academicJournals

Vol. 10(4), pp. 403-415, 23 February, 2015
DOI:10.5897/ERR2014.1989
Article Number: 587E30150486
ISSN 1990-3839
Copyright © 2015
Author(s) retain the copyright of this article
http://www.academicjournals.org/ERR

Educational Research and Reviews

*Full Length Research Paper*

# Turkish pre-service physics teachers' preferred learning styles

**Şebnem KANDİL İNGEÇ**

Gazi University Gazi Faculty of Education, Physics Education Ankara/Turkey.

Received 06 November, 2014; Accepted 2 February, 2015

**This study aims to determine the dominant learning styles of pre-service physics teachers and to examine them in terms of variables such as gender, information and communication technologies skills, academic achievement and type of motivation. Survey model was used.The sample composed of 50 pre-service physics teachers. The data were collected for this study from three sources; demographic information (DI), Learning Style Inventory (LSI), "Information and Communication Technologies Skills" (ICT skills). 1999 version of Learning Styles inventory developed by Kolb and adapted to Turkish by having the studies of validity and reliability by Evin Gencel was used. ICT skills developed by Wilkinson et al., which was prepared by Haznedar through adapting some items from the attitude scale aimed at e-learning, which made it more convenient and up-to-date for Turkey. The data were analyzed by using frequency, percent value, mean scores, standard deviation, Chi-square test, independent samples t ANOVA. The results show that general learning styles preferred by the pre-service physics teachers were "Diverging". Considering this finding, it is observed that this study is different from the studies in literature. When the literature is taken into consideration, it appears that prospective teachers generally prefer 'assimilating' and 'converging' learning style. According to another finding of the study, the learning styles were not related to gender, type of motivation, information and communication technologies skills (ICT skills), and academic achievement.**

**Key words:** Learning styles, pre-service physics teachers, motivation, information and communication technologys.

## INTRODUCTION

It was well known fact that learning must be a continuous process in modern society, and in academia in particular. In other words, learning is a dynamic, lifelong process. Malik and Janjua (2011) pointed out that individuals involved in the process of learning often develop attitudes and behaviors which determine preferences and expectations in the way they learn. These preferred ways are called learning styles.

According to Felder and Brent (2005), the problem is that no two students are alike. They have different backgrounds, strengths and weaknesses, interests, ambitions, senses of responsibility, levels of motivation, and approaches to studying. If a teacher knew the optimum teaching styles for all students in a class, it would be possible to know students' strengths and weaknesses. As every teacher discovers, no two students approach

E-mail: singec@gazi.edu.tr

Authors agree that this article remain permanently open access under the terms of the Creative Commons Attribution License 4.0 International License

learning in exactly the same way. When teachers teach using their own preferred style not all of students will have the identical style. Inevitably learning will be diminished for some. As stated by Felder (2010), awareness of learning style differences can help instructors teach in a manner that effectively reaches most students rather than putting a large subset of them at a disadvantage. Teachers need to be aware of learning styles to avoid mismatches in style between instructors and learners. According to Wlodkowski (2008), if students are taught in a manner heavily mismatched with their learning styles, one might expect that their resulting discomfort would diminish their motivation to learn.

As stated by Grillo (2012), through differentiation of physics curriculum, teachers are able to meet various students' learning styles. Educators are able to differentiate the curriculum so that it builds on students' strengths and addresses their weaknesses. Teaching techniques found in Just-in-time Teaching: Blending Active Learning with Web Technology were used in the lesson planning and instruction of the course taught (Grillo, 2012). Therefore, the critical role that a learning style approach can play in terms of physics education.

Numerous studies of research on adult learners suggest that increased learning gains can be achieved when instruction is designed with students' learning styles in mind (Dunn et al., 1990; Lenehan et al., 1994; Ranne, 1996; Larkin-Hein, 2000; Larkin-Hein and Budny, 2001, 2003). Additionally, several researchers of physics education have pointed out the importance of teaching with learning styles in the Physics Classroom (Larkin-Hein and Budny, 2001, 2003). However, there are no research studies on using motivation type as a component of formal assessment of student learning styles. The current study aimed to determine the relations that motivation type and individual learning style.

