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The Mathematics Learning Styles of Vocational College Students

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Abstract: The researcher investigated the mathematics learning styles of vocational college students during fall 2017 and spring 2018. 94 students enrolled in the vocational college of a public university completed the questionnaire "How Do I Actually Learn?" developed by Forster. Scale has four learning styles: reflective, inquisitive, diligent and user. The results of the research revealed that the most preferred learning model was user learning style in mathematics learning. Most of the students preferred to learn mathematics by writing the solutions, and reading through their notes or work. There were also statistically significant differences in mathematics learning styles among students according to their academic achievement. According to the results, students with high level of success were more inquisitive than students with low levels.

Keywords: *Learning styles, mathematics learning styles, mathematics education, vocational college.*

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Introduction

Although its conceptual roots have been in the field of psychology (Cassidy, 2004), important research on learning styles has been carried out over the last forty years in the area of education. Educators have believed that “every person had a learning style and persons' learning styles were as individual as their signatures” (Dunn, Beaudry & Klavas, 2002). It is generally acknowledged that learning styles indicate the way in which “each learner begins to concentrate on, process and retain new and difficult information” (Dunn, Dunn & Perrin, 1994, p. 12).

There are different definitions of learning style in literature. Grasha (1996) defined learning style as “personal qualities that influence a students’ ability to acquire information to interact with peers and the teacher, and otherwise to participate in learning experiences”. Negovan (2010) considered that the learning style referred to the organization and control of the strategies and knowledge acquisition and was configured by the cognitive, emotional and personality characteristics of the learner. Felder and Silverman (1988) described learning style as an individual’s preferred way of acquiring, retaining and processing information.

Learning styles have been assessed in different ways based on various theoretical learning models. Felder-Silverman, Honey and Murnford, Kolb, Dunn and Dunn’s VAK (Visual, Auditory, and Kinesthetic) and VARK (Visual, Aural, Read or Write and Kinesthetic) theories reflect the most common frameworks in the field of education. Some learning styles theories are based on preferences for certain types of cognitive processing (Honey & Mumford, 1992; Kolb 1984), while others are based on specific areas of personality (Felder-Silverman, 1988). An important research that characterizes students’ learning preferences in mathematics is also proposed by Forster (1999). Forster (1999) considers a model according to four fundamental dimensions helping educators to plan learning environments in mathematics course (Idil, Narli & Aksoy, 2016): reflective, inquisitive, diligent, and user.

The reflective dimension represents the manner in which individuals tend to learn by responding to questions in class work. The students with reflective learning style are characterized by their ability to answer the teachers’ and their friends' questions and to explain her/his works to the class.

The inquisitive dimension represents the manner in which individuals tend to learn by asking for an explanation in whole-class work. The students with inquisitive learning style are characterized by their ability to ask the teacher whether he agrees with her/his ideas in whole-class work, ask for an explanation in whole-class work and ask the teacher and friends to explain things.

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The diligent dimension represents the manner in which individuals tend to learn by listening to the teacher in whole-class work. The students with diligent learning style are characterized by their ability to work with the class on problems, work by herself / himself, and write the solutions.

The user dimension represents the manner in which individuals tend to learn by using graphics calculator/ computer and listening to the teacher in whole-class work. The students with user learning style are characterized by their ability to use calculator/ computer, experiment the process on the calculator/ computer, and listen to the teacher in whole-class work.

Learning styles has been the focus of a vast number of research studies in the educational literature. However, research studies investigating students' learning styles in mathematics are limited. This paper aims to analyze vocational college students' learning styles in mathematics by using Forster's learning model. Moreover, the research's purpose is to investigate students' learning styles according to their achievement in math class.

Methodology

Research Design

In the research, the general screening model of quantitative research methods was used to determine the mathematics learning styles of vocational high school students. The screening models aims to describe a situation that is in the past or is existing as it is. The event, person or object that is subject to research is tried to be described as it is in its own conditions, and the characteristics of individuals, groups or physical environments (abilities, preferences, behaviors, etc.) are summarized (Karasar, 2015).

