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The relationship between learning styles and achievement in calculus course for engineering students

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Abstract

The researches that have been done recently indicated that individuals' ability to learn and interact might increase when the proper conditions are met that suitable for every single individual in terms of pace of comprehension and power of understanding. There are plenty of factors for formation of learning. One of the factors is the personal characteristic, which are resisted to change. Once you determined applying the proper way of teaching the students depending on their perceptions skills, it would simplify the process of selecting the appropriate teaching strategy. Therefore, the strategy selected through the students' characteristics of learning creates a strong influence over the students' performances at class. This fact aids to shift the importance towards to the students instead of the instructor and his/her routine teaching style. In this study it has been defined how the engineering students' learning styles are categorized. Moreover it has been examined that whether one or more learning styles are dominant among the group members or not. The purpose of this study is to raise the success level of the engineering students in calculus course which is an essential course in engineering education. Therefore it has been analyzed whether the success depends on the way of learning style or not. The data has been used in this paper is gathered from David Kolb's learning styles model and the students' grades in their calculus course. A one-way analysis of variance (ANOVA) was conducted to evaluate the relationship between learning style and success for calculus course in engineering programmers. Consequently; base on the findings, a significant difference has been found among students' learning styles and their performance on the calculus course. The results determined the discriminatory learning styles.

1. Introduction

Ability to learn is one of the vital characteristics of human. Humans get the behaviors and the attitudes that they need, by the impact of their environment and the endowments. This ability of learning directly affects the casual life-style of them. Therefore modern societies keep enhancing their learning styles (Cuceloğlu, 1991).

The studies made in the first and the second quarter of the twentieth century point out that any institution that is related with education has reached to a reductionist frame. This classical conditioning switched its purpose to

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experiential learning theory in the 1960's. The cognitive theorists such as Bloom, provided the nature of learning via fresh approaches. Learning style can be expressed such as gathering information, processing information, the improvement of thinking, and the way to the selection of reaching to the knowledge. It has been stated in numerous

studies that learning is an abstract time period that born with the personal experiences (Mezirow, 1981; Freire , 1985). In various studies, it has been determined that learning is formed by the interaction between the individual and individual's environment. Furthermore, it creates some alterations on the person's attitudes in long-term.

Besides, it is stated that there are plenty of different learning styles depending on the individuals. Defining the individuals' learning style helps them to be aware about their weaknesses. Therefore it helps to the individuals to promote themselves to a higher personal level in terms of their attitudes and behaviors (Felder, 2002; Fallan, 2006).

Dunn (1990) described learning style as "the way each learner begins to concentrate, process, and retain new and difficult information". Kolb (1984) described learning style as "the way process the possibilities of each new emerging event which determines the range of choices and decisions we see, the choices and decisions we make, to some extend determined the events we live through, and these events influence our future choices…Human individuality results from the pattern or program created by our choices and their consequences". In order to determine the best way of learning for with certain personal skills, there have been made plenty of studies. One of these studies is Kolb's learning style inventory. In Kolb's study, the learning styles are defined by a circle and the position of the individual in this circle is determined. According to Kolb's learning theory, the definition of learning is gathered by converting the information into the experience. In the studies which have been made with the assistance of Kolb's learning style inventory, it has been explained either the learning style's importance over academically success or the relation between the learning styles and the variables that affect the learning style.

The common purpose of the studies in the field of mathematics education is to boost the success of the students. Therefore the recent studies focus on this purpose overall. According to these studies, the reason of the failure is just because of the inconsistent learning methods and the awful learning styles (Miller, et.al. 1992; Hartman, 1995; Schroeder, 1993; Montgomery, and Groat, L.N., 2000). Instructors should be aware of the application of the proper learning method in order to increase the tendency to succeed for the students. Once the instructors determined the most accurate learning method depending on the level of student, it would be more simplified to select the proper strategy to apply over the students (Arslan & Aksu 2005). There are plenty of studies that state the success and the performance increase when the proper teaching style matched with the proper learning style (Novin, et al. 2003; Knox, 1986; Holvikivi, 2007; Knox, 1986; Felder,.et.al.,2002). There the harmony should be maintained. No one can disagree that every single student will be diligent and is going to understand easily all the time. Simply it is not easy for someone to change the learning style of his own. However this might be changed by the assistance of experiences and the time. The teaching method that focuses on the students' preferences and their skills increases their motivation as well as simplifies the way they understand.

