Impact of VARK Learning Model at Tertiary Level Education

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Abstract—Individuals are generally associated with different learning styles, which have been explored extensively in recent past. The learning styles refer to the potential of an individual by which s/he can easily comprehend and retain information. Among various learning style models, VARK is the most accepted model which categorizes the learners with respect to their sensory characteristics. Based on the number of preferred learning modes, the learners can be categorized as uni-modal, bi-modal, tri-modal, or quad/multi-modal. Although there is a prevalent belief in the learning styles, however, the model is not being frequently and effectively utilized in the higher education. This research describes the identification model to validate teacher's didactic practice and student's performance linkage with the learning styles. The identification model is recommended to check the effective application and evaluation of the various learning styles. The proposed model is a guideline to effectively implement learning styles inventory in order to ensure that it will validate performance linkage with learning styles. If performance is linked with learning styles, this may help eradicate the distrust on learning style theory. For this purpose, a comprehensive study was conducted to compare and understand how VARK inventory model is being used to identify learning preferences and their correlation with learner's performance. A comparative analysis of the findings of these studies is presented to understand the learning styles of tertiary students in various disciplines. It is concluded with confidence that the learning styles of students cannot be associated with any specific discipline. Furthermore, there is not enough empirical proof to link performance with learning styles.

Keywords—Learning style, VARK, sensory preferences, identification model, didactic practices.

I. INTRODUCTION

THE theory of learning styles has been controversial in the literature as some of the researchers are in favor of the concept while the others are against it. The basis for the use of learning styles is that individual differences between learners can supposedly be captured through different experiments, which can classify learner into different styles. For such student centric learning, it is essential to accommodate all the students with different leaning preferences. In tertiary education, students are adults and need to understand their learning preferences in depth to take control of the learning process. It is also necessary that the teachers understand the learning preferences of their students so that they can cater all of the students based on their preferred learning modalities. It is important that the teachers facilitate their students to become expert learners instead of using passive teaching

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approach.

According to many, but not all, interpretations of learning style theory, teaching individuals using the approaches which match the theory of learning style will result in improved learning [1]-[4]. There have been 70 different parameters which are studied to analyze the learning styles; however, very few of these have been utilized in practice, thus igniting the controversy. There have also been studies which do not support the learning styles [5], [6] with a point of view that this may have the pigeon hole effect on the learner. They provide several reasons against the effectiveness of the theory, such that, the students may become overconfident of their ability to master the subjects which are perceived as matching to their learning style, or it is also possible that the diagnosed style does not match the actual preference of the learner, or having unrealistic expectations form the teachers to cater every student's learning styles.

There are many examples where the teachers believe in learning styles and have the opinion that teaching according to individual style can help improve learners' performance. However, in practice very few of these teachers actually use the learning styles in their lectures [5]. Teachers have to be creative in instructional design and pedagogy for creating effective teaching and learning environment which caters all of the learning preferences.

Fleming and Mills suggested four modalities that reflect the experiences of both the teachers and the students [7]. However, this study focused on the learning styles of the students and the impact of these styles on their performance. The modalities discussed by Fleming and Mills [7], as shown in Fig. 1, include, visual (V), aural/auditory (A), reading/writing (R), and kinesthetic (K).
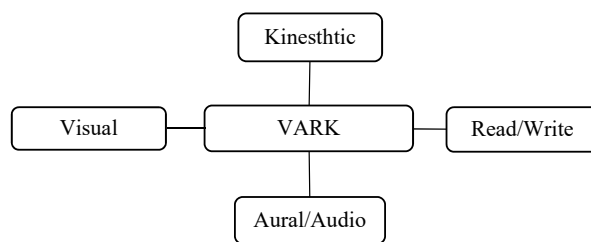

Fig. 1 The VARK model of the learning styles

The visual learners prefer graphic information including figures, maps, charts etc. The aural/auditory learners prefer to learn through lectures, group discussions, self-talk etc. The third modality is reading/writing in which the learners focus

on text based data such as, reports, lecture notes, journals. The last modality of VARK is kinesthetic where the learners prefer demonstration, simulations, case studies, practical etc. These learning styles are summarized in Table I along with a few technical and non-technical examples.