Participants

Participants consisted of 94 students enrolled in the vocational college of a state university. 43 out of 94 of the respondents were female. Ages ranged between 18 and 32, with a mean of 22.13 (SD: 1.25). Students were grouped into five categories (1=FF, 2= DD, DC, 3= CC, 4=CB, BB, 5=BA, AA) based on their mathematics success scores (M = 2.89, SD = 0.95). The distribution of mathematics success scores of students are shown in Table 1.

Instrument

In order to determine the mathematics learning styles of the students, "How Do I Actually Learn?" questionnaire was used. Besides the questionnaire, the general demographic data i.e. age, gender, self-reported academic performance data was also collected.

"How Do I Actually Learn?" questionnaire developed by Forster (1999) was adapted to Turkish by Yenilmez and Cakir (2005) and validity and reliability studies were carried out. It contains 22 questions with 5-point Likert-scale items. Scale has four learning styles: reflective (8, 9, 12, 13, 14 and 18 items), inquisitive (6, 15, 16, 17, 19 and 20 items), diligent (2, 3, 7, 11 items) and user (1, 4, 5, 21, and 22 items). Yenilmez and Cakir (2005) calculated the instrument's reliability coefficient as 0.80. In this study, the reliability coefficient of the scale was found to be 0.82.

The data analysis was carried out using descriptive statistics and analysis of variance. The descriptive statistics were used to see demographics of the participants and general picture of subscales scores. One-way analysis of variance (ANOVA) was conducted to assess any differences in the mathematics learning styles among students based on the mathematical achievement.

Table 1. The distribution of mathematics success scores of students

Mathematics Success Scores	N	Percentage (%)
1	14	14.9
2	30	31.9
3	26	27.7
4	13	13.8
5	11	11.7

Research Results

Figure 1 presents the mean scores of vocational college students for items on "How Do I Actually Learn?" questionnaire. The mean scores of participants were mostly between 3.00 and 4.00. The majority of students responded that statements in the questionnaire were true or slightly true. These results indicate that the most vocational school students had mathematics learning styles often used. These results show that the majority of the vocational school students have mathematical learning styles that they use in learning mathematics.

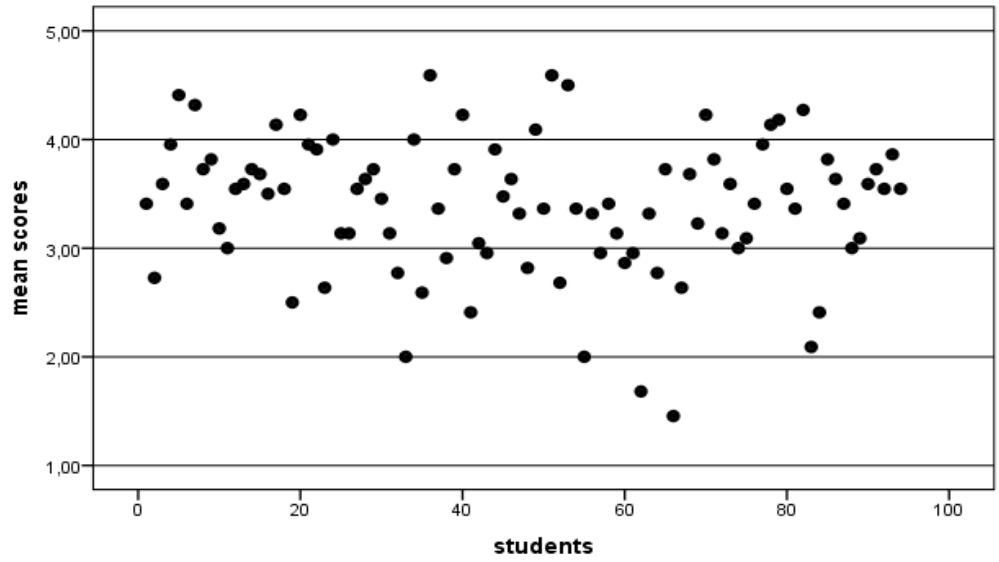

Figure 1. The distribution of the mean scores of students

Figure 2 presents the mean scores for items on "How Do I Actually Learn?" questionnaire. According to Figure 2, the highest ratings of the scale received item 3 (M=3.87) and item 1 (M=3.81), respectively. Item 3 states that students actually learn by writing the solutions. Item 1 states that students actually learn by reading through their notes or work. On the other hand, the lowest mean score corresponds to item 15 (M=3.16) which states that students actually learn by asking for an explanation in whole-class work.

