

The Relationship Between Learning Styles And Achievement In Physics Course And Calculus Course

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Abstract

The aim of this study was to investigate the relationship between learning styles and success achievements in Physics I and Calculus I in fall semester of 2005-2006 academic year in Physics Department of Anadolu University, Turkey. 72 students from first and second grades attended to this research. Kolb's Learning Style Inventory was used to collect data in this study. This instrument consists of a survey with 12 sentences to find out how the students learn in different situations. Learning preferences are two combination scores that indicate the student's preferences for abstractness or concreteness and for action or reflection. Students' learning styles were determined by using Kolb's Learning Style Inventory and it was investigated whether students' achievement on Calculus I and Physics I were different or not, according to these learning styles. It was found that there was meaningful relationship between students' learning styles and students' achievements on Physics I. Students on converger learning style category were more successful than the others. Besides, it was not found any meaningful relationships between students' learning styles and students' achievements on Calculus I.

Introduction

The common aim of the studies in science and mathematics education is the success of student. For this reason, recent educational researches generally concentrate on how the successes of students are increased.

Nowadays, it is generally known that the students are not so successful in science classes. Naturally, this failure is caused both by teaching and learning. Logical arrangements of knowledge and relationship with each other connected with approach to problem solving, and usage of knowledge in memory, and learning of knowledge by student. Thus, while the teachers determine the appropriate learning methods to increase the student's success, it is important to know the student's learning styles (Anderson, Demetrius, 1993; Hartman, 1995).

Physics and Calculus are the lectures which are privileged for the physics students. Generally, these students have a negative approach to Calculus. On the other hand, Calculus is an important component of Physics education. If Calculus is not learned well and can not be used, analyzing and interpreting observations and experiments in Physics is not possible. Making the solutions of concrete problems developed using abstract concepts in Physics easy, the interpretation of physics problems become meaningful. Calculus I is a 5-credit course and consists of lecture and recitation components. Students meet two times a week for 135 minutes class sessions. Physics I is also a 5-credit course and also consists of lecture and a recitation components. Students meet three times a week for 90 minutes class sessions. Besides the Physics I sessions, students have a 90 minutes long laboratory weekly. The name of this separate course is Physics Laboratory I which is a 1-credit course.

When the aims of lectures of physics and calculus are determined, each student must be considered by his own individual properties. For an effective science education, instead of giving ready knowledge, formation of basic concepts by students and finding formulas and rules themselves are necessary. Besides, applications in science education such as experiments and observations are important. For this reason, using students' skills of hands and minds, giving possibility for the students to create new things and developing their skills, learning must be realized as adaptation to technological developments (Jensen, Wood, 2000).

Most teachers know that each student learns differently and tries to accommodate these different ways of understanding (Sharp, Harb, Terry, 1997; Novin, Arjomand, Jourdan 2003 ; Jensen, Wood, 2000 ; Knisley, 2002). The results of this approach can be used to address issues such as the effective role of a teacher and appropriate uses of learning style. That means, teachers can guide the development of curricular and instructional reform.

Researches in education for decades suggest that students utilize individual learning styles, and instruction should be multifaced to accommodate a variety of learning styles (Schoenfeld, 1999; Felder, 1993; Bodi, 1990). Thus, a model of science learning should include strategy building as a learning style (Eyring, Johnson, Francis, 1993).

Some studies show that identifying a student's learning style and then providing instruction consistent with that learning style contribute to more effective learning (Rosenthal,1995; Inagaki, Morita, Hatano, 2000). The matching students' learning preferences with compatible instructional interventions significantly improves academic achievement (Dunn, Grigg, 2000).

Methodology

First and third semester students at Anadolu University, Science Faculty, Physics Department (n=72) attended to this research. Data was collected for this study from three sources; Learning Style Inventory (LSI), and Grades of Achievement Acquired in Physics (GAAP) and Calculus course (GAAC). (GAAP) and (GAAC) scores is maintained by the help of Faculty Records Office.

Learning Style Inventory (LSI): Kolb developed the Learning Style Inventory in 1985. The LSI was a 12 item self-report questionnaire in which four words described one's style in a rank. One word in each item was corresponding to one of the four learning modes. These four different learning modes are Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC) and Active Experimentation (AE). Concrete Experience (CE) emphasizes feelings rather than thinking. Reflective Observation (RO) focuses on deriving understanding by observation and reflection. Abstract Conceptualization (AC) focuses on the use of logic and analysis rather than feeling. Active Experimentation (AE) focuses on practical applications rather than observing.

Kolb's model assumed that active experimentation (AE), with reflective observation (RO) and abstract conceptualization (AC) with concrete experience (CE) are opposite modes. By combining the four learning modes, four learning styles can be achieved. Students classified as being more active than reflective and more abstract than concrete are named Convergers, whereas more concrete than abstract and more active than reflective are named accommodators. Then, more reflective than active and more abstract than concrete are named assimilators,

whereas more concrete than abstract and more reflective than active are named divergers (Kolb, 1984). Figure 1 shows these learning modes and learning styles.