TABLE I
VARK LEARNING STYLES WITH EXAMPLES

Learning Styles	Non-Technical Examples	Technical Examples
V (Visual)	Charts, graphs, symbolic figures, maps, pictorial representations, posters	Videos, spreadsheets, data visualizer, mind maps
A (Aural/ Audio)	Lecture, group discussions, self-talk and talking out, interview, stories, discussion topics and ideas.	Radio, webinars
R (Reading/ Writing)	Text based input: Books, notes, quotations, lists, diaries, journals, reflections, essays, manuals	PowerPoint, research articles, blogs and e-news
K (Kinesthetic)	Working on project, practical demonstration, case studies, performance, role playing	Programming, Computer aided design

Students usually do not have a single learning style; they may require more than one sensory modality for information processing. Multi-modal learners can be categorized as bi-modal, tri-modal or quad-modal with several different combinations for preferred learning styles as described in Table II.

TABLE II
VARIOUS CATEGORIES OF THE MULTIMODAL LEARNING STYLES

Modes	Description
Bi-modal	Visual and Auditory (VA) Visual and Reading/Writing (VR) Visual and Kinesthetic (VK) Auditory and Reading/ Writing (AR) Auditory and Kinesthetic (AK) Reading/Writing and Kinesthetic (RK)
Tri-modal	Visual, Auditory and Reading/Writing Visual, Auditory and Kinesthetic (VAK) Visual, Reading/Writing and Kinesthetic (VRK) Auditory, Reading/Writing and Kinesthetic (ARK
Quad-modal	Visual, Auditory, Reading/Writing, and Kinesthetic (VARK)

To evaluate learning styles of the students, VARK inventory or questionnaires are used. These questionnaires determine a person's sensory preferences for information processing. Numerous research studies endorsed the idea of using learning styles for improved outcome in higher education [4]-[6], [13], but very few provide the empirical evidence. These studies only identify the learner styles and report them which is not enough. It is vital that educators understand positive association of learning styles theory with leaner's performance. For this purpose, this research has been conducted to show that there is not enough empirical evidence of learner styles linkage with performance. The study also proposed the identification model as a guide to link learning styles effectively with learner's performance.

II. LITERATURE REVIEW

The lack of empirical evidence of performance linkage ignites the debate on the use of learning styles. The researchers against the theory argue that if students are labeled with a specific learning style, this can reduce their ability of learning by categorization, or may bias them to pursue career as directed by specific learning preference. This is why the findings of these research studies are compared to understand the learning styles of tertiary student in various disciplines. This can help understand if students can be associated with any discipline or career using leaning styles.

Fleming provided the case studies of teachers and students who benefited for VARK instrument [8]. Fleming suggested that students changed the learning approach after identifying their learning styles and it improved their learning process and performance. Lanham stated that VARK model can also help cognize one's communication preferences, which leads to achieve set goals [9].

To understand learning preferences of dentistry students, mixed study was conducted in India by Sharma et. al. According to their findings, undergraduate students of dentistry prefer multimodal when analyzed to understand the learning style using VARK questionnaire [10].

Kim et al. did multi-institutional study to examine the learning preferences of surgery residents in comparison with other students [1]. For this purpose, multiple-choice questions were developed using Fleming's VARK inventory. They have reported a clear difference between learning styles of general population and surgery resident students.

Nasiri et al. used VARK questionnaire to identify the relationship between student's final exam score, gender, grade level with respect to their learning style. The participants for the study were chosen of dental higher education [2]. There was no significant relationship found between student's grade level, gender and learning style preferences. According to their findings, students preferred multimode for learning as 98.9% use multiple learning style for their learning. With respect to the final exam score, in this study, students with visual learning styles had better performance. One of the reasons of these findings can be the teaching method compatibility with students' style. As mentioned in this study, the instructors used teaching methods including educational videos and power point slides, which were more suited for the visual learners. The authors did not discuss if teachers use or try to incorporate different modalities in their pedagogy to cater student of all learning style and its effect on their academic performances.