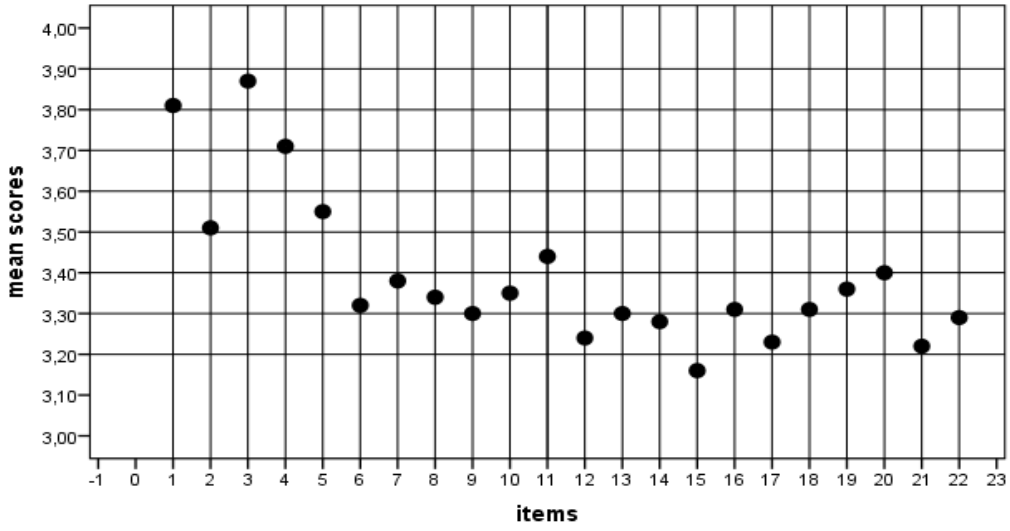

Figure 2. The distribution of the mean scores of items

The descriptive statistics for "How Do I Actually Learn?" questionnaire are reported Table 2. The highest mean scores belongs to the user learning style (M=3.52) and the lowest mean scores belongs to reflective learning style (M=3.29).

Table 2. Descriptive statistics for all subscales

Learning styles	N	$\bar{X}$	SD
Reflective	94	3.29	0.75
Inquisitive	94	3.30	0.81
Diligent	94	3.51	0.70
User	94	3.52	0.94

The distributions of the mean scores of the mathematics learning styles of the vocational college students according to their mathematics success scores are presented in Table 3. The highest mean score of reflective, diligent and user learning style were scored by students with medium level (3), and the highest mean score of inquisitive learning style were scored by students with high level (4). On the other hand, the lowest mean score of reflective learning style were scored by students with low level (1) and high level (5). The lowest mean score of inquisitive and user learning style

were scored by students with low level (1). The lowest mean score of diligent learning style were scored by students with high level (5).

Table 3. Mean scores and standard deviations of the mathematics learning styles according to mathematics success scores

Learning styles	1		2		3		4		5	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Reflective	3.14	.80	3.36	.94	3.57	.43	3.40	.58	3.14	.64
Inquisitive	2.92	.86	3.36	.93	3.56	.60	3.58	.43	3.53	.76
Diligent	3.46	.76	3.65	.72	3.66	.62	3.44	.57	3.32	.74
User	3.27	1.06	3.45	.85	3.63	.82	4.00	.90	3.57	.88

A series of analyses of variance (ANOVAs) was performed to evaluate the differences in learning styles among students according to mathematics success scores. The results are shown in Table 4.

Table 4. Differentiation of learning styles mean scores according to mathematics success scores

Learning styles		SS	df	MS	F	p	Differences
Reflective	Between Groups	2.380	4	.595	1,071	.375	-
	Within Groups	49.414	89	.555			
	Total	51.794	93				
Inquisitive	Between Groups	7.340	4	1.835	3,004	.022	1-4
	Within Groups	54.370	89	.611			
	Total	61.710	93				
Diligent	Between Groups	1.308	4	.327	,660	.622	-
	Within Groups	44.102	89	.496			
	Total	45.409	93				
User (Technology)	Between Groups	5.414	4	1.353	1,555	.193	-
	Within Groups	77.470	89	.870			
	Total	82.884	93				

SS = Sum of squares, df = Degree of freedom, MS = Mean squares.