Many different learning style instruments are available for use by teachers and researchers in literature such as "Felder's Index of Learning Styles" (ILS) (Felder, 1993), "The Learning Channel Preference Test "(LCPT) (O'Brien, 1989), Learning Style Profile" (LSP) (Keefe and Monk, 1988), "Learning Styles Inventory" (LSI) (Kolb, 1985) and "Gregorc Style Delineator" (Gregorc, 1982). As Cavas (2010), Kolb explained that LSI is different from other tests of learning style and personality used in education by being based on a comprehensive theory of learning and development. Some researchers had examined the Kolb Learning Style Inventory (KLSI). They argued that the KLSI might well be useful to researchers, educators and practitioners. Veres (1991) found increased stability in their stydy. Raschick et al. (1998)'s research also found the KLSI a useful tool for optimizing the relationship between supervisors and their students. Lu et al. (2007) emphasised that based on these favorable results, KLSI became a well-accepted instrument. The KLSI was adapted by many countries to investigate learning styles (Can, 2010; Evin Gencel, 2007; Yoshitaka, 2005). There are several approaches to teaching undergraduate physics and engineering students using both the Dunn and Dunn and the Kolb learning style models discussed in literature (Larkin-Hein and Budny, 1999; Larkin-Hein, 2000; Larkin-Hein and Budny, 2001). It was reported that the Dunn and Dunn learning style model is employed with non-majors enrolled in introductory physics at American University and the Kolb learning style model is employed with freshman engineering students at Purdue University. Important to note was the fact that the learning style assessment tool used was not as critical as the actual assessment of learning styles. In summary, Kolb's Learning Style Model is the most widely accepted learning style model and has received a substantial amount of empirical support (Manolis et al., 2013). In this research, The Kolb Learning Style Inventory was used as the data collection tool in order to detect the learning styles of teacher candidates.

The Kolb learning style model was based on Kolb's experiential learning theory. Kolb has described four basic learning styles: accommodative, assimilative, divergent, and convergent (Richmond and Cummings, 2005). Incorporated within each learning style is a combination of two of the four learning modes: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC), and Active Experimentation (AE). The assimilative learning style is characterized by the ability to reason inductively. As stated in the study by Larkin-Hein and Budny (2000), the Diverger's dominant learning characteristics involve the perception of information through Concrete Experience that is then processed through Reflective Observation. A characteristic question of this type is "WHY?". The Assimilator's dominant learning characteristics involve the perception of information through Abstract Conceptualization, that is then processed through Reflective Observation. A characteristic question of the Assimilator is "WHAT?" The Converger's dominant learning characteristics involve the perception of information through Abstract Conceptualization, with information being processed through Active Experimentation. A characteristic question of this learning type is "HOW?" The Accommodator's dominant learning characteristics involve perception of information through Concrete Experience, with information being processed through Active Experimentation. A characteristic question of this learning type is "WHAT IF?"

It is very important to determine the learning styles, which are related with the learning conditions of individual and her/his preferences in the process of learning (Ülgen, 1997, p.38); determine whether she/he learns better through hearing, speaking, doing-experiencing or combining all these together (Açıkgöz, 1996, p.52); express the style of obtaining and processing the information that

starts when every learner concentrates on a new and challenging information (Dunn and Dunn, 1993); and showing how a student responds to stimulants and uses these stimulants during learning (Claxton and Ralston, 1978). As Currie (1995), teachers should help students in developing their dominant learning styles in order to enable them to be more effective learners, and know what and how to learn and how to use what they have learned. According toVeznedaroğlu and Özgür (2005), providing an educational service that is convenient for learning styles will not only increase the academic achievement of students, but also develop a tolerance towards the different, become more disciplined and develop a positive attitude towards education. Besides, knowing the learning styles and planning the learning – teaching activities accordingly may show that many students with the so-called learning disability do not indeed have any learning disability and they could easily learn as long as convenient environments and stimulants are provided.

According to Şengül et al. (2013), when the studies conducted about learning styles were analyzed, it was seen that a great number of relational studies were carried out about this subject. In these studies, it was looked for relations between several variables such as class level, gender, age, way of learning, type of programs in high schools, type of faculties, critical thinking tendencies (Özdemir and Kesten, 2012; Bahar and Sülün, 2011; Can, 2011; Çaşkurlu and Baykara, 2011; Şeyihoğlu, 2010; Demirbaş and Demirkan, 2007). As Şengül et al. (2013), if the learning styles which are defined as the tendencies of students in the methods for collecting and organizing information are identified, it will be easier to understand how individuals are learning and what kind of a teaching design should be implemented. For this reason, the researchers who studied on learning styles made various definitions by evaluating the subject from different perspectives. Thus, it is thought that this study will contribute positively to the field.