In one study, Asiry administered VARK questionnaire to determine learning preferences of dental students in Saudi Arabia [11]. The author concluded that leaning preferences do not change throughout their undergraduate studies. The VARK questionnaire importance is emphasized for identification of students' learning styles. It has been established that teachers as well as students should understand students learning strategies for professional studies for provision of better leaning environment and for instructional design.

According to Klement, the students of education preferred the kinesthetic learning style [12]. This study also analyzed the gender bias and concluded that both men and women have

same proportional representation for the preferred learning style.

Prithishkumur and Michael used quantitative approach to examine learning preferences of medical undergraduate students using VARK questionnaire [13]. They have concluded that multiple means of representation need to be incorporated in instructional design because according to their findings more students were multi-modal than uni-modal. Good et al. identified the learning modalities of health professional students and suggested that student motivation positively enhanced when students recognized their learning styles [14]. The study suggested that VARK is a significant teaching tool and also helps enhance performance.

Stirling and Alqurani used VARK inventory to identify learning styles of Saudi Arabia nursing students. They established that learning style of middle east nursing students were not different form the western students except middle east students are more inclined towards kinesthetic than western students [15].

Individual students store and process information in different ways, this may be the reason that learning styles need to be catered so that academic performance of students can be improved by providing information in their favored learning modality. Arbabusarjou et al. conducted the study to determine the relationship between academic performance and learning style of medical students using VARK learning style standard questionnaire [3]. The notion has been dismissed by provided statistical results.

Marcy analyzed student responses towards learning style and the medium that helps identify their learning styles such as VARK inventories [16]. According to their findings, students found the questionnaire and inventories very helpful to identify their learning styles and also the process very easy. Student participants also claimed that the identification of learning styles and its incorporation in their studying method improved their learning. The participants of this study were first year Physician Assistance (PA) students.

Marie and Maxilom identified the preferences of learning styles and multiple intelligence of business studies students using quantitative method and proposed that curriculum design, workbooks, teaching materials need to be catered according to student needs [17]. According to their findings, business students prefer four intelligences, such as, intrapersonal, bodily-kinesthetic, naturalistic and interpersonal intelligences, and reading/writing the most among VARK learning styles. This study provided evidence that students have preferred learning style in higher education but it does not provide any information if these needs are being catered in the recent pedagogical methods used by their teachers.

Zapalska and Brozik emphasized on the use of VARK instrument to enhance learning process in online learning environment [18]. For this purpose, VARK instrument was used to understand macro-economic students. Learning preferences was understood of the participants for selecting online courses. It is established that VARK instrument can be very helpful to understand students' learning preferences. Therefore, it can be used in online courses to identify student specific learning styles and instructor should share information with students regarding their learning style. The authors concluded that online courses should carter the needs of all student preferences by providing information through various options.

Young and Seibenhener tried to understand the students' preferred teaching strategies in nursing programs. They used quantitative pilot study to understand the learner's preference of instructional strategies [19]. They considered various strategies such as traditional, flipped classroom model, online activities, and guest lectures with inter-collaborator approach. They used VARK questionnaire to understand student-learning styles of 90 nursing students. The findings helped design the instructions to deliver nursing education. It has been established that instead of traditional static didactic approach, students' preferred learning styles need to be incorporated in nursing education for effective learning and teaching environment.

Haq et al. analyzed the learning preferences of medical and dental students using VARK questionnaire [20]. They have concluded that learning style knowledge can help student develop metacognition abilities required in the professional study and teacher in expanding their didactic experience and better outcome. In their analysis they have found that majority of the medical and dental students have uni-modal preference in learning style whereas very few has multimodal so teacher needs to integrate multiple strategies to accommodate all learners in their classroom.

