that classifies teacher and student learning as dependent, independent, or collaborative. Howard-Jones (2011) has reported that out of 158 graduate education trainees surveyed, some 82% considered that teaching children in their preferred learning style could improve learning outcomes. When students are provided with information and tools to help them work to their strengths, their confidence, attitude and academic achievement may improve (Charkins *et al.*, 1985; Carns and Carns, 1991; Dunn *et al.*, 1995, 2009; Lovelace, 2005; Boström and Lassen, 2006). This approach is appealing not only because it benefits students and schools but also because it does not require monumental effort on the part of the classroom teacher. Borg and Shapiro (1996) use the Myers-Briggs Type Indicator (MTBI) to evaluate macroeconomic principles in students and professors to see if personality type affects student grades and whether students with personality types similar to those of their professor perform better. They conclude that students whose personality type suggests a preference for a structured learning environment perform significantly better in macroeconomic principles courses than those whose personality type suggests a preference for either independent learning or extensive interaction during class. In addition to being consistent with Charkins *et al.* (1985), these authors find that students who share a personality type with their professor perform significantly better. Ziegert (2000) tests the hypothesis that faculty and student personality types affect student abilities to understand economics, as measured by the Test of Understanding of College Economics (TUCE) and course grade. Similar to Borg and Shapiro, she uses the Myers-Briggs personality type indicator and finds that 'thinking' students (those that make objective judgments) outperform feeling 'students' (those that make decisions based on personal values). Her research also suggests that 'intuitive' students (those that focus on the larger picture prior to details and learn from insight) outperform 'sensing' students (those that prefer experience-based learning). Ziegert (2000) finds no evidence of a gender gap in her study; once personality differences have been accounted for. Gender is not a statistically significant predictor of success in economics. Finally, in contrast to Borg and Shapiro (1996) and Charkins *et al.* (1985), Ziegert's (2000) research work does not suggest that commonality between instructor and student personality type improves student performance.

There are many methods available for assessing learning styles, with each method offering a distinctly different view of learning style preferences. The method used in this study defines the preference in learning style in terms of the sensory modality in which a student prefers to take in new information. Four sensory modalities of learning have been defined: visual, auditory, read–write and kinesthetic (Forrest, 2004). Visual learners prefer the use of symbolic devices such as diagrams, graphs, flow charts and models that represent printed information. Auditory learners prefer to hear information and, thus, learn better through discussions, lectures, tutorials and talking through material with themselves or others. Read–write learners prefer printed words and texts as a means of acquiring new information; they thus prefer textbooks, lecture notes, handouts, lists and glossaries. Kinesthetic learning employs a combination of sensory functions; such learners have to feel or live the experience to learn; they prefer simulations of real practices and experiences, lessons that emphasize on performing an activity, field trips, exhibits, samples, photographs, case studies, real-life examples, role-plays and applications to help them understand principles and advanced concepts. Some learners have a preference for any one of these learning modalities (uni-modal learners), whereas multimodal learners do not have a strong preference for any single method. They rather learn via two or more of the modalities. Multimodal learners thus are sub-classified as bi-, tri- and quadri-modal learners, who prefer to use two, three, or four styles, respectively (Fleming and Mills, 1992a). The learning style can be assessed using the visual, auditory, read–write and kinesthetic (VARK) questionnaire developed by Neil Fleming. The validity of the VARK model as well as other learning style theories has been questioned and criticized extensively. One extensive look at learning style models suggested that the instruments designed to assess individual learning styles were questionable, while other critics have suggested that labeling students as having one specific learning style can actually be a hindrance to learning. Despite the criticism and lack of empirical support, the VARK model remains fairly popular among both students and educators. Though there is little research on the quality and reliability of the VARK questionnaire, many students immediately recognized that they were drawn to a particular learning style. Others felt that their learning preferences lie somewhere in the middle. However, in their review of learning style instruments, Hawk and Shah (2007) noted that the VARK model was the only one of five studied learning style models that contains the read–write and kinesthetic dimensions. According to the VARK website, 58% of individuals report a match between the questionnaire results and their own perceptions of learning preferences. The study relies on the VARK inventory to assess learning styles. In author's view, this inventory provides a valuable measure of learning style because it directly assesses how students prefer to learn, rather than indirectly predicting their learning strengths through a personality assessment.

