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# Assessment of Learning Styles Among Clinical and Normal, Nonclinical Participants: An Experimental Study

Zhi Lin[1, *]

[1]*School of New Channel Jinqiu Academy, Chengdu, Sichuan, China*
[*]*Corresponding author email: joleenzlin@stu.ahu.edu.cn*

**ABSTRACT**
This study aimed to identify Visual, Auditory, and Kinesthetic (VAK) learning styles of clinical and nonclinical samples, to check the relationship between VAK learning styles and clinical factors, demographic variables. Two central questions were addressed: 1) Could there be a variation in learning styles between the nonclinical and clinical samples? 2) Is there a gender and age difference in the VAK learning styles of the nonclinical and clinical samples? These were achieved by evaluating 33 senior high school students (nonclinical samples), 13 males and 20 females, and 14 individuals (clinical samples), 5 males and 9 females. The self-designed Learning Style Assessment Test and Learning Modalities Dominance Index were used during the process. It demonstrates that, with the exception of visual learning style, nonclinical and clinical characteristics have an effect on auditory and kinesthetic learning styles; in both nonclinical and clinical populations, there's no significant association between VAK learning styles and demographic characteristics. Based on the findings thus far, learning styles under clinical factors may be qualitatively different, and that psychiatry and otorhinolaryngology-audiology could be joined for treatment. More ramifications of the present results are being investigated for future research, along with teaching and treatment method design. The development of new treatment diagnoses and therapy regimens, while also their clinical relevance, are still poorly understood, necessitating more research.

***Keywords:*** *Learning Styles, Clinical Factors, Therapeutic Efficacy, Age, Gender*

## 1. INTRODUCTION

### *1.1. Learning styles and VAK modalities*

There has been a profusion of definitions and taxonomies of learning style over the last several decades [1]. In the language educational literature, Keefe's 1979 description of "learning style" as "information processing" is widely referenced in the language pedagogical literature, that is, "the story and retrieval of information" [2]. This model is a synthesis of all cognitive, affective, and physiological elements possessed by a learner to aid in the completion of a learning task.

Learning style refers to the learner's normal and habitual learning pattern and technique, and it is impacted by personal variables (age, gender, interest, emotion, character, and motivation, etc) along with environmental factors (social, educational, and cultural backgrounds, etc). Learning style study may add to our understanding of nature vs. nurture while also improving learning impact and motivation. As a result, various studies focused on learning style research.

Kolb's Visual, Auditory, and Kinesthetic (VAK) learning style models were chosen for this investigation because they indicate methods in problem solving scenarios, the cognitive mode, the manner of thinking, and the dominant mode of seeing information [3], all of which may be used in education and therapy. VAK styles are often used to categorize learners as Visual learners, Auditory learners, or Kinesthetic learners. Visual learners learn best through observation. Drawings, pictures, diagrams, and demonstrations help this group of learners understand better. Auditory learners benefit most from listening to audio (e.g., recorded lectures, interacting with others). Physical activities help kinesthetic learners learn more. Kolb's and VAK learning style models are

commonly utilized in the field of adaptive learning environments [4].

### *1.2. Learning Styles with Educational Goals*

There has been growing interest in studying learning styles with educational goals. In general, researches have suggested that teachers in high schools should ensure that their pupils are acquiring the necessary information and abilities. Some pupils, for example, struggle to internalize certain aspects of the curriculum, which could be ascribed to the effectiveness of different learning styles [5]. This implies that if teaching tactics are more aligned with students' learning styles, learning outcomes may improve, students may apply it more effectively, have a more positive attitude toward their subjects, and excel [6,7].

### *1.3. Learning Styles with Therapeutic Orientation*

In contrast to nonclinical sample focused studies, the psychotherapist's motives in selecting patients' learning style-oriented therapeutic orientation are an understudied subject. Nonetheless, research has shown that learning styles under clinical conditions can differ qualitatively. According to Iliadou and Iakovides [8], central auditory processing disorders co-exist in patients with mental disorders (e.g., learning disabilities, attention deficit hyperactivity disorder, dyslexia, autism, chronic alcoholism, Alzheimer's disease, adult autistic disorder, Schizophrenia, anorexia, and mental retardation). In this regard, the objectives of this paper are to discover variations in VAK learning styles, notably poor auditory performance, between clinical samples with mental diseases and nonclinical samples.