Ictenbas and Eryilmaz determined learning preferences of engineering students using VARK questionnaire [21]. They stated that the learning outcome of the students can be influenced positively if the instructors incorporated different learning styles in their lectures. Learning styles identification provides guideline for effective didactic strategies. The VARK questionnaire is administered to identify learning styles of three engineering disciplines i.e. computer engineering, manufacturing engineering and mechatronics engineering. They have concluded that with respect to engineering discipline, learning preferences vary, so teachers need to assimilate various ways to provide instructions with so all students' learning styles can be accommodated.

According to Moayyeri, learning styles in different disciplines vary significantly [4]. Author analyzed the relationship between different fields of study and learning styles. Author also identified the relationship of language acquisition ability with learning style by administering VARK questionnaire on students who are in different disciplines but are learning English as Foreign Language (EFL). He established a significant link between learning styles and language achievement; especially if students have reading style, their language achievement is better than those who have other learning styles.

Newton and Miah used survey-based approach to find out how use and belief differ in learning style at higher education level [5]. According to their founding 58% teachers believe in learning style but only 33% actually incorporate learning style in their learning strategies. Student perception of learning style

and their own perception and use of learning style at higher education is also very important, which is not discussed in this study.

Hawk and Shaw reviewed five learning style tools including VARK, Kolb experiential model, Felder-Silverman's model, the Gregorc Style, Delineator and Dunn and Dunn productivity environmental preference tool [22]. They discussed the evidence of validity of the mentioned tools. According to review, VARK is sensory/perception model with moderate evidence of reliability and validity. Leite et al. assessed the reliability and validity [23]. The validity was examined through confirmatory factor analysis and it reveals adequate reliability and evidence of validity. When Rasch analysis was used to assess the validity of sub-scale of VARK tool for under-graduate students, it confirmed the invariability of the tool across age gender and educational context [24].

Othman and Amiruddin discussed the significance of VARK model in teaching and learning process in detail [25]. VARK model has been explained in terms of enhancing student cognitive ability by providing information in students' preferred sensory modality. Cognitive, affective, psychological and physiological aspects have been discussed with respect to learning styles.

Varlerdi et al. explored the learning preferences of graduate engineering students using VARK survey questionnaire as an instrument [26]. They suggested that just understanding about learning preferences is not enough but changing the student studying method on basis of finding can be useful for learning outcome. Teachers also need to understand their own leaning preferences because they often use their way of learning in their teaching process to reach the student with learning difficulties.

Gilakjani stated that English as a Foreign Language (EFL) university student's sensory preference for information was visual [27]. The author stressed on the significance of learning styles in the learning and teaching process for effective learning outcome. In this study Perceptual Learning Style Preference Questionnaire (PLSPQ) was used as an instrument. This instrument identifies visual, auditory and kinesthetic preferences but do not identify the read/write preferences, which can be vital for learning language as established by [4]. The reason for using the PLSPQ instrument described by author was that it is easy and quick to administer and interpret and its validity and reliability is supported by the research.

Fleming and Baume provided the origin, development, use of VARK help-sheet and survey [28]. They also provided the new development in the VARK questionnaires and help sheet to improve it. VARK is provided in several languages and it is also being improved with time [28]. Assessment and incorporation of learning preferences can impact students' learning choices significantly [29]. Knowing one's learning style is essential to improve the learning process which can have a positive impact on the performance. Identification of the learning styles can help in exploring how the learners like to be taught. Although VARK model can help in understanding how the individuals like to communicate in leaning process, it does not reflect the quality of communication [28]. This is why, to incorporate learning styles, identification of teacher's instructional approach and quality of communication need to be identified [5].