Background knowledge about VARK

The VARK questionnaire developed by Fleming (1995), version 7.0, has 16 questions that generate the profile of modal preferences regarding information processing, presentation and learning. The questionnaire was developed to identify which of the sensory modalities subjects prefer to employ when learning or presenting information. These preferences are about the ways in which they want to take-in and give-out information. The modalities are: visual, aural-auditory, read–write and kinesthetic. Each VARK question presents a situation likely to be within the respondent's experience and asks him to select from among alternative actions. Each answer represents a modal preference. That means, the students might have uni-modal preferences or multimodal preferences for their learning. For instance, a student might feel that both visual and auditory learning is the most appealing. Respondents may select multiple answers and all answers are counted. These results are based on the algorithm developed by Fleming for interpreting the VARK score. Uni-modal comes with mild, strong and very strong attributes. It says that if the difference between the scores for the respondent's highest and the next highest mode score is 2, 3, 4 and 5, the preference is 'mild'; the difference score 4, 5, 6 and 7, the preference is 'strong'; and the difference score 6, 7, 8 and 9, the preference is

'very strong' viz-a-viz the total VARK score that lies between 14 and 21, 22 and 27, 28 and 32 and 32 and above, respectively. According to Boatman *et al*. (2008), as the study distinguishes between mild, strong and very strong preferences, we can assess the importance not only of learning style preference, but also of preference strength. Second, the scoring system identifies respondents with multimodal preferences, rather than forcing them into a particular category. This scoring feature adds a subtle dimension to the inventory that is lacking in other learning style assessment methods. Thus, the present study has categorized uni-modal respondents based on their preference toward 'mild,' 'strong,' and 'very strong' as well as multimodal preference.

Significance of the study

There is a strong intuitive appeal that teachers and course designers should pay closer attention to students' learning styles by diagnosing them, by encouraging students to reflect on them, and by designing teaching and learning interventions around them. However, aligning teaching strategies to learning styles may or may not be effective as the existing research has found that matching teaching methods to learning styles had no influence on educational outcomes. Students might find that understanding their own learning preferences can be helpful. For instance, if the student knows that visual learning appeals to him/her most, using visual study strategies in conjunction with other learning methods helps in remembering the subject better. VARK provides students with an indication of their preferences for learning and as such it will indicate stronger and weaker preferences. It would be wonderful if students could explore their weaker preferences and enhance them using all the VARK strategies associated with them. A student with a strong read–write preference might learn to use visual strategies for note-taking or expressing his or her learning. A student with a strong visual preference might attend a course to assist with kinesthetic ways of taking information in or for expressing it. Application of VARK also helps them in venturing into unknown areas where the opportunities and challenges are more in terms of learning and growth.

By analyzing the literature in the area of VARK learning styles, there exists a wide gap in the area of microstudy on learning styles of students at the PG and undergraduate levels. Thus, here lies the underlying motivation to take up a study on, 'Alignment of teaching style to learning preferences: impact on student learning' through the identification of the following problems.

Statement of the problem

Everyone has some type of learning style and a different information processing patterns. Once one understands how our brain works best in processing and grasping the information, one feels confident and elated. However, the students fail to make a deep understanding of the concept as they are not aware of their true learning styles. The superficial understandings of the subjects make them struggle in the examination as they come out with poor performance. Once students are no longer struggling with a subject as they know how to prepare for it, they will feel better about themselves and won't be stressed out about tests or papers. Many a times there is no alignment between the teaching style of the teachers and the learning preferences of the students due to which the learning will hardly be effective. Students also will not know their true learning styles and study in a manner their peers are studying which actually may not bring out productive performance from them. Keeping this view in mind, study focuses on the learning style and preferences of students.

Objectives

Keeping the above problem areas in mind, the study, 'Alignment of teaching style to learning preferences: impact on student learning' is carried on with the following objectives.