For applications, as psychotherapy is a learning process [9], considering learning styles as significant aspects in the treatment process, as well as incorporating them in treatment diagnoses and therapeutic schedules has the potential to improve therapeutic efficacy for mental disorders. Similar findings have generally been obtained by Andreou & Vlachos [10], they found out knowing and understanding our learning style makes it possible to study more successfully. This is doubly true for those who learn in a variety of ways, such as those with learning disabilities, taken together, if clinical samples are deficient in the auditory modality, and the way therapy is often delivered disadvantages them, new treatment diagnoses and therapeutic schedules based on a proper VAK learning style evaluation will be needed.

### *1.4. Learning Style with Gender and Age*

In addition, research has shown that learning preferences may be affected by gender and age [11,12]. Therefore, apart from the differences among clinical factors in VAK learning styles, gender and age differences were also examined in this study.

### *1.5. Purpose of the Present Study*

The purpose of this study is to: 1) examine the influence of clinical factors on variation in learning styles; 2) assess the relations between learning styles and the two demographic variables (age and gender) among clinical and nonclinical participants.

Notably, despite the existence of several resources relevant to VAK learning, a thorough review of the literature revealed that little was known about VAK learning style in experimental conditions. That is, earlier studies of learning styles have relied heavily on self-oriented preferences revealed in questionnaires. This raised concerns about memory recall accuracy and recognition of the corresponding VAK modalities in questions.

Specifically, Dobson [13] discovered a significant link between preferred sensory modality and course performances in his recent study. However, preferred learning style had no effect on course performance in a study of optometry undergraduates done by Prajapati et al. [14]. These data shed some light on the correlation between preferences and performances, but whether or not this correlation exists is controversial. Performances in VAK modalities may be more valid assessment measures in this regard. Given the concerns noted above, to prevent inaccuracy in self-assessments (questionnaires), this study then focuses on performance of VAK learning styles in experimental conditions regarding clinical factors, demographic variables (age and gender). Knowing this information may aid in the development and implementation of teaching methods and therapy tactics that optimize an individual's motivation.

To achieve those goals, a self-designed Learning Style Assessment Test and Learning Modalities Dominance Index were used to measure individual learning style preferences. 33 senior high school students (nonclinical samples,13 males), and 14 individuals (clinical samples,5 males) were recruited to explore the relationship between these variables.

## 2. METHODS

### *2.1. Participants*

The study was carried out on high school students (sample 1) during their break times, and on patients (sample 2) during their doctor's ward round. People from the target population were asked if they were available and willing to participate at the time. Sample 1 consisted of 33 senior high school students (nonclinical samples), 13 males and 20 females from Beijing and Shanghai,

China. Sample 2 consisted of 14 people (clinical samples), 5 males and 9 females recruited from the Department of Mental Health Centre at West China Hospital. The ages of the nonclinical samples ranged from 15 to 18 years (SD = 0.67). Clinical samples ranged in age from 4 to 67 years, with 2 suffering from schizophrenia and 12 suffering from mood disorders. All of them were psychologically stable, with a sense of control over their thoughts and actions. In total, 47 participants (100% of the sample) completed the survey and experiment correctly and were included in the analysis. All participants had Chinese as their first language.

## *2.2. Material*

### *2.2.1 Demographic variables*

Independent variables (age and gender) were collected using surveys (e.g., asking about the biological sex with the options ‘male’ or ‘female’).

### *2.2.2. VAK Dominance*

For the experiment, a self-designed Learning Style Assessment Test (LSAT) was given to samples in mainland China to test the theories: 1) Learning style preferences differed between males and females and different age groups; 2) Learning style preferences differed between nonclinical and clinical samples. Since learning modalities determine the sifting, assimilation and retrieval of all information produced [15], the LSAT created a profile of participants' learning performances and assessed their dominant method of gathering and using information via visual, aural, and kinesthetic approaches. The test ran on PsychoPy software and consisted of 9 dishes (made-up recipes with entirely random food kinds, such as marinated kangaroo meat with popping candy, to prevent inaccuracy from participant's schema on the known recipe) presented in visual, aural, and kinesthetic ways. Each of the three assessments, visual, auditory, and kinesthetic, consists of three dishes. To prevent inaccuracy from participants performing better due to familiarity, the order of VAK assessments given to participants was random (e.g., participant 1 – VKA, participant 2 – KAV, participant 3 - KVA).