III. METHODOLOGY AND RESULTS

To identify learning styles of tertiary level students of various disciplines, extensive analysis has been done using the data and results reported by several reputed researchers. The criteria for the selection of article was to find related studies which used VARK inventory to identify students' learning styles as it is the most accepted learning style model. VARK questionnaire has been validated by researchers [7], and it is not specific for certain discipline. The analysis was focused on the tertiary level [30] with the following considerations:

- Teachers in tertiary level have research expertise and are more familiar with current literature.
- It is argued that learning styles restrict students to certain disciple [6].

In higher education the disciplines selected for this study are medical and surgery, engineering, nursing, dentistry, social and basic sciences students.

Only peer reviewed research studies were considered. Following things were considered for the search result:

- Full English text available without any cost.
- Learning style
- Participant belong to higher education
- VARK model is being used
- Uni-modal and multi-modal findings are reported
- The positive view towards theory
- The negative view towards theory
- Learning styles linked with performance
- Guidelines to link performance with learning style

For this study, 15 research studies were selected keeping the above mention criteria in mind. The study also compares how the performance is linked with learning styles and also the description of learning styles using multimodal VARK.

Comparison of VARK Findings for Uni-Mode

For dentistry, the students mostly learn through practical work, so they are categorized as kinesthetic learners [10], [11], [20]. However, Nasiri et al. report that 1.1% students are aural learner and the rest lie in the multi-modal category [2].

For uni-modal, in surgery most of the students are kinesthetic learners however several lie in aural spectrum [1]. According to [1], [2], most medical students are kinesthetic learners. In another study, the findings state that most medical students are read/write learners [3].

For the nursing domain, in [15], [19] most of the students are kinesthetic leaners. However, in [16] most students fall in the multimodal learning style, as shown in Table III.

For mechatronics and manufacturing engineering, most of the learners lie under aural learning style [21], whereas one study shows that most of the students 36.6% are read and write learner [4]. According to [21], computer-engineering students are equally distributed as aural, kinesthetic, read and write, that is 19.7 %. Rest of the student lies under multimodal spectrum.

For social and basic sciences, 50.8% education students are kinesthetic learners, whereas, 40.5% business students, 79% humanities students, and 33.3% basic sciences students are R/W learners [17], [4].
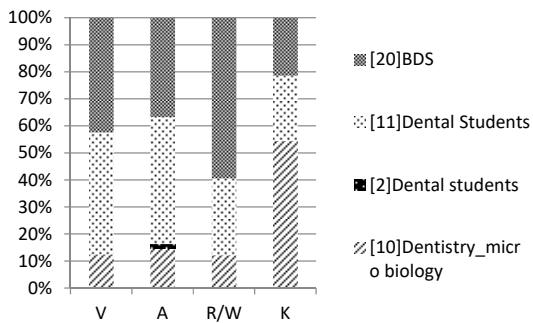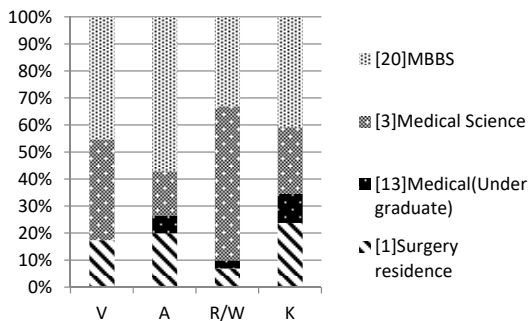

Fig. 2 Learning Styles of Dental Students

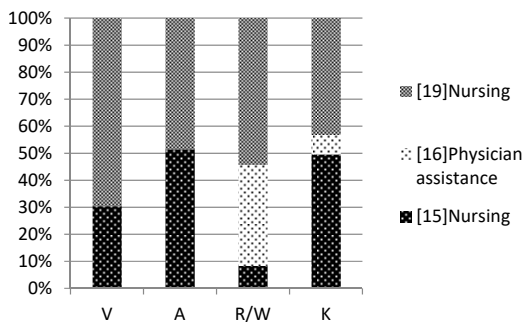Fig. 3 Learning Styles of Surgery/Medical Students

Fig. 4 Learning Styles of Nursing Students

Comparison of VARK Findings for Multi-Mode

In one of the studies [18], 100% of the business students were identified as multimodal, where they learn through multiple modes. However, these results contradicted to [17]. Similarly, in nursing studies, for multimodal learning style, study results are highly contradictory, 72% students are multimode learners [16]. But other studies' findings say otherwise; 18.9% and 43.9% [19], [15].