1. To know the learning style of the students as per VARK.
2. To understand the learning preferences of the students.
3. To know the strength of the learning modes of the students.
4. To find out the relationship between the teaching style and learning preferences of the students.

5. To understand whether the students carry out study habits as per their learning preferences.
6. To understand the relationship between the marks scored by PG and UG students in SSLC, PUC and University exams and their VARK mode.

METHODOLOGY

The study is a micro study and has been confined to Mangalore region of Dakshina Kannada District of Karnataka state, India. The study was conducted in PG departments of the affiliated colleges as well as the UG departments in Mangalore. The responses were received from 250 UG students and 250 PG students. The UG students comprised of engineering graduates from the electrical, electronics, mechanical and civil background. The PG students are comprised from M.Com, MBA, Journalism and MCA background. The sample respondents were interested in finding out their learning style as per VARK and took interest in filling the questionnaire promptly. The VARK questionnaire version 0.7 developed by Fleming (2001) with 16 questions to test the learning styles and preferences was administered to students. The permission was taken from Fleming as the study was making use of the copyright version of the VARK questionnaire developed by him. Along with the VARK questionnaire, another structured questionnaire was also prepared to understand the background of the students. The questions were asked to understand their scoring pattern in SSLC, PUC as well as University marks. The nature of the students in matching their study habits to their learning preferences was also understood. SPSS version 21 was used and *t*-test, chi-square and ANOVA were applied to analyze the data.

FINDINGS AND DISCUSSION

1. Learning style of the students as per VARK, learning preference and the strength of VARK mode: Table 1 states certain important observations such as VARK style, learning style assessed by self and also the strength of VARK style. There is some gap between VARK style according to the study developed by Fleming and the learning style assessed by self in real terms. Respondents who have opted for all four modes of learning such as visual, auditory, reading and kinesthetic learning styles in different combinations were 128, but according to the self-assessment VARK mode was adopted by 64 respondents. Respondents who fell in the category of K, A, R, V were 52, 98, 27 and 03, respectively, through the VARK study though the self-assessment of learning for K, A, R, V comprised of 36, 24, 69 and 44 respondents, which leaves a substantial gap between VARK assessment and self-assessment. There is little research on the quality and reliability of the VARK questionnaire. However, in their review of learning style instruments, Hawk and Shah (2007) note that the VARK model is the only one of five studied that contains the read/write and kinesthetic dimensions. According to the VARK website, 58% of individuals report a match between the questionnaire results and their own perceptions of learning preferences. This finding corroborates the finding of the present study that either there could be some bias by the respondents in responding or as the VARK study takes into account the learning styles in various permutations and combinations, it feels that there is gap in real assessment and VARK assessment of learning style.

The findings also state that 317 respondents were multimodal and 183 respondents were uni-modal with mild, strong and very strong attributes. These results are based on the algorithm developed by Fleming for interpreting the VARK score. It says that if the difference between the scores for the respondent's highest and the next highest mode score is 2, 3, 4 and 5 the preference is 'mild'; the difference score 4, 5, 6 and 7, the preference is 'strong'; and the difference score 6, 7, 8 and 9, the preference is 'very strong' viz-a-viz the total VARK score that lies between 14 and 21, 22 and 27, 28 and 32 and 32 and above, respectively. VARK scoring system is preferable to those of other learning style inventories. According to Boatman *et al*. (2008), as the study distinguishes between mild, strong and very strong preferences, we can assess the importance not only of learning style preference, but also of preference strength. Second, the scoring system identifies respondents with multimodal preferences,

Table 1: Frequencies on VARK style, learning style (self), and the strength of VARK mode

