

Preferred Mathematical Learning Styles According to Psychology of VARK Model

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Abstract

The objective of the current research is to identify the preferred mathematical learning styles according to VARK model among the students of the Mathematics Department, as well as the preferred mathematical learning styles according to VARK model among the students of the Mathematics Department in conformity with the gender variable. The research sample consisted of (264) male and female students from the third stage in the Department of Mathematics in the College of Education for Pure Sciences/University of Mosul for the academic year (2022/2023). To achieve the objectives of the research, the researchers adapted VARK scale in mathematics, and it consisted of (17) items of multiple choice type with four alternatives according to the learning styles within VARK model (visual style, auditory style, reading/writing style, and kinetic style). The validity and reliability of the scale was found, and after collecting the data and analyzing it statistically, finding the repetitions and the percentage of the research sample, the results were as follows:

1. (44%) of students of the Mathematics Department preferred the reading/writing learning style (R), followed by the visual style with a rate of (35%), then the kinetic style with a rate of (13%) and finally the auditory style with a rate of (8%).

2. There is no difference in learning styles according to VARK model, in conformity with the gender variable.

Keywords: learning styles, learning styles according to VARK model, Psychological Theories, psychologist.

Research problem

Students' knowledge of their educational patterns may contribute to guiding them properly in all areas of their lives, as this has a positive impact on their executing of the best achievements and maximum learning outcomes. As the performance of the learners affected by these methods positively or negatively; when the learning styles are in harmony with the different teaching methods and activities that take into account the presence of various learning styles in the classroom, the effect is positive, and when the teaching methods and classroom activities do not meet the diversity of learners according to their learning styles, their performance in dealing with information will be negative. Thus, identifying students' preferred learning styles may help provide diverse educational experiences that are compatible with their educational styles, and this may lead to an increase in their motivation and willingness to learn (Pashler & et al, 2008).

Among the recent models in learning styles is VARK model, through which it is possible to identify the prevailing patterns among students of the Department of Mathematics so that we can determine teaching methods and take into account the individual differences of students and address the students' poor achievement, Therefore it was necessary to use VARK mathematical learning patterns before starting the teaching process, and this is what It was confirmed by the study of Mustafa and Bena (2022) and the study of Kamal et al. (2021).

Based on the above, the research question can be defined in the following form:

What is the percentage of mathematical learning styles according to VARK model among students of the Department of Mathematics?

1. What are the preferred mathematical learning styles according to VARK model among the students of the Department of Mathematics in the College of Education for Pure Sciences according to the variables of gender and totality?
2. Is there a statistically significant difference at the level of ($\alpha \leq 0.05$) between the preferences of students of the Department of Mathematics for learning styles according to VARK model, in conformity with the gender variable?

The Importance of The Study

In light of this scientific and technological development, education in general and scientific education in particular is responsible for preparing human cadres to keep pace with the rapid scientific and technological progress in various fields of life. The society's tool in shaping the thought and loftiness of individuals is education, as it operates within a specific social shadow in which it expresses a social point of view and based on the society's values, trends and goals that derived from the society's philosophy, it chooses its experiences and implements the education policy to achieve the goals of the educational system. (Shaver, 2015).

The improving of the educational process in terms of curricula and teaching methods leads to improving students' achievement and makes them able to keep pace with the scientific progress that is observed in the current era. Keeping pace with the rapid scientific and technological progress that affects the curricula in general and the mathematics curricula in particular, as well as the employment of educational theories to serve the teaching and learning of mathematics in terms of the use of appropriate and new teaching methods are among the foundations upon which the mathematics curriculum depends in the various stages of education(ALIMDJANOVA, D. N., & BERDIEV,2022)

Mathematics is the language of the mind, and it is one of the most important academic subjects among the curricula, as it is the science on which other sciences are based, it represents the summit of abstract thinking that transforms science into symbols and symbolic relationships, and encourages and activates thinking and meditation. Mathematics is one of the main sciences known to humanity and the undisputed master of science that all technological development and various fields of knowledge that contribute to building human civilization and scientific progress are linked to it (Chval & el,2015).

Learners are distinguished by different brains and levels of intelligence depending on environmental or genetic factors, so they learn in different ways and styles, and affect their performance and achievement, so it is necessary to take into account the individual differences between them when presenting the educational content to them, in order to obtain close educational results within the required standards, and because learners differ in previous experiences, mental processes, personal preferences, and IQ, a different data must be presented to each learner, and the teacher should allow the learner to choose the style that suits him in the learning process. The ability to know the learning patterns of learners helps make the educational process personal, meaningful, and more effective.(National Academies of Sciences,2018).