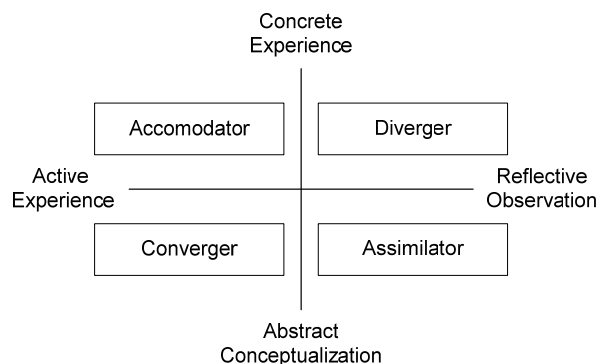


Figure 1 .Kolb’s Learning Style Model

The convergers learn by developing individual strategies. Their favorite question is “How ?”. The accommodators learn by trial and error. Their favorite question is “What if ?”. The assimilators learn from detailed explanations. Their favorite question is “What ?”. The divergers built on past experience. Their favorite question is “Why ?”(Hunkeler, Sharp, 1997).

Results

Data was analyzed by overall learning mode comparisons as well as Physics and Calculus courses’ achievements. The statistical procedure used to test the aim of this study was one way module of SPSS named ANOVA. One way ANOVA was conducted to determine whether there exists a statistically significant difference in Physics and Calculus course achievements among students classified in the four learning mode categories. Each dimension of the learning mode was analyzed separately with respect to the dependent variables of Physics and Calculus course achievements of students enrolled. As shown in Table 1, a statistically significant difference can be examined in Physics course achievement (PA) and the four different learning modes (LM). As shown in Table 2, no significant difference can be examined between Calculus course achievements and the four different learning modes (LM).

Table 1. Means and Standart Deviations of four learning mode on Physics courses.

Learning Mode	N	Means	Standard Deviations
AE	26	45.48	12.24
AC	22	35.71	9.58
RO	19	26.88	17.92
CE	5	19.85	12.61

In this study it is examined how student’s learning modes affected their Physics course achievements. In this analysis, the independent variable was students’ learning modes and the

dependent variable was their achievements in Physics courses. The means and standard deviations of the student's learning modes are indicated in Table I. Using one-way ANOVA module in SPSS, it was found that there was a statistically significant difference between Physics achievement of students with the four learning modes ($F(2,40) = 6.86, p = 0.003$).

Thus, it appears that the students had different learning modes while being instructed Physics. As can be seen in Table I, the highest mean was observed for Active Experience (AE) and the lowest mean was observed for the Concrete Experience (CE). The Active Experimentation mode describes students who take an active role influencing others as well as situations. These students welcome practical applications rather than reflective understanding as well as actively participating rather than observing. The Concrete experience mode describes students who prefer to feel more than to think. Students in this mode tend to be intuitive decision makers (Hein, Budny, 1999).

Secondly, this study examined how student's learning modes affected students' Calculus course achievements. In this analysis, the independent variable was the students' learning mode and the dependent variable was the students' Calculus course achievements which are obtained from the Faculty Records Office. The means and standard deviations of the learning modes for each student are indicated in Table 2. Using one-way ANOVA module in SPSS, no statistically significant difference between the Calculus scores of students with four learning modes could be found ($F(2, 40) = 2.79, p = 0.073$).

Table 2. . Means and Standard Deviations of four learning mode on Calculus course scores

Learning Mode	N	Means	Standard
AC	22	53.79	10.49
RO	19	47.75	14.45
AE	26	44.86	9.82
CE	5	43.02	12.03

Thus, it appears that even though the students had varying learning modes while instructing Calculus, the learning modes of students did not vary significantly.

The highest mean was observed for Abstract Conceptualization and the lowest mean for the Concrete Experience. The Abstract Conceptualization (AC) mode describes students who prefers to think more than to feel. Such students tend to have a scientific approach to problem solving as opposed to a more artistic approach. Table 3 shows frequencies and percentages of the learning style (LS) of students in the sample.

Table 3. The percentages of the learning style of the students

Learning Styles	Frequence	Percentage
Converger	29	40
Assimilator	27	38
Diverger	12	17
Accomodator	4	5

According to these results, 40% of students enrolled major preferred Converger learning style. Students who prefer the Converger learning style learn by applying and testing information. However, 38% of students enrolled preferred Assimilator learning style. Students who prefer the Assimilator learning style learn by reading, observing, collecting data and analyzing. Almost 17% of students enrolled preferred Diverger learning style. Students who prefer the Diverger learning style, have an excellency in insight thinking, brainstorming, creativity, and working in groups (Sharp, Harb, Tery, 1997). Finally, the remaining 5% of the students enrolled preferred Accommodator learning style. These students excell at creative problem solving, seeking new possibilities and enjoy discussion.