VARK Style	Frequency	Per cent	Self style	Frequency	Per cent	Strength of VARK mode	Frequency	Per cent
AK	1	0.2	A	24	4.8	Multimodal	317	63.4
K	52	10.4	AK	20	4.0	Mild 'A'	68	13.6
A	98	19.6	AR	10	2.0	Mild 'K'	42	8.4
AK	28	5.6	AV	2	0.4	Mild 'R'	24	4.8
AKR	8	1.6	K	36	7.2	Mild 'V'	1	0.2
AKRV	17	3.4	KA	4	0.8	Strong 'A'	10	2.0
AKV	7	1.4	KV	1	0.2	Strong 'K'	20	4.0
AKVR	27	5.4	R	69	13.8	Very strong 'A'	15	3.0
AR	13	2.6	RK	18	3.6	Very strong 'R'	3	0.6
ARK	18	3.6	RV	1	0.2	Total	500	100.0
ARKV	23	4.6	V	44	8.8			
ARVK	9	1.8	VA	44	8.8			
AV	2	0.4	VAK	18	3.6			
AVK	1	0.2	VAR	29	5.8			
AVKR	6	1.2	VARK	64	12.8			
AVR	2	0.4	VK	39	7.8			
AVRK	7	1.4	VR	72	14.4			
KA	14	2.8	VRK	5	1.0			
KAR	6	1.2	Total	500	100.0			
KARV	18	3.6						
KAV	3	0.6						
KAVR	4	0.8						
KR	7	1.4						
KRA	4	0.8						
KRAV	8	1.6						
KRVA	7	1.4						
KVA	7	1.4						
KVAR	9	1.8						
R	27	5.4						
RAK	4	0.8						
RAKV	2	0.4						
RAVK	8	1.6						
RK	3	0.6						
RKA	3	0.6						
RKAV	7	1.4						
RKVA	6	1.2						
RVAK	6	1.2						
RVKA	1	0.2						
V	3	0.6						
VA	5	1.0						
VAK	5	1.0						
VARK	4	0.8						
VK	1	0.2						
VKA	5	1.0						
VRK	3	0.6						
VRKA	1	0.2						
Total	500	100.0						

rather than forcing them into a particular category. This scoring feature adds a subtle dimension to the inventory that is lacking in other learning style assessment methods. Thus, the present study has categorized respondents based on their preference toward 'mild,' 'strong,' and 'very strong' as well as multimodal preference.

2. Outcome of the learning habits of PG and UG students of affiliated colleges in Mangalore: From the survey conducted in engineering college as well as M. Com and MBA colleges and the output shown in Table 1, 183 students [(91 males and 92 females) 36.6%] preferred uni-modal learning. Among the uni-modal learners, 21(11.48%) students preferred visual, 47(25.68%) preferred auditory, 55(30.05%) preferred read–write mode, and 60 (32.79%) preferred kinesthetic mode of learning. Three hundred and seventeen students [(138 males and 179 females) 63.4%] preferred multimodal learning. Among the multimodal learners, 128 (40.37%) students preferred bi-modal, 117 (36.90%) preferred tri-modal and 132 (50.67%) preferred quadri-modal learning. Gender differences were not observed in the learning style preferences. Unlike the study conducted by Wehrwein *et al.* (2007), we did not find any gender differences in either the learning style or the performance. In the Class 10 or equivalent examination, the mean (±SD) percentage of marks obtained by students who preferred uni-modal, bi-modal, tri-modal and quadri-modal learning was 85.63(±8.60), 84.33(±7.99), 86.45(±8.61) and 84.82(±10.80), respectively. In the Class 12 or equivalent examination, the mean (±SD) percentage of marks obtained by uni-modal learners and multimodal learners was 81.70(±10.18) and 82.17(±11.08), respectively. In the university part I examination, the mean (±SD) percentage of marks obtained by students who preferred uni-modal learning and multimodal learning was 72.01(±7.20) and 70.93(±9.55), respectively. Since (F = 0.904; df = 3 P = 0.439 >0.05), (F = 1.351; df=3; P=0.257 >0.05) and (F = 1.599; df = 3; P = 0.189 >0.05), there is no statistical significance and relationship between the learning style preference and the performance in all the three previous examinations that were considered in the present study.

3. Relationship between the teaching style and learning preferences of the students: With a view to understanding the relationship between the teaching style and the learning preferences of the Students' independent sample t-test and chi-square tests are applied and the output is depicted in Tables 2 and 3.

An independent sample t-test was applied to understand the relationship between the learning preferences of the students and the teaching styles of the teachers.