For the engineering disciplines, [21] reports that computer engineering students are 27.9% multimodal, manufacturing engineering students are 13.6%, and the mechatronics engineering students are 29.2% multimodal. For social sciences students, multimodal was not identifies in reviewed research [5], [15]. For medical students [13], [3], [20] 86.8% 17.7% 14.9% are identified as multimodal learners with respect to learning styles whereas for surgery 61% students are multi-modal [1]. Dentistry students' learning style as multimodal varies widely 56.82%, 87%, 58.4%, 30.7% in different studies [10], [2], [11], [20].
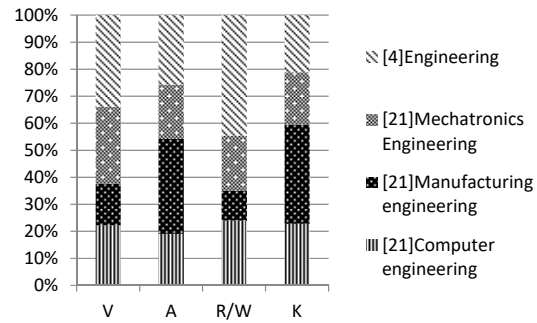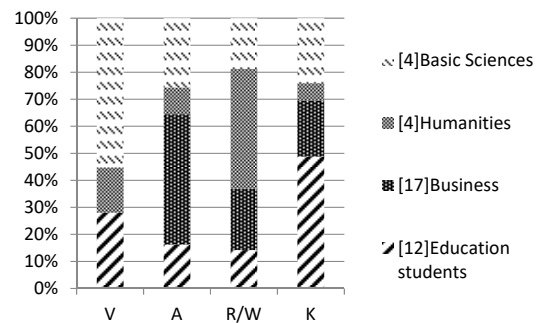

Fig. 5 Learning Styles of Engineering Students

Fig. 6 Learning Styles of Social Sciences Students

IV. DISCUSSION AND RECOMMENDATION

The findings of this comparative analysis show that in tertiary education, learning styles vary significantly among different disciplines, such as, engineering, medicine, dentistry, nursing and social sciences. It is also seen that in the same discipline students' learning preferences are different, as explained in the results section and shown in Figs. 2-6 and Table III. This finding provides the insight that students of same discipline may have different learning styles, thus contradicting the concern shown by [29] about restricting students to a certain discipline or subject. Moayyeri states that certain disciplines have specific learning styles [4]. However, the results clearly show that in the same discipline learners like to learn in different ways. This is why teachers need to be creative and provide instruction considering all learning modalities. If teachers use multimodalities in their class, all learner needs can be addressed. Felder suggested balanced instructional approach on each of the learning style dimension [31].

Although there are a lot of literature that discusses the

effectiveness of learning style, many researches consider learning styles as myth, despite the fact that 33% of teachers identify and cater learning styles of students in their pedagogy [5], [6], [32]. The researchers who are against the theory of learning styles base their conclusion on the lack of evidence regarding the effectiveness of the learning styles [6]. However, Fleming argues that knowing ones learning style is not harmful to anyone and may help many students in improved learning approach [33]. He suggested, when students understand their learning style, they can demand variety in instructional designing that helps their needs [33]. For professional education, learning style examination is significant in development of personalized instruction [34]. Once teachers understand needs of each learner in their classroom, then they can provide balanced instruction [35]. This leads to multi-instructional approach, which is always more fruitful in teaching and learning process [36], [37]. If learning styles of individuals are considered by teachers and students themselves, they have constructive result with respect to student's performance [3], [38]. So it is important to determine the link of learning styles on performance for validating its usefulness. But in the reviewed literature only few papers [1]-[4] identify learning styles of student and linked them with performance whereas only [2], [3], [14] provided statistical proof. The identified learning styles of the same discipline varied tremendously in reviewed researches, it may also be required that sample size for identification of learning preferences should be large enough to understand specific disciplines' student learning style. In reviewed literature [10], [2], [4], [16]-[18] have sample size less than 90. It is also important to identify multiple learning preferences, because students mostly have more than one learning preferences, but in reviewed literature [3], [4], [12], [15]-[17], [20] only uni-modal learning styles are identified.