For visual, static words and images were presented (Fig. 1. a). For auditory, a recording of a female voice is played. The recording stated the recipe step by step, without tonal change. The auditory stimulus pages were blank screens with the instruction 'Pay close attention to the audio' (Fig. 1. b). For kinesthetic, a game was programmed which requires participants to continuously click the screen. Pages for kinesthetic stimulation were Gifs that demonstrated how the game is played. Participants can apply utensils to food by clicking on them, or they can

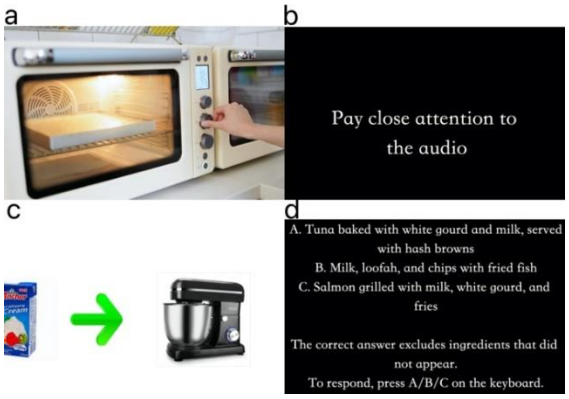


**Figure 1.** VAK Learning Flow Chart.

Note: Fig. 1. a stands for visual stimuli, Fig. 1. b stands for auditory stimulus, Fig. 1. c stands for kinesthetic stimulus, and Fig. 1. d stands for example question page.

place food in containers by clicking on them (Fig. 1. c). The teaching trails ran roughly 32 seconds each, and participants were kept under wraps about the recipe's name. Following the teaching trial, they were given a question in which they must determine the name of the recipe based on what they have learned. An example question would be, 'Please select the recipe based on what you have learnt'. The correct recipe name should not include any ingredients that did not exist in the training trial (Fig. 1. d). Because LSAT is still in its early phases, no credible study has been published. Statistical analysis found, however, that the V, A, and K modal subscales had high validity, with no strong correlations detected between the various modal subscales, lending validity to the experimental method.

## *2.3. Procedure*

Participants were initially shown a video on a laptop regarding the study's specifics. Participants indicated their readiness to "sign" a permission document by following the instructions and clicking on the space button. Consent was acquired by informing them the study entails and the research objective. Age and gender were collected using questionnaires. Participants were subsequently instructed to take the LSAT, which included a teaching trail and a test trail. The teaching tail was provided in visual, aural, and kinesthetic formats (each lasting roughly 32 seconds). Each of the three assessments, visual, aural, and kinesthetic, is made up of three dishes. Following the teaching trial, the test trail inquired about the recipe's name. The order in which the VAK assessments were delivered to participants was randomly chosen. Their replies and reaction times were tallied and evaluated. Only accurate responses receive points (i.e., correct answer = 1-point, incorrect answer = 0 point).

### *2.4. Analysis*

PsychoPy results are collected from excel sheets, the data are organized to leave 'LSAT score' for analysis.

As noted by Kirschner [16], given that VAK model entails the underlying assumption that there is a reliable and valid way to determine the learner's dominant modality (i.e., style), this study then aims to identify participants' learning modalities dominance through their performances in LSAT. When comparing raw data (e.g., LSAT scores) across individuals, extraneous variables (e.g., working memory capacity, intellectual abilities, educational level, etc.) are included, a measure is required to demonstrate the variability in dominance explained by the VAK modalities alone in the absence of all other extraneous variables. Because a single person's score in VAK modalities is unaffected by extraneous variables, this scoring measure examines raw data in VAK modalities across an individual for dominance before converting this to Learning Modalities Dominance Index (LMDI) for within-group comparisons. This measure is used to compare grouped data.

Raw data were composited into a single model with a total dominant index 25.2 (25.2 stands for Final Index Score, which is a simplified version of a common multiple of all participants' aggregate LSAT scores across all VAK modalities). This figure was then distributed differently for each participant based on their performance. Individual LSAT scores of 1, 1, 2 were used as example, and the Final Index Score was computed by dividing the Initial Index Score by (1+1+2)/ 25.2=6.3. (6.3 denotes Index Ratio, representing the quotient obtained). The ultimate LSAT score is V 1*6.3, A 1*6.3, and K 2*6.3. (i.e., V6.3, A6.3, K12.6). The median intraclass correlation of .73 across codes, based on above one set of LSAT scores, indicates evidence for the construct validity of the LMDI.