Understanding how students learn is an important focus for teachers, as this helps them choose the appropriate educational strategies, and their lack of knowledge of the learning patterns of their students and the appropriate educational strategies for them leads to a defect in the learning process for the student at the psychological, academic and even social levels. Therefore, it is necessary for teachers to be aware of the learning styles of their students, and the appropriate strategies for each style, and this awareness of learning styles must be transmitted to the student himself, as this increases the student's self-monitoring in his learning process using the appropriate strategies for him and at the same time trying to adapt with other patterns.(Hannah, R,2013)

There are many studies that emphasized the importance of learning styles according to VARK, including: the study of Al-Mawla (2022), the study of Eid (2022), and the study of Timsaah (2020).

Hence, the importance of the current study emerges, and it is hoped that it will be useful in:

- Guiding workers and those interested in the field of education to the necessity of diversify teaching methods and styles and to choose means and techniques in accordance with the educational patterns preferred by students.
- The researcher presented a measure of learning styles according to VARK model, which he adapted in mathematics and is suitable for the Iraqi environment. Researchers and those interested in teaching mathematics can benefit from it.
- Opening the way for other studies to study and identify learning patterns in all educational stages.
- The scarcity of local studies - as far as the researcher is aware - that dealt with learning styles that have been adapted in mathematics according to VARK model.

Purpose of the Study

The study aimed to identify the mathematical learning styles according to VARK model among the students of the Department of Mathematics in the College of Education for Pure Sciences.

Study Questions

1. What are the preferred mathematical learning styles according to VARK model among the students of the Department of Mathematics?
2. What are the preferred mathematical learning styles according to VARK model among the students of the Mathematics Department in conformity with the gender variable?

The Boundaries of the Study

- Spatial boundaries: Department of Mathematics / College of Education for Pure Sciences at the University of Mosul.
- Temporal boundaries: the academic year 2022-2023.
- Human boundaries: Third-year students in the Department of Mathematics/College of Education for Pure Sciences/University of Mosul.
- Objective boundaries: Preferred mathematical learning styles according to VARK model.

Define Terms

Learning Styles

Kolb (1984) defines learning styles as “the preferred way for an individual to perceive and process information” (Manolis & et. al, 2013:45).

Kinsella (1995) defined the learning style as “referring to the individual’s natural and preferred ways and habits in processing and retrieving new information and skills that persist regardless of education or content (Yeh & Wang, 2013:133).

The researcher defines them procedurally as: the ways preferred by students of the third stage in the Department of Mathematics / College of Education for Pure Sciences / University of Mosul in receiving, preparing, processing, absorbing and integrating mathematical information into their knowledge structure to form their own individual experiences, which are measured through the most chosen alternative by students in the adapted VARK questionnaire in mathematics, which was prepared for this.

Theoretical Framework

VARK Model

In 1992, Dr. Neil Fleming, along with Mills, developed the VARK model (Fleming and Mills, 1992). (Biscardi, J. M. & et. al 2019).

Fleming classified the learners based on their tendencies and preferences, and the model consisted of four educational styles, namely:

- Visual style
- Aural style
- Read/Write style
- Kinesthetic style

Fleming believes that learners differ in their learning styles, so they may be unilateral in their learning style, that is, they use one of (VARK) styles in their learning, or multiple as they use two or more styles, and they are more flexible than those who learn in an individual style (Fleming, N., & Baume, D.,2006).

VARK model focuses on the sensory-perceptual media through which the learner learns, focusing on how the brain represents the experience it encounters, and the method of receiving stimuli with the aim of assimilating them. And that the preferred method used by the learner in organizing and processing information and experiences is the method that distinguishes him in his learning, his reception of information that comes to him from the environment, as well as his method of solving problems that he encounters during educational situations. (Kohler, S., & Dietrich, T. C. ,2021).

Characteristics of VARK Model

- A learner's preferred patterns influence his behavior, including learning.
- The learner's preferred patterns are not fixed, but they are relatively stable.
- Understanding the learner's learning style is necessary to improve his/her learning abilities.
- Both the learner and the teacher can identify and provide examples of their use of their preferred style of learning.
- The learner's knowledge of his preferred learning styles and working on them is an important condition for improving his learning.
- Information delivered to the learner using strategies that align with their preferred learning styles are more likely to be understandable and motivating.
- The information that the learner understands through his own learning styles shows an increase in his levels of understanding and passion for knowledge.
- Access to information in a way that suits the learner's learning style is more understandable and easy.
- Each learning style has educational strategies that are more appropriate than others, meaning that there are educational strategies that are better compatible with some styles than others.
- The use of appropriate strategies for the educational style achieves perseverance and helps in achieving educational tasks, active learning, depth of knowledge and revitalization of metacognition.(Hussain, I.,2017).