In this sense, the aim of this study is to identify dominant learning styles and whether these learning styles differ according to gender, information and communication technologies skills, academic achievement and type of motivation.

## Highlights

1. We determine the learning styles of physics pre-service teachers
2. We examined the learnig styles in terms of different variables like information and communication skills, learning method.
3. The order of the learning styles of pre-service physics teachers who participated in the study is as follows: diverging, accommodating, converging and assimilating.

## Theoretical background and research questions

In 1971 and 1972, Prentice-Hall published two books about the emerging concept of learning style (Kolb, 1971; Dunn and Dunn, 1972). According to Kolb (1984), there are four learning environments that support the various learning styles and their associated modes. The Dunns posed a model that included 18 environmental, emotional, ociological, and physical student characteristics. The Dunns and Kolb were not the only researchers developing learning style constructs. Dunn (1984) points out that during the 1970s Canfield and Lafferty (1970), Gregorc (1979), Hunt (1979), Ramirez and Castaneda (1974) and Schmeck (Schmeck et al., 1977) all developed varied definitions, models, instruments, and techniques for assessing students' characteristics.

Prior to the mid-70s, many researchers have examined the learning styles and learning style models (Gregorc, 1979; Keefe, 1979; Dunn, 1983; Dunn et al., 1989; Dunn and Dunn, 1993; Kazu, 2010). Penger and Tekavčičhave (2009) listed chronological taxonomy of research on learning styles from 2000 until the 2008. They emphasize that the learning styles literature has had a revival during the past years, especially in the first decade of the 21st century. Since 2007 and 2008, there has been an increasing interest in the learning styles; accordingly, to the growing interests of learning styles theories in management education (Penger and Tekavčičhave, 2009).

According to Kazu (2010), the studies about learning styles mostly focus on the success of learners in traditional learning environments, attitudes towards learning environments or the rate of involvement in learning environments. Similarly, there are many studies that show that success and performance increase when the correct teaching style matches the right learning style (Orhun, 2013, Novin et al., 2003; Felder et al., 2002). Many researchers have investigated relationships between these learning approaches and the variables such as gender, age, type of alma mater and level of students' class (Özgür and Tosun, 2012; Can, 2011; Bahar et al., 2009; Kılıç and Karadeniz, 2004; Demirbaş and Demirkan, 2007; Kılıç, 2002; Çaycı and Ünal, 2007).

Upon reviewing the literature regarding the learning styles that are considered among the most important components of the process of learning-teaching (Evin-Gencel, 2007; O'Banion, 1997;13-19;Guastello, 1998; 18; Ekici, 2003;10); it is seen that there is a great number of studies on classroom teachers (Karademir and Tezel, 2010; Can, 2011; Genç and Kocaaslan, 2013; Kaf Hasırcı, 2006; Mutlu, 2008; Çaycı and Ünal, 2007). There are also studies on mathematics pre-service teachers (Genç and Kocaaslan, 2013; Peker and Yalın, 2002; CEIT, 2013) and science teachers (Bahar and Sülün, 2011; Genç and Kocaaslan, 2011). However, there is a remarkable lack of studies on physics pre-service teachers. It is required to determine the learning styles of

pre-service physics teachers and the variables affecting these styles in order to enable the teachers to realize an educational design regarding the learning styles based on the necessity for them to primarily have information about their own learning styles. Thus, this study aimed to determine the learning styles of pre-service physics teachers and the variables affecting these styles. This study, which was performed with pre-service physics teachers, is thought to make a contribution to the removal of the deficiency in literature. Besides, there are also studies examining the learning styles in terms of the variables of age, gender (Karademir and Tezel, 2010; Arslan and Babadoğan, 2005; Bahar et al., 2009) and class level. Playing a significant role in education, learning styles are important in directing the possible studies and arrangements when they are examined in terms of different variables like the information and communication skills, learning method and work manner. In this regard, the following research questions were constructed;

1. What are the dominant learning styles preferred by pre-service physics teachers?
2. Do the learning styles preferred by pre-service physics teachers vary according to their gender, information and communication Technologies skills,type of motivation,and academic achievement?