In this paper it is questioned that the dominant learning style's affects over achievement in calculus course of the undergraduate students who decided the selection of working fields.

2. Methodology

The purpose of the study was to investigate whether the success in calculus course depends on the way of learning style or not. The subjects were 3th semester-students (n=87) who enrolled in Anadolu University Engineering Faculty in the fall term of 2009. The study involved collecting data from two sources: the Learning Style Inventory (LSI), and Grades of Achievements Acquired in Calculus (CA).

1.1. Learning Style Inventory (LSI)

Learning preferences of students have been measured by Learning Style Inventory (LSI) and developed and revised by Kolb (1985). The LSI has been a very useful tool in contributing to our understanding of the role of individual differences in the learning process.

Kolb (1985) theorized that learning is a four-stage process involving concrete experience (feeling), reflective observation (watching), abstract conceptualization (thinking), and active experimentation (doing). Kolb also stated that pairs of these activities may be represented along two dimensions of active-to-reflective (defined as doing-watching) and concrete-to-abstract (defined as feeling-thinking). Individuals classified as being more active than reflective and more concrete than abstract Kolb (1985) called accommodator, whereas more abstract than concrete

are called converger. More reflective than active and more abstract than concrete individuals are called assimilator, whereas more concrete than abstract are called diverger.

The LSI instrument used in the study consisted of twelve incomplete statements, each with four possible completion phrases. Students were asked to rank the completion phrases, using the numbers from 1 to 4, according to how they felt personally when they were applied to them. Results indicated the learning style modes of students in four categories. These categories are concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE). A total score for each of the four modes is summed over the twelve items, and the rank order of those four sums is used to calculate the scores. The mode having the highest rank was labeled as the student's Primary Learning Scale. The results of learning style modes were then combined to classify each student into one of four learning styles: Accommodator, Assimilator, Converger, or Diverger. The four learning styles are represented by the four quadrants of the plane, as shown in Figure 1.
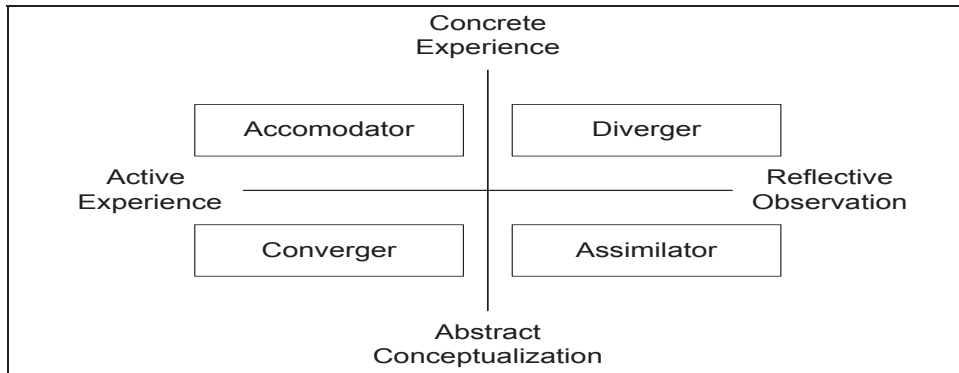

Figure 1. Kolb's learning styles

2.2. Grades of achievements acquired in calculus (CA)

Grades of achievements acquired in calculus (CA) are defined by the grade point average at theend of the 2009 academic year. CA scores obtained from the faculty records office .

3.Findings and results

Data were analyzed by the overall learning-style variable comparisons, as well as comparison calculus achievement. The statistical procedure used to test the aim of this study was two-sample t-test. Two-sample t-test was conducted to determine whether there was a statistically significant difference in calculus achievement among students classified in the four learning mode categories or not. Each dimension of the learning mode was analyzed separately with respect to the dependent variable of calculus achievement for students. The findings of this analysis resulted in statistically significant differences. As shown in Table I, a statistically significant difference was found between calculus achievement (CA) and the four different learning modes categorized for students enrolled.

Table 1. Two-sample t-test of CA and LSI for students.