Table 2: Group statistics

	Uni-modal or multimodal	*N*	Mean	Std. Deviation	Std. error mean
Matching teaching styles to	Unimodal	183	1.5683	0.49667	0.03671
learning preferences	Multimodal	317	1.4164	0.49374	0.02773

Table 3: Independent samples *t*-test showing the relationship between the teaching styles to learning preferences

		Levene's test for equality of variances		*t*-Test for equality of means						
		F	Sig.	*t*	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
									Lower bound	Upper bound
Matching teaching styles to learning preferences	Equal variances assumed	0.417	0.519	3.307	498	0.001	0.15190	0.04594	0.06165	0.24216
	Equal variances not assumed			3.301	378.033	0.001	0.15190	0.04601	0.06143	0.24237

Output from Table 2 shows that the mean value of the uni-modal learning preferences is on the higher side, i.e. 1.5683 ±0.49667, compared with the mean value of multimodal learning preferences (1.4164 ± 0.49374). The *t*-test findings from Table 3 show that $t = 3.307$; df = 498; $P = 0.519$; $\alpha = 0.01$; $P = 0.519 > 0.05$, which indicates there is no significance between the learning preferences of the students and the teaching style of the teachers. This also shows that the teaching style of the teachers do not match with the learning preferences of the students. Though the teaching style encompasses not only the lecture but also audio, visuals and kinesthetics, it does not satisfy all categories of students with different learning preferences.

However, this had to be substantiated by Pearson chi-square test to authenticate the finding. Out of 500 student respondents, 183 were uni-modal and 317 were multimodal, i.e., 70 were bi-modal, 78 were tri-modal and 169 were quadri-modal (Table 4). In the present study, the number of students opting for multimodal is more than those opting for uni-modal learning preference. Hence, the test results prove to the fact that students are happy with the teaching styles adopted by the teachers.

To understand the association between the learning preferences and teaching style the chi-square test was applied. The output is shown in Table 5. Pearson chi-square (χ^2) =10.520; df = 3; $\alpha = 0.05$; $P = 0.015 < 0.05$, which shows that there is a statistically significant association between learning preferences and teaching style of teachers.

Table 6 shows the descriptives on learning preferences, viz., Uni-modal, Bi-modal, Tri-modal and Quadri-modal. With a view to further understand the relationship between the learning preferences and the teaching style of the teachers, ANOVA was applied and the output is shown in Table 7.

The output from ANOVA in Table 7 shows that *F* value is 3.553, df = 3 and the *P* value is 0.014, which is lower than the alpha ($\alpha = 0.05$) and thus the results are significant. ANOVA also corroborates the fact that there is a relationship between the learning preferences of the students and the teaching style adopted by the teachers.

Table 4: Cross tabulation of teaching styles to learning preferences

		Matching teaching styles to learning preferences		Total
VARK mode	Uni-modal	79	104	183
	Bi-modal	40	30	70
	Tri-modal	43	35	78
	Quadri- modal	101	68	169
Total	264	236	500	

Table 5: Chi-square test showing the association between teaching styles to learning preferences

	Value	df	Asymp. Sig. (2-sided)	Monte Carlo Sig. (2-sided)			Monte Carlo Sig. (1-sided)		
				Sig.	95% confidence interval		Sig.	95% confidence interval	
					Lower bound	Upper bound		Lower bound	Upper bound
Pearson chi-square	10.520[a]	3	0.015	0.015[b]	0.012	0.017			
Likelihood ratio	10.544	3	0.014	0.015[b]	0.013	0.017			
Fisher's exact test	10.485			0.015[b]	0.013	0.017			
Linear-by-linear association	8.931[c]	1	0.003	0.004[b]	0.003	0.005	0.002[b]	0.001	0.002
N of valid cases	500								

a. 0 cells (0.0%) have expected count less than 5. b. The minimum expected count is 33.04.