## METHODOLOGY

In this study, survey model was used to determine the pre-service physics teachers' learning style and the variation of the participants' learning style according to gender, information and communication technologies skills, academic achievement and type of motivation.

### Participants

The target population of the study was composed of physics teacher candidates who receive training in the Gazi University, Ankara, Turkey. A total of about 80 students attended the faculties of the university.The study group is consisted of 50 physics pre-service teachers. Regarding the pre-service teachers who participated in the study; 30 (60%) were females and 20 (40%), males. The percentages of pre-service teachers are 26% for Grade 2; 10% for Grade 3, 24% for Grade 4 and finally 40% for Grade 5. Participants of this study from these grades were randomly selected to participate in the study.

### Instruments

The data were collected for this study from three sources; demographic information (DI), Learning Style Inventory (LSI), "Information and Communication Technologies Skills" (ICT skills).

The first section focused on the demographic profile of the respondents such as name, gender, age, academic achievementand class. The section contained 14 items. This was followed by question on type of motivation. Pre-service teachers were asked to respond to their type of motivation; external or internal.

The second section focused on dominant learning styles of the participants. The learning style of pre-service physics teachers was measured using the Learning Style Inventory (LSI) developed by Kolb (1999) , which was adapted into Turkish and tested in terms of its validity and reliability by Evin-Gencel (2007). The LSI is a 12 item questionnaire in which respondents attempt to describe their learning style. Each item asks respondents to rank order four sentence endings that correspond to the four learning modes─ concrete experience, reflective observation, abstract conceptualization, and active experimentation. Four options in each item are graded between 1 and 4. While the lowest score obtained from the scale is 12, the highest score is 48. Following this grading, sum of Concrete Experience-CE, Abstract Conceptualization-AC, Active Experience-AC and Reflective Observation-RO scores was calculated and the differences between AC-CE and AC-RO were found. The differences between AC-CE and AC-RO change between -36 and +36. While a positive score obtained from AC–CE indicates that the learning is abstract, a negative score indicates that it is concrete; similarly, scores obtained from AE–RO indicate that the learning is either active or reflective (Evin-Gencel, 2007). The LSI essentially encompasses a two dimensional (x-y plot) approach. The points were AC-CE and AC-RO scores intersect on the x and y-axis is identified as the most suitable learning style for the learner. After this process, the LSI of each participant was classified either as 'accommodating', 'diverging', 'assimilating' or 'converging'.

The third section focused on ICT skills of pre-service physics teachers. This part consists of 28 items with the questionnaire. ICT skills developed by Wilkinson et al. (2010), which was prepared by Haznedar (2012) through adapting some items from the attitude scale aimed at e-learning, which made it more convenient and up-to-date for our country. For the answers to be given to the items, a 5-point Likert-type rating that is frequently used by the researchers was preferred. Accordingly, the rating is as follows: "Strongly Disagree" (1), "Disagree" (2), "Undecided" (3), "Agree" (4) and "Strongly Agree" (5)."ICT skills" scale has three dimensions which are information technologies, communication technologies, and mobile technologies. The reliability coefficient of this scale is α= 0.933. Since the "ICT skills" scale has 28 items, the lowest and highest scores that can be taken from the scale are 28 and 140 respectively (Haznedar, 2012).

### Data analysis

We coded the digital data that were obtained from the data collection tools, entered them into the computer via the SPSS 21.0 package software and performed analyses based on lower problems. We used descriptive statistics like frequency, percentage distribution, cross tabulation in analyzing the demographic data and determining the dominant learning styles of pre-service teachers. Analysis results were given and interpreted in tables. We used the Chi-square independent test, which is among the non-parametric tests, in the analysis of the data concerning other lower problems of the study. This test is used in determining whether there is a significant relationship between two classified variables (Büyüköztürk, 2007:148). We performed the one-way variance analysis of independent variables to determine whether the difference between the average of more than two independent groups was significant or not.

## RESULTS

Examining the results, it is seen that 10% of physics pre-service teachers have an assimilating learning style, 22% accommodating, 16% converging and 52% diverging (Figure 1).