Two central questions were addressed. First, is there a difference in VAK learning style of nonclinical and clinical sample (samples 1 and sample 2)? To explore this, two t-test was used to compare visual, auditory, and kinesthetic learning dominance (i.e., LMDI) in nonclinical and clinical samples. LMDI was compared between nonclinical and clinical samples; all nonclinical groups were compared with only the adolescent clinical sample group, bringing clinical samples into accordance with nonclinical samples in the age variable.

The visual, auditory, and kinesthetic learning dominance of samples 1 and sample 2 were assessed to determine if there are distinct learning styles based on their gender and age. To explore this, SPSS is used to determine the relationship between the independent variables and Learning Modalities Dominance Index in visual, auditory, and kinesthetics, respectively. Pearson correlation analysis is used to investigate the relationship in detail.

Gender was classified as male and female. For age, given that the distinction between concrete stages (7 to 11 years old) and formal operational stages (adolescence to adulthood) is inferential reasoning, that is, hypothetical thinking is not yet developed in a child under 12, and the child can only solve problems that apply to concrete events or objects (i,.e, through kinesthetic learning). Concerns have been raised about the possibility of limiting the child's ability to think about things that they have not actually experienced during visual and auditory learning, causing them to be incapable of drawing conclusions from their thinking and thus influencing their LMAT scores in these two categories. As a result, the use of a median break was deemed appropriate, splitting all clinical samples into two groups using a median break at 12 years (i.e., < 12 years vs. 12 years and beyond). The split resulted in 5 clinical samples being assigned to the under 12 years group, and 9 to the 12 years and above group. Given that the nonclinical sample ranged in age from 15 to 18 years, it is only used to categorize gender.

## 3. RESULT

During the process of learning, students learn by experience, imagination, thinking and doing. The Learning Modalities Dominance Index in VAK modalities was formulated to identify the respondents' dominance in dimensions of learning styles.

### *3.1. Overall Learning Styles Preferred by Normal, Nonclinical Samples*

In nonclinical samples, nine participants (27.27%) preferred a unimodal learning style (highest LSAT score in one modality), whereas 72.73 percent (24 samples) preferred a multi-modal learning style (highest LSAT score in two and three modalities), with biomodal and three modal. 11 nonclinical samples (33.33%) preferred two modes, whilst 13 nonclinical samples (39.39%) did not have a preference in their learning styles.

In nonclinical samples, the mean and SD for raw scores of visual, auditory, and kinesthetic learning styles were 2.40± .79, 2.21± .74 and 2.48± .75, respectively. 23 samples of all nonclinical subjects were visual learners (single/multiple highest LSAT score/scores in this modality), 19 samples were auditory learners, and 24 samples were kinesthetic learners. More specifically, a participant who received raw scores of 2, 2, 2 in VAK modalities has a more equitable blend of three learning styles, being visual, auditory, and kinesthetics learners.

### *3.2. Overall Learning Styles Preferred by Clinical Samples*

In clinical samples, eight participants (57.14%) preferred a unimodal learning style, while 42.86 percent (6 samples) preferred a multi-modal learning style

(biomodal, three modal). For the multi-modal group, 5 clinical samples (35.71%) preferred two modes and 1 clinical sample (7.14%) did not have a preference in their learning styles.

The mean and SD for the raw scores of visual, auditory, and kinesthetic learning styles among clinical samples were 2.00± .68, 1.29± .91 and 2.71± .47, respectively. Among all clinical participants, 6 samples were visual learners (single/multiple highest LSAT score/scores in this modality), 1 sample was auditory learner, and 14 samples were kinesthetic learners. It is worth noting that in clinical samples, all unimodal learners (8 samples) were kinesthetic learners.