Table 6: Descriptive on learning preferences

	N	Mean	Std. deviation	Std. error	95% Confidence interval for mean		Minimum	Maximum
					Lower bound	Upper bound		
Uni-modal	183	1.5652	0.49708	0.03665	1.4929	1.6375	1.00	2.00
Bi-modal	70	1.4286	0.49844	0.05958	1.3097	1.5474	1.00	2.00
Tri-modal	78	1.4416	0.49983	0.05696	1.3281	1.5550	1.00	2.00
Quadri-modal	169	1.4024	0.49183	0.03783	1.3277	1.4771	1.00	2.00
Total	500	1.4720	0.49972	0.02235	1.4281	1.5159	1.00	2.00

Table 7: ANOVA showing relationship between teaching styles to learning preferences

	Sum of squares	df	Mean square	F	Sig.
Between groups	2.622	3	0.874	3.553	0.014
Within groups	121.986	496	0.246		
Total	124.608	499			

4. Understanding the link between study habits and the learning preferences: With a view to understand whether the students practice the study habits according to their learning preferences the chi-square test was applied. Table 8 shows the cross tabulation of study habits to learning preferences. From the output shown in Table 9, Pearson chi-square (χ^2) =2.422; df = 4; $\alpha = 0.05$; $P = 0.659 > 0.05$, which shows that there is no statistically significant association between study habits and learning preferences of students. Out of 500 student respondents, only 215 students have agreed that their study habits matched to their learning preferences. Out of these 215 students, 84 students preferred uni-modal form of learning and they stick to matching their study habits to their learning preference. The remaining 131 students who preferred multimodal learning preferred to study through multimodalities such as seeing the visuals, listening to lectures, reading and writing and also by following kinesthetics. The remaining majority of 285 students have declined to say that their study habits match with the learning preferences of them. Out of 285, 99 students had uni-modal and 186 had multimodal form of learning. To corroborate the findings further, the independent sample *t*-test was also applied and the results are depicted in Table 11.

Output from Table 10 shows that the mean value of the uni-modal learning preferences is on the higher side, i.e., 3.1967 ± 1.34842 compared with the mean value of multi modal learning preferences (3.0599 ± 1.30707). The *t*-test findings from Table 11 shows that $t = 1.114$; df = 498; $P = 0.411$; $\alpha = 0.05$; $P = 0.411 > 0.05$, which indicates there is no significance between the study habits and learning preferences of the students. Thus it can be concluded that the students are not taking attention of their learning preferences due to which the performances of the students might get affected. However, with a view to understand further whether the learning preferences have any impact in scoring in three major examinations, namely SSLC, PUC and Graduation, ANOVA was applied.

5. Impact of learning style on marks scored by PG and UG students in SSLC, PUC and University exams: ANOVA was applied to understand whether learning preferences such as uni-modal, bi-modal, tri-modal or quadri-modal has any impact at all in the performance of the respondent candidates. The mean value of all the three examination marks of all 500 student respondents was calculated for the purpose. The results of ANOVA are shown in Table 12.

Since ($F = 0.813$; df = 3; $P = 0.487 > 0.05$), there is no statistical significance; thus, we can conclude that the students scoring in the examination is due to other factors other than the learning preferences. Thus, no matter whatever is the learning preference of the student the performance in the examination may not get affected. Whether the student performance in the examinations

Table 8: Cross tab showing the study habits and learning preferences of the students

		Uni-modal or multimodal		Total
		Uni modal	Multimodal	
Matching study habits to learning preferences	Strongly disagree	21	35	56
	Disagree	47	99	146
	Neutral	31	52	83
	Agree	43	74	117
	Strongly agree	41	57	98
Total		183	317	500

Table 9: Chi-square test showing matching study habits to learning preferences

	Value	df	Asymp. Sig. (2-sided)	Monte Carlo Sig. (2-sided)			Monte Carlo Sig. (1-sided)		
				Sig.	95% confidence interval		Sig.	95% confidence interval	
					Lower bound	Upper bound		Lower bound	Upper bound
Pearson chi-square	2.422[a]	4	0.659	0.667[b]	0.658	0.676			
Likelihood ratio	2.424	4	0.658	0.668[b]	0.659	0.678			
Fisher's exact test	2.460			0.661[b]	0.652	0.670			
Linear-by-linear association	1.241[c]	1	0.265	0.276[b]	0.267	0.285	0.144[b]	0.137	0.151
N of valid cases	500								

a. 0 cells (0.0%) have expected count less than 5.b. The minimum expected count is 20.50.