The literature emphasized that learners have inconsistent learning preferences. Learning preferences fluctuate with respect to concepts and disciplines [39]. Thus learners' styles of any discipline cannot be assumed by teachers. Additionally, teachers often believe in learning style positive association with performance but they do not incorporate it in their teaching practice [5]. Research has shown that learning style helps improve learning outcome [1]-[4]. For self-directed learning, if the learners are able to identify their learning preferences then they can understand the concepts more effectively [40]. For educational application of learning style, experimental approach needs to be used including fundamental vital criteria [41]. We recommend the identification model as shown in Fig. 7 to validate teacher didactic practice and student's performance linkage with learning styles. The model has been explained below.
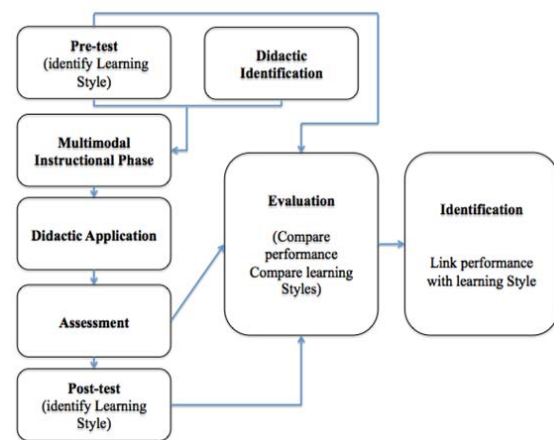

Fig. 7 Recommended model for identification

TABLE III
MULTIMODAL LEARNING STYLES' RESULTS FOR VARIOUS DISCIPLINES

Ref No.	Discipline	N	Uni-modal (%)	Bi-modal (%)	Tri-modal (%)	Quad-modal (%)	Multi-modal (%)
10	Dentistry (microbiology teaching)	44	43.18	29.5	11.3	15.9	56.82
1	Surgery residence	132	39	15.9	13.7	31.8	61
2	Dental students	88	1.3	18.1	56.8	23.8	98.7
11	Dental Students Undergraduates	269	41.6	18.1	18.1	22.1	58.4
12	Education students	354	100	NP	NP	NP	NP
13	Medical (Under graduate)	91	13.8	72	15	0	86.8
15	Nursing	125	56.1	17.1	6.5	20.3	43.9
3	Medical Science	220	82.3	NP	NP	NP	17.7
16	Physician assistance	18	27.8	NP	NP	NP	72.2
17	Business	32	100	NP	NP	NP	NP
18	Business (Macroeconomics)	25	0	20	64	16	100
19	Nursing	90	81	15.5	3.3	NP	18.8
20	MBBS	219	85.1	NP	NP	NP	14.9
20	BDS	153	69.3	NP	NP	NP	30.7
21	Computer engineering	61	72.1	21.3	6.5	NP	27.9
21	Manufacturing engineering	22	86.4	13.6	0	NP	13.6
21	Mechatronics Engineering	24	70.8	25	4.2	NP	29.2
4	Humanities	70	100	NP	NP	NP	NP
4	Engineering	80	100	NP	NP	NP	NP
4	Basic Sciences	70	100	NP	NP	NP	NP