### *3.3. Nonclinical and Clinical Samples*

Equal variance in LMDI was assumed. The 33 individuals in the clinical group ($M$ = 8.38, $SD$ = 2.18) displayed auditory dominance with a $p < .001$, $t(45) = 4.50$, demonstrating that nonclinical and clinical has an effect on auditory learning mode. Nonclinical groups have a higher mean in auditory than clinical groups, implying that auditory dominance in problematic situations is greater in nonclinical groups. Despite nonclinical groups have a lower mean in kinesthetic than clinical groups, the difference between nonclinical and clinical with kinesthetic was not significant ($p$ = .086). Furthermore, the difference between nonclinical and clinical with visual and kinesthetic was not significant, signifying that nonclinical and clinical had no effect on visual and kinesthetic modality or vice versa.

When the age variable was appropriately controlled, equal variance in LMDI was assumed. The 33 people in the clinical group ($M$ = 8.38, $SD$ = 2.18) show higher auditory dominance than the 4 adolescents (13-18 years) in the nonclinical group ($M$ = 3.57, $SD$ = 2.41), and the difference was significant, $t(35) = 4.24$, $p < .001$). Furthermore, nonclinical subjects ($M$ = 13.23, $SD$ = 2.41) had a higher kinesthetic dominance score than clinical subjects ($M$ = 9.36, $SD$ = 2.67), and there was a significant difference between the two groups, $t(35) = -2.76$, $p$ =.009 < .01). The difference between nonclinical and clinical with visual was not significant, implying that nonclinical and clinical had no effect on visual modality and vice versa.

### *3.4. Gender as a Determinant of Normal, Nonclinical Samples' Learning Styles*

Pearson correlation analysis was conducted to study the relationship between learning styles' dimension and gender in nonclinical groups. The total number of collected results was 33 (13 male/ 21 female). As can be observed from the table 1, there was no significant association found between the visual ($r$ = - .020, $p$ = .911) and auditory ($r$ = .253, $p$ = .155), and kinesthetic learning styles ($r$ = - .033, $p$ = .853) of nonclinical groups with gender.

**Table 1.** Pearson Correlation between Learning Style and Gender in Nonclinical Samples

| Learning style | Pearson Correlation *(r)* | *p* |
|---|---|---|
| Visual | - .020 | .911 |
| Auditory | .253 | .155 |
| Kinesthetics | - .033 | .853 |

**Table 2.** Pearson Correlation between Learning Style and Demographic Variable (Gender and Age) in Clinical Samples

| Demographic Variable | Learning style | Pearson Correlation *(r)* | *p* |
|---|---|---|---|
| Gender | Visual | .151 | .605 |
| | Auditory | .512 | .062 |
| | Kinesthetics | .255 | .378 |
| Age | Visual | -. 006 | .983 |
| | Auditory | -. 311 | .279 |
| | Kinesthetic | -. 015 | .959 |

### *3.5. Demographic Variables (Gender and Age) as Determinants of Clinical Samples' Learning Styles*

To determine if gender and age is an important a Determinant of Students' Learning Styles, pearson correlation analysis is used. Results from the analysis were reported in Table 2. The total number of collected results was 14 (5 male/ 9 female). As can be observed from the table, there was no significant association between visual ($r$ = .151, $p$ = .605), auditory ($r$ = .512, $p$ = .062) and kinesthetics ($r$ = .255, $p$ = .378) learning style with gender. Furthermore, there were no significant relationships between any of the four dimensions visual ($r$ = - ,006, $p$ = .983), auditory ($r$ = - .311, $p$ = .279) and kinesthetic ($r$ = -. 015, $p$ = .959) learning styles with age.

## 4. DISCUSSION

Intra-cultural differences in learning modalities across the Chinese samples with respect to type of population (nonclinical vs. clinical), gender (male vs. female) and age (under 12 years vs. 12 years and above), were statistically tested and a distribution by type of sample was produced. In this section, reported results are discussed and the research questions are answered.

In this study, a major finding that the majority of nonclinical samples preferred a multimodal learning

style, whilst most of the clinical samples preferred the unimodal learning style. Kharb et al. [17] also found one single approach as teaching method does not work for every student or even for most of the students. These findings call for suitable teaching and treatment methods and strategies to meet the differences in the clinical factors. The other important finding revealed that the preferred style (i.e., based on single/multiple highest LSAT score/scores in VAK modalities) amongst the majority of nonclinical and clinical samples was the kinesthetic learning style. Meanwhile, under the control of age variables, significant differences in learning preferences were revealed in clinical factors in auditory modality, with clinical groups having a significantly higher kinesthetic dominance. This is consistent with other studies that have previously shown that amongst the bachelor and associate nursing students in China, the high prevalence with a unimodal learning style was the kinesthetic style [18]. It is advised that more hands-on teaching and treatment approaches be completely implemented in order to improve efficiency and achievement. Future research will be required to establish whether or not kinesthetic reinforcements boost performance in any manner.