Conclusions and Recommendations

Information about students' learning styles is important for both the teacher and the students. Teacher with deep understanding students' learning styles can easily adapt their teaching methods to students with different learning styles. Those teachers are more likely to motivate student learning. The students who know their own learning style become better learners and have more positive attitudes about their studies.

In this study, we investigated whether Physics students are classified into different learning styles and whether one or more specific learning styles predominate within this group. Then the relationship between students' learning modes and achievement of Physics course, and Calculus course were investigated.

According to these findings, Physics students have different learning modes and learning styles. The greatest parts of the students are more practical, active and they learn by doing and by thinking.

It was found in this study that the learning modes during instruction did affect students' learning of Physics and did not affect students' learning of Calculus.

We can conclude from this information that students learn Mathematics very difficult and feel prejudiced about Mathematics. It can be concluded that teachers' instructional styles do not have a large effect on students' achievement in Calculus. These results run counter to the prior research studies on the effect of learning modes on students' Calculus achievement (Dunn, 1986; Fullerton, 1995; Zack, 1999; Inagaki, Morita, Hatano, 2000).

If there was not enough difference between learning modes and students' mathematics achievement, this would have reduced differences in student achievement.

This study found that the learning mode of students during instruction affected students' learning Physics which agrees with the prior research, which was shown that learning modes can affect how well students learn (Hein, Budny, 1999; Knisley, 2002; Novin, Arjomand, Jourdan, 2003).

The results of this study have determined that there are significant differences in the methods of instruction for students which should be tested for mathematics.

References

- Anderson, R., Demetrius, O. (1993). A flow map method of representing cognitive structure based on respondents narrative using science content. *Journal of Research in Science Teaching*, 30.(8), 953-969.
- Bodi, S.(1990). Teaching effectiveness and bibliographic instruction: The relevance of learning styles. *College & Research Libraries*, 51, 113-119.
- Dunn, R., (1986). Learning styles. Link between individual differences and effective instruction, *Nourth Carolina Educational Leadership*, 2 (1), 4-22.
- Dunn, R., & Griggs, S.A. (2000). Practical approaches to using learning styles in higher education. Westport, CT: Bergin & Garvey.
- Eyring, J.D., Steele Johnson, D., & Francis, D.J.(1993). A cross-level units of analysis approach to individual differences in skill acquisition. *Journal of Applied Psychology*, 78(5), 805-814.
- Felder, R.M.(1993). Reaching the second tier: Learning and teaching styles in college science education. *Journal of College Science Teaching*, 23(5), 286-290.
- Fullerton, O.(1995). Using talk to help learn mathematics. *English Quarterly*, 27(4), 10-17.
- Hartman, V., F., (1995). Teaching and learning style preferences: transitions through technology. *VCCA, Journal* 9(2), 18-20.
- Hein, T.L., Budny, D.D.(1999). Teaching to Students' Learning Styles: Approaches that Work. 29th ASEE/IEEE Frontiers in Education Conference 12c1-7. San Juan, Puerto Rico
- Hunkeler, D., and J.E. Sharp. (1997). "Assigning Functional Groups: The Influence of Group Size, Academic Record, Practical Experience, and Learning Style,". *Journal of Engineering Education* 86(4), 321-332.
- Inagaki, K., Morita, E., & Hatano, G. (2000). Teaching learning of evaluative criteria for mathematical arguments through classroom discourse: A cross national study. *Mathematical Thinking and Learning*, 1(2), 93-111.
- Jensen, D., & Wood, K. (2000). Incorporating learning styles to enhance mechanical engineering curricula by restructuring courses, increasing hands-on activities, and improving team dynamics. ASME Annual Conference, Orlando, FL.
- Knisley, J. (2002). A four-stage model of mathematical learning. *The Mathematics Educator*, 12(1), 11-16.
- Kolb, D.A.(1984). *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs. New Jersey: Prentice Hall.
- Kolb, D.A.(1985). *Learning Style Inventory: Self-scoring Inventory and Interpretation Booklet*. Boston MA.: McBer & Co.
- Novin, Adel, M., Arjomand, Lari, H., Jourdan, L. (2003). An investigation into the preferred learning styles of accounting, management, marketing, and general business majors. *Teaching & Learning* 18(1), 24-31.
- Rosenthal, J., (1995). Active Learning Strategies in Advanced Mathematics classes. *Studies in Higher Education*, 20 (2), 223-228.
- Schoenfeld, A.H. (1999). Looking toward the 21st century: Challenges of educational theory and practice. *Educational Researcher*, 28(7), 4-14.
- Sharp, J., E., Harb, J.N., & Terry, R.E. (1997). Combining Kolb learning styles and writing to learn in engineering classes. *Journal of Engineering, Education*, 86(2), 93-101.
- Zack, V.(1999). Everyday and mathematical language in children's argumentation about prof. *Educational Review*, 51(2), 129-146.