TABLE IV
THE COMPARATIVE ANALYSIS OF ALL REVIEWED PAPERS

Ref No.	Academic performance linkage with Learning styles	Statistical evidence of performance linkage with learning styles using P value	Teacher's existing practice	Sample size	Multi modal Incorporation
10	NP	NP	Yes	S	I
1	P	NP	No	S	I
2	P	P	No	S	I
11	NP	NP	No	A	I
12	NP	NP	No	A	NI
13	NP	NP	No	A	I
15	NP	NP	No	A	NI
3	P	P	No	A	NI
16	NP	NP	No	S	NI
17	NP	NP	No	S	NI
18	NP	NP	No	S	I
19	NP	NP	No	A	I
20	NP	NP	No	A	NI
21	NP	NP	No	A	I
4	P	P	No	S	NI

Pretest Phase: Pretest is the very first step in identification model in which student-learning styles are identified using VARK inventory. In this phase quantitative approach can be used to identify student-learning styles. Learning style inventory helps students identify their learning preferences and understand the best modalities to improve their learning process [42].

Didactic Identification Phase: With pre-test phase it is also important to understand teachers existing pedagogy and instructional design [5]. So, qualitative or quantitative approach can be used to understand this. Teachers often believe in the learning style theory but do not incorporate it in their lesson planning [5]. Teachers have to be included in identification and then the data and information about teacher's instructional design and pedagogical strategies can be validated by getting information form students in this phase. If students are included in this phase it is also necessary to compare the results and analyze them then identify didactic approached used by teachers. This will give the clear picture of teacher's didactic approach.

Multimodal Instructional design: After understanding teachers' didactic approach and how much all learning styles are catered in teachers' instructional design, in multimodal instructional design, teacher will develop the pedagogical instruction to cater all the learning styles. The instructional design needs cater all learning styles [1], [2], [10], [11] so learner will not restrict them to specific learning style. Additionally, they will be able to explore other learning modalities.

Didactic Application: Teacher will use the developed Multimodal instructional design to teach the students in didactic application phase. In this phase teachers' pedagogy will support all learning styles of students.

Assessment: Student academic performance will be assessed next in this phase so that difference of using all learning style can be understood. In this way learning styles' effectiveness can be seen if student outcome increases and it will be established that if student learning styles are catered then it effects their performance positively as supported by research [2]-[4], [10], [25].

Post-test: In post-test phase, student-learning styles are identified using VARK inventory again using quantitative approach.

Evaluation Phase: In this phase, student performances are compared before and after the incorporation of multimodal learning styles. This helps in analyzing whether or not there has been any change in learner's performance because of the incorporation of learning style model. Wilson-Hull suggests that incorporation of learning styles impacts positively on the learners' performance [43]. It can help understand if students' learning styles are affected when they are taught through several learning modalities.

Identification Phase: In identification phase, findings of evaluation phase will help identify linkage between learning styles and performance.

Research supports that performance is positively enhanced when learner's preferred modalities are incorporated [2]-[4], [10], [25]. But only [10] has validated that teachers incorporate learning styles before identification of learning style. Through evaluation phase student learning styles and their performance data will be achieved that can be used to link the learner's performance with their learning styles. This can contribute to eliminate doubt in effectiveness of learning style incorporation in teaching and learning practices as expressed by [5], [6]. Furthermore, it can validate of identified learning styles actually impact the performance or not.

V. CONCLUSION

VARK model only provides sensory modalities information not students strength and weaknesses or teacher use. The results of these studies are inconsistent. These findings provide the insight that student of same discipline may have different learning styles. Thus the concern about restricting student to certain discipline or subject is unsubstantiated. The results clearly show that in the same disciple learners like to learn in different ways. This is why teachers need to be creative and provide instruction considering all learning

modalities. If teachers use multimodalities in their class, all learners' needs can be addressed. The review of research has shown that literature has not validated the performance linkage with the learning styles. Also, the sample size of few studies is inadequate. With use of identification model, learning styles can be linked with learner's performance. Additionally, student and teachers will be able to understand that with incorporation of multimodal approach, learner's performance is positively affected.

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