Clinical samples were expected to have different learning styles than normal, nonclinical samples. The results did confirm this hypothesis, since significant differences in learning preferences were found in the clinical factors in auditory modality. Clinical groups have a significantly lower auditory dominance. In addition, as predicted by Iliadou & Iakovides [8], Central auditory processing disorders were found to be co-exist with various mental disorders such as: attention deficit hyperactivity disorder, dyslexia, autism, Alzheimer's disease, adult autistic disorder, Schizophrenia, etc. Based on this conclusion, the viable idea is that psychiatry could be integrated with otorhinolaryngology-audiology to solve mental disorders. Additional research is required to investigate the efficacy of treatment reform techniques based on the learning style preferences of all clinical samples in this study.

Auditory learning was not shown to be dominant in clinical samples, and auditory impairments may coexist alongside mental illnesses. Interestingly, an increasing number of research papers back up the benefits of giving music therapy in addition to standard treatment for patients with mental illnesses [19, 20]. It's debatable if music therapy's efficacy is overstated. Noteworthy, the placebo-controlled study on music therapy is the primary mode of assessing the efficacy of the music therapeutic process. Given some of the key characteristics of high-quality research identified by DeNora & Wigram [21], the question of how comparable music therapy is as a tried and tested intervention with appropriate scientific credibility when compared to speech and language therapy, psychology, psychotherapy, and medicine arises. Clearly, further research is needed to evaluate the appropriateness and efficacy of music therapy to other treatments over a comparable length of treatment, in conjunction with a good or appropriate way of observing, accounting for, and assessing.

The second question posed in this study, (Is there a difference in VAK learning style of nonclinical and clinical samples based on their age and gender?) is going to be answered and discussed, according to the obtained results. It was found that age gender does not have any effects on VAK learning styles in nonclinical and clinical samples. This result supported the study conducted by Javadinia et al. [22]. They aimed at investigating whether Learning Style among students is age dependent. The results indicated that there was no significant relationship between students' VAK learning styles with age. In addition, Mohammadi et al. [23] found that in terms of age, medical students training at MUMS showed no significant association between VAK learning style. However, in the studies by Mohammadi et al., a significant relationship between visual and learning style of students with gender was reported. It is probable that the alternative approaches to cultural differences, as well as the variety of learning styles constructs and measurements utilized in the aforementioned studies, resulted in distinct dominant learning styles.

### *4.1. Limitations*

Several important limitations to the present study must be mentioned. First, as noted earlier, there is no consensus on a measure of VAK learning modalities. Although this study focuses on how individuals overcome difficulties by utilizing the VAK learning style, it does not rule out the possibility that raw data 3, 3, 3 is too simple for participants, resulting in no preference in their learning styles.

Second, Gholami and Bagheri [24] believe that the influence of problem-solving styles on VAK learning styles is significantly positive. As a result, it is critical to determine whether and how other variables may mediate VAK learning style.

Finally, while the current study investigates the role of clinical conditions and demographic characteristics on VAK modalities, no conclusions about cause and effect can be drawn. As a result, a proper prospective design study that evaluates for all of the current measurements at both times will substantially aid in clarifying the causal relationships between clinical factors and demographic variables with VAK modalities.

## 5. CONCLUSION

In conclusion, this study addressed a number of concerns and limitations that remained unaddressed in previous research on VAK learning. The aim of the study was to investigate the relationship between VAK learning

styles regarding clinical factors, demographic variables (age and gender). The results of the study show that nonclinical and clinical factors have no effect on visual and kinesthetic learning styles, with the exception of auditory learning style; no statistically significant age or gender difference in VAK learning style category was discovered in clinical and nonclinical samples. It is crucial to highlight that this study does not imply that auditory treatment methods are ineffective, nor does it advocate for the widespread use of kinesthetic treatment methods. According the findings of this study, being aware of the patients' learning styles may benefit in the adaptation of therapy tactics. It asserts that treatment strategies should be adjusted to best match each individual based on a proper VAK learning style assessment.

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