Learning Styles According to VARK Model

- **First: the visual style:** the learner with the visual style uses certain sentences such as (let me see) and needs to see the body language of the teacher in order to understand the content and tends to sit at the front of the class to avoid visual confusion, and during the lesson he prefers to take notes to absorb the information.(Fahim, A. & et. al,2021).

They also have visual competence and are distinguished in imagination and are prone to creativity and innovation. (Hussain, 2017).

- **Second: Aural Style:** The Aural pattern learner uses sentences such as (tell me) (let's talk about this topic) and has the ability to accomplish a new task after hearing an explanation about it from an expert person. He prefers to take oral instructions .(Fahim, A. & et. al,2021).

- **Third: The Read/Write Style:** the learner in this style relies on the read and written meanings and understanding of ideas, and learns better by reading or writing ideas and meanings. The learner who prefers this style is characterized by his tendency that educational experiences are presented to him written or spoken, and has the desire to write down all educational experiences, as well as has high skills in receiving, preparing and processing written and read experiences, which makes his awareness of educational experiences better through written and read media. He also has the ability to read and write well and is familiar with organizing lectures and taking notes. (Chaudhry & Ashar & Ahmad, 2020).

- **Fourth: The Kinesthetic Style:** the learner in this style relies on tactile perception to learn ideas and meanings, learns better through work and manual practice, uses all senses in learning, prefers real and natural situations and models, uses computers and laboratories, bears a high degree of responsibility, and has high skills In receiving, preparing and processing practical experiences, which makes his awareness of educational experiences better through practical experimental media. The learner with a kinesthetic style prefers a learning method that relies on doing manual activities, real situations, simulation of reality, and tangible experiences to understand the learning experience and interact with the learning environment as well as by practice rather than listening or watching and tends to prefer exploring concepts through experimentation, in addition he needs less oral or written instructions and more practical activities. The learner with a kinesthetic style enjoys making things and learning through them. (Espinoza-Poves, J. L. & et. al 2019).

He uses sentences such as (let's try), (how do you feel) and is able to accomplish a new task through experience and prefers to discover through experience without looking at the written instructions. (Amanian, S., & et. al 2020).

Study Procedures and Methodology

The researchers followed the descriptive approach, and the research community was identified, which is represented by the students of the Department of Mathematics in the College of Education for Pure Sciences at the University of Mosul for the academic year (2022-2023), whose number is (1200). The sample of the study was determined from it, and it is an intentional sample, and it was represented by the students of the third stage in the Department of Mathematics in the College of Education for Pure Sciences, (264) male and female students who participated in answering the questionnaire (scale) concerned for the purpose of the study.

Education for pure sciences (264) male and female students participated in answering the relevant questionnaire (scale) for the purpose of the study. After the researchers looked at the literature and studies that dealt with VARK learning model, they did not find a measure for undergraduate students that measures the learning style according to VARK in mathematics, so the researchers adapted a measure according to VARK learning styles in mathematics, and VARK scale prepared by Neil Fleming and Bonwell was adapted (Fleming & Bonwell, 2002) Which was developed by Johnes (Johnes, 2004) and translated and adapted by Al-Zaghal (2004). After that, the scale was presented to a group of experts and arbitrators with specialization in the fields of education,

psychology, teaching methods, and the field of measurement and evaluation on the validity and appropriateness of the scale items for each dimension. The test, in its initial form, settled on (17) items.

Application of the Test to the Survey Sample

The scale was applied to students of the third stage in the College of Computer Science and Mathematics in the Department of Mathematics / University of Mosul as an exploratory sample in order to know the clarity of the instructions and the clarity of the paragraphs of the scale and to know the time taken to answer, on Monday, 10/10/2022. By the researchers to stand on students' inquiries about paragraphs whose meaning is not clear. It was found that all items of the scale have clear meaning and wording, as well as instructions, and the time taken to answer the test was (15) minutes.

Scale Correction

The scale consisted of (17) paragraphs, and each paragraph contained four alternatives to answer according to the pattern that the student learns according to VARK model in learning. The scale was corrected in conformity with the consideration of the repetition most chosen by the student as the preferred pattern for the student. The validity and stability of the scale were verified, and stability was achieved by a re-test. Thus, the scale in its final form consisted of (17) items that represented the four learning styles according to VARK model, namely (the visual style, the Aural style, the read/write style, and the kinesthetic style). It was applied to the research sample on Thursday, 29/12/2022.