The analysis of variance (ANOVA) shows that there were significant differences between two groups on the inquisitive learning style ($F(4,89)= 3.004$, $p =.02$). Results of post hoc comparisons, performed in order to determine which groups these differences originate from, confirmed a significant difference in the mean scores of students with low (1) and high levels (4) of success. According to the results, students with high level (4) of success were more inquisitive than students with low levels.

Discussion and conclusion

It was observed that vocational college students in this study had various mathematical learning styles that they used in learning mathematics. Item 3 (M=3.87) and item 1 (M=3.81) received the highest ratings of the scale, respectively. Most of the students have preferred to learn mathematics by writing the solutions, and reading through their notes or work. On the other hand, item 15 (M=3.16) received the lowest mean score. Students have believed that learning by asking for an explanation in whole-class work was less effective in mathematics.

Researches indicate that awareness of learning styles may be advantageous for both students and educators. Knowing their own learning styles can assist individual to develop their engagement with various teaching and learning activities in the curriculum, and can support the individual's professional lifelong learning (Jiraporncharoen et al., 2015). According to the results of this study, students have preferred to work on their own and in their own time rather than collaborate. This could be due to congested classes and inadequate cooperation among students. Acat, Ozer and Yenilmez (2004) believed that one of the main reasons for this situation was the traditional understanding of education. They pointed out that teacher-centered understanding that did not attach importance to interaction could be a limiting factor in student participation in the class.

According to the results, it was seen that the most preferred learning model was user learning style. The user learning style (M =3.52) received the highest ratings of the four learning styles which indicates students tend to learn by using graphics calculator/ computer and listening to the teacher in whole-class work. The participants have in general believed that using graphics calculator or computer helped them in learning and understanding mathematics. The results were inconsistent with some previous studies investigating learning styles in learning mathematics. Uz (2016), for example, investigated the learning styles of middle school students between 12-14 years old in Mersin (Turkey) and Riga (Latvia) in terms of achievement in maths class. She reported that the most preferred learning styles in Turkey and Latvia were diligent and reflective learning style, respectively.

The results of this study indicated that significant differences were found between learning styles and mathematics achievement scores. A majority of the students with the low (1-2) and medium level (3) of success embraced the diligent learning style. Students with high level (4-5) of success embraced the inquisitive and user learning style, respectively. The results revealed that a significant differentiation between learning styles and mathematics success scores on the inquisitive learning style. It was found that students with high level of success were more inquisitive than students with low levels. Finding of this study is in line with the investigation of Yenilmez and Cakir (2005) which reported that the most preferred learning style of students with high level of mathematics success was the inquisitive learning style. The results of another study by Vizeshfar and Torabizadeh (2018) on nursing students show that a significant statistical difference between learning styles and academic achievement According to Vizeshfar and Torabizadeh (2018), considering students' learning styles in achieving a better educational outcome is very important. Therefore, educators should pay attention to their students' individual differences for the learners' educational needs to be met effectively. However, the findings of some studies contradict the findings referred to above. For example, in a study by Rahman and Ahmar (2017) on first year students, no relationship was found between the students' learning styles and their academic achievement in mathematics. The differences among these results can be attributed to the fact that these studies have been performed in different cultures (Vizeshfar & Torabizadeh, 2018). To obtain more global results, the similar research can be carry out in environments with different types of samples (Kaleli-Yilmaz, Koparan & Hanci, 2016).

Studies suggest that the understanding of learning style could greatly enhance academic success of individual (Sternberg, Grigorenko & Zhang, 2008). Based on the results of the study, it may be suggested that educators need to be aware of learning styles of their students. Because mathematics is a discipline characterized by abstract knowledge, accurate results and strong logical procedures (Cai, 2007), it is possible to diversify the learning activities that better match the learning style of students carrying the intense cognitive load. When students are exposed to matched teaching and learning styles according to their learning styles, a more effective learning environment may have been created them in achieving success. Therefore, to extend this study, students' academic achievements in mathematics can be investigated in detail in the learning environment created according to their learning styles. It may also be more effective to use mixed methods combining quantitative and qualitative research techniques to better understand students' mathematics learning style.

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