Table 10:Group statistics

	Uni-modal or multimodal	*N*	Mean	Std. deviation	Std. error mean
Matching study habits to learning preferences	Unimodal	183	3.1967	1.34842	0.09968
	Multimodal	317	3.0599	1.30707	0.07341

Table 11: Independent sample *t*-test showing relationship between the study habits and learning preferences of students

		Levene's test for equality of variances		*t*-Test for equality of means						
		F	Sig.	*t*	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
									Lower bound	Upper bound
Matching study habits to learning preferences	Equal variances assumed	0.678	0.411	1.114	498	0.266	0.13678	0.12276	–0.10441	0.37798
	Equal variances not assumed			1.105	370.249	0.270	0.13678	0.12379	–0.10664	0.38021

was influenced by the size of the class was also tested with the help of the independent sample *t*-test and the output is shown in Table 14.

The results from Table 13 show that the mean value of the students preferring to learn in class less than or equal to 30 is on the higher side, i.e., 79.6992 ± 6.84048, compared with the mean value of the students (77.6914 ± 6.29426) who prefer bigger class of more than 30 strength. Only 21 students out of 500 have chosen to learn in a bigger class. The *t*-test findings show that t=–1.321; df = 498; P = 0.519; α = 0.05; P = 0.718 > 0.05, which indicates there is no significance between the size of the class and the marks scored by the students.

Observations derived from the findings:

- There may not be proper alignment between the teaching style of the teachers and the learning preferences of the students though statistical association may be there between them.
- There may be less correlation between the learning style of the students identified through VARK and learning style identified by self.
- The strength of the learning modes does not have impact on student learning and performance.
- There is no relationship between learning style of the students and the study habits followed by them.
- There is no relationship between learning style of the PG and UG students on marks scored in SSLC, PUC and University exams by them.
- The size of the class is not an influencer in impacting the performance of the students.

DISCUSSION

Learning habits of the students vary as per the preferences of the students. In a class where the teacher's focus is mainly to cover and uncover the modules in the particular course, the delivery pattern might not match the expectation of the students in terms

Table 12: ANOVA showing relationship between the learning style of the students and the mean marks

	Sum of squares	df	Mean square	F	Sig.
Between groups	113.728	3	37.909	0.813	0.487
Within groups	23126.365	496	46.626		
Total	23240.093	499			

Table 13: Group statistics

	Class strength to learning preference	*N*	Mean	Std. deviation	Std. error mean
Mean marks of 3 exams	More than or equal to 60	21	77.6914	6.29426	1.37352
	Less than or equal to 30	479	79.6992	6.84048	0.31255

Table 14:Independent sample *t*-test showing the relationship between the size of the class and the marks

		Levene's test for equality of variances		*t*-Test for equality of means						
		F	Sig.	*t*	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
									Lower bound	Upper bound
Mean marks of 3 exams	Equal variances assumed	0.131	0.718	–1.321	498	0.187	–2.00774	1.52038	–4.99489	0.97942
	Equal variances not assumed			–1.425	22.122	0.168	–2.00774	1.40863	–4.92812	0.91265

of their learning preferences. However, there is an association between the teaching habits and the learning preferences of the students; therefore, the performance is shown as a mark of positive outcome. The performance in the examination of the students is influenced by their art of recollection of the subject content and reproduction capacity. Thus, the parameters such as teaching style, learning habits, learning preferences and class size are not the causative factors in influencing the output of the students.

CONCLUSION

The learning in the preferred style makes learning easier and more fun. It will have a positive effect on performance of the students. Research has proved that if learning is made pleasurable, the performance in examinations will improve. However, no learning style is superior as it hardly plays a role in influencing the performance of the students. This study reiterates that understanding one's learning style makes the learning effective and meaningful. Combining the learning styles or using the learning styles independently will definitely ensure the desired result of better assimilation as well as fruitful results in the examination.

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