Interpreting and Discussing the Results

In order to answer the research questions, which included

The first question: **What are the preferred mathematical learning styles according to VARK model among the students of the Department of Mathematics in the College of Education for Pure Sciences in conformity with the variable of gender and totality?**

In order to verify the question and in order to identify the preferred pattern among the students of the Department of Mathematics in the College of Education, the researcher found the number of repetitions of the preferred mathematical learning patterns for all students, and then calculated the percentage for each of the four patterns according to VARK model, as shown in Table (1) below:

Table (1)

NO.	Genders	learning style	code	NO.	iterations	The ratio	arrangement
1	Males	Visual style	V	123	45	36.5%	2
2		Aural style	A		9	7.4%	4
3		Read/Write style	R		55	44.7%	1
4		Kinesthetic style	K		14	11.4%	3
1	Females	Visual style	V	141	48	34%	2
2		Aural style	A		12	9%	4
3		Read/Write style	R		61	43%	1
4		Kinesthetic style	K		20	14%	3
the total		Visual style	V	264	93	35 %	2
		Aural style	A		21	8 %	4

	Read/Write style	R		116	44 %	1
	Kinesthetic style	K		34	13 %	3

By observing the above table, we find that the preferred mathematical learning style for third-stage students in the Mathematics Department is the read/write style (R). It obtained the highest percentage which is (44%), followed by the visual style with a rate of (35%), then the kinesthetic style with a percentage of (13%), and finally the Aural style with a percentage of (8%).

The researcher attributes the superiority of the written and visual style to the fact that the students of the Department of Mathematics tend to prepare charts and graphs, and tend to learn in form of collaborative groups, taking notes, writing summaries, and rephrasing mathematical problems to lead them to deep understanding, as well as drawing mental maps and building perceptions of mathematical concepts and using color coding in taking notes, preparing models and making poster models, and for their learning to be better, they must be encouraged to write notes and taught in the form of cooperative groups and urged to summarize in order to gain a deeper understanding. In addition to preparing charts and illustrations during their teaching because they learn by doing this better. As for those who prefer learning in the visual style, which was 35% of the students and came second, they learn better through visual media, graphs, charts and pictures, and it is necessary to focus on colors during their teaching and presentation illustrative pictures of them, as well as displaying figures and models of posters, and those who prefer this style are distinguished in imagination and prone to creativity and innovation. This discrepancy in students' preference for learning styles confirms the existence of individual differences, as individual differences are a function of distinguishing learning styles, so the results were different despite the close age of the students and their specialization is the same. Researchers and those interested in education emphasize taking into account individual differences during teaching in order for their learning to be better.

The second question: **Is there a statistically significant difference at the level ($\alpha \leq 0.05$) between the preferences of students of the Mathematics Department for learning styles according to VARK model, in conformity with the gender variable?**

To verify this question, the researcher calculated the repetition of the research sample for the preferred learning styles, then applied the chi-square test (χ^2), and the result was included in Table (2) below:

Table (2)

Genders	style				NO.	χ^2		Statistical significance
	V	A	R	K		Calculated value	the tabular value	
males	45	9	55	14	123	2.273	7.81	non function
females	48	12	61	20	141			
the total	93	21	116	34	264			

It is clear from Table (2) that the calculated value of chi-square among learning styles for males and females reached (2.273), which is less than the tabular value (7.81) at the level of significance ($\alpha \leq 0.05$) and the degree of freedom (3). This means that there is no statistically significant difference between the preferences of learning styles according to VARK model for male and female students. The researcher attributes that the mathematical learning patterns according to VARK model among the students of the Department of Mathematics in conformity with the gender variable, that the results were in the same order for both sex, males and females due to the fact that they live in a close social, educational and cultural environment, and that they have studied the same curricula throughout their academic lives with the same teaching styles and methods, as

well as their integration into university studies in one educational environment, which may have affected their preferred learning styles in the study of mathematics.

Conclusions

- The read/write style and the visual style excelled, respectively, among the students of the Department of Mathematics.
- Mathematics students prefer lessons that have tangible real-world applications.
- Focusing on teaching strategies that take into account the read/write style and the visual style.

Recommendations

- Training teachers of the Department of Mathematics on the use of learning styles before starting to teach students.
- Include mathematics curricula to take into account students' written and visual learning style.
- Preparing training courses for teachers about learning styles.

Proposals

- Mathematical learning styles according to VARK model among students of the Department of Mathematics in the faculties of the University of Mosul.
- Mathematical learning styles according to VARK model and their relationship to mathematical thinking among students of the Department of Mathematics.
- Designing a proposed strategy according to VARK model in teaching mathematics.

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