Variable	$\overline{X}$	S	t
CE	22.7	7.12	14.98
RO	30.56	5.18	29.12
AC	34.92	7.34	22.7
AE	32.45	5.8	24.43

p < .05

It was seen that in Table I, there was difference in average. Namely, there were significant differences between the learning mode and the calculus achievement. The t-test revealed that, the larger differences in the average CE, RO, AC, AE learning mode scores occurred for the abstract conceptualization (AC) learning mode in calculus achievement. In the abstract conceptualization (AC) stage a person's learning involves using logic and ideas, rather than feeling, to understand problems or situations In general, students who prefer abstract conceptualization create theories to explain observations, lectures, papers and analogies. These students case studies, theoretical readings, and thinking alone (Hartman 1995; Schroeder 1993; Sutliff, Baldwin, 2001).

The Kolb LSI was used to classify all students into the four learning styles. According to the classification results, 43% of the students preferred the Converger learning style. A Converger perceives reality through abstract conceptualization and processes it through active experimentation. S/he prefers to perceive information by thinking and doing. Students who prefer the Converger learning style make decisions and solve problems objectively using factual data. Given the recent news events regarding creative accounting techniques, it is appropriate to continue to encourage students in this area. According to the classification results, 32% of the students preferred the Assimilator learning style. Assimilators follow the convergers. An Assimilator perceives information abstractly and processes it reflectively. S/he learns by watching and thinking and stability, expert opinion, accuracy, detailed information. Students who prefer the Assimilator learning style learn best from lectures and demonstrations. Her/his strength lies in the ability to create theoretical models. According to the classification results, 17% of the students preferred the Diverger learning style and %8 of the students preferred Accommodator learning style. The number of Accommodators is very limited.

ANOVA was conducted to evaluate the relationship between learning style and success for calculus course in engineering programmers. The results show that there is meaningful difference in calculus achievement for the different learning styles. Convergers and Assimilators performed better than the Divergers and Accommodators.

Miller, et.al., (1992) used Kolbs' theory to analyze the precalculus course in programming and problem solving. They found that most engineering students were Assimilators. This is not general conclusion since Goold and Rimmer (2000) found that successful computer engineering students were Convergers. These conclusions verified our findings: both Converger and Assimilator learning styles are high on the abstract conceptualization scale.

When comparing the preferred learning styles of students in the department of chemistry, it is not surprising to find that they preferred the Converger and the Assimilator learning style. Not surprisingly, least students were observed to prefer the Accommodator learning style in the groups since the Accommodator learning style is the most pragmatic and least academic of the four learning styles.

4.Discussions

According to the findings, students mostly preferred the Converger learning style. The Convergers' dominant learning abilities are abstract conceptualization and active experimentation. They are active learners who prefer discovery-type inquiry. Computer assisted instruction is a possibility for them. The Convergers make decisions and solve problems particularly by using factual data. To facilitate the Converger students' learning, the instructor of these students should approach teaching from an objective approach, which permits students to learn by doing and having them work on problems.

According to the findings, students second preferred the Assimilator learning style. The Assimilators' dominant learning abilities are abstract conceptualization and reflective observation. They learn by watching and thinking. The Assimilators are good organizers and planners. In order to motivate Assimilators the use of cases that require them to assimilate and synthesize information to establish a theory is important. These learners prefer to observe in their learning.

Diverger was the third preferred style by students. These are imaginative and emotional individuals. The Accommodator was the least preferred style by students. This learner's educational background is often in technical or practical fields.

5.Conclusions and Recommendations

While determining the purpose of the calculus course, the students' personal skills should be considered. An effective calculus course, the students should be forced to gather formulas and to create the equations by themselves instead of giving them the formulas and the equations in advance. Moreover a teaching method has to be served to the students which drive them to use their mental skills in order to find fresh information by themselves.

In this study, we investigated whether students in Chemistry Department are classified into different learning styles and whether one or more specific learning styles predominate within this group. In addition to the relationship between students' learning styles and calculus achievement, are investigated. According to the findings, students have different learning styles. The results show the importance of a diversified teaching approach that includes all learning styles defined above. Acknowledgement of students' individual learning styles can play a critical role in the learning process. Then the use of formal learning style assessments can provide useful information that benefits the student as well as the instructor.

As a conclusion, once you determined applying the proper way of teaching the students depending on their perceptions skills, it would simplify the process of selecting the appropriate teaching strategy. Therefore, the strategy selected through the students' characteristics of learning creates a strong influence over the students' performances at class.

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