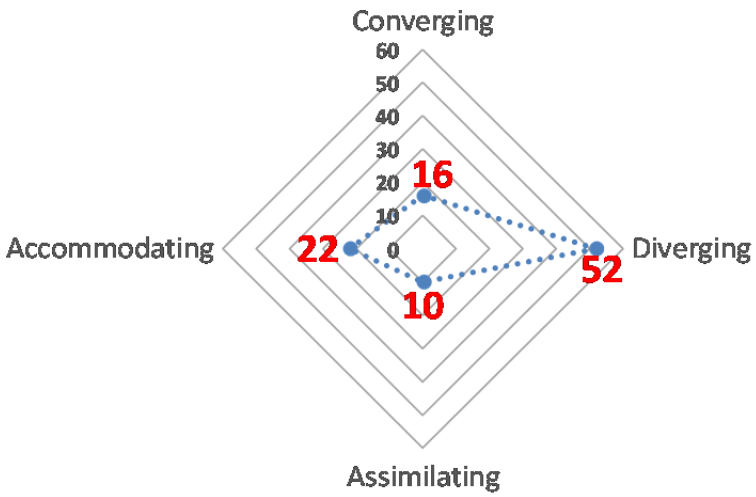



**Figure 1.** Distribution of the learning styles of physics pre-service teachers according to percentage.

**Table 1.** Results of the $\chi^2$ test for the differentiation of the learning styles of physics pre-service teachers according to gender.

| | | | Learning style | | | | Total |
|---|---|---|---|---|---|---|---|
| | | | Diverging | Accommodating | Assimilating | Converging | |
| Gender | Female | N(%) | 14 (46.7) | 7(23.3) | 2(6.7) | 7(23.3) | 30(100.0) |
| | Male | N(%) | 12(60.0) | 4(20.0) | 3(15.0) | 1(5.0) | 20(100.0) |
| | | N(%) | 26(52) | 11(22) | 5(10) | 8(16) | 50(100.0) |

$X^2$=3.825, df=3, p=0.281.

It is seen that physics pre-service teachers have different learning preferences, which is supported by the findings of many studies in literature (Özgür, 2013; Can, 2011; Yenice and Saracaoğlu, 2009; Kaf, 2006; Çelenk and Karakış, 2007; Özbek, 2007; Oluk et al., 2007; Çaycı and Ünal, 2007).

## Differentiation of the learning styles of physics pre-service teachers according to gender

The distribution of the learning styles of pre-service physics teachers according to gender is thus: 60% of male physics pre-service teachers have a Diverging learning style, 20% Accommodating, 15% Assimilating and 5% Converging; whereas 46.7% of female pre-service teachers have a Diverging learning style, 23.3% Accommodating, 6.7% Assimilating and 23.3% Converging (Table 1). Accordingly, it is seen that female and male pre-service teachers who participated in the study mostly have the Diverging (46.7%-60.0%) learning style. While female pre-service teachers have the Assimilating learning style at minimum (6.7%), male pre-service teachers have the Converging learning style at minimum (5%).

According to these findings, the most important results are as follows; both male and female pre-service teachers mostly have the Diverging learning style and the distribution rates of physics pre-service teachers with the Assimilating, Diverging and Accommodating learning style according to both genders are very close to each other. According to these values, it could be asserted that female and male pre-service teachers have similar learning styles. The results of the Chi-square test regarding whether there is a significant relationship between the learning styles of pre-service teachers and gender or not (Table 1). According to the table, there is no significant relationship between the learning styles and gender ($X^2_{(3)}$ =3.825, p>0.05). In the light of the data being obtained, it could be asserted that the learning styles of physics pre-service teachers do not show any difference according to gender.

We performed the Independent Samples t-Test in an attempt to determine whether the gender and learning styles of physics pre-service teachers showed a difference in terms of the score averages of horizontal

**Table 2.** T-test results of the lower dimension averages of the learning styles of physics pre-service teachers (X, Y) (AC+CE. and AE+RO) according to gender.

| Lower dimension of learning style | Gender | N | $\overline{X}$ | Sd | t | df | p |
|---|---|---|---|---|---|---|---|
| AC+CE | Female | 30 | .43 | 8.455 | -1.366 | 48 | .178 |
| | Male | 20 | 4.00 | 9.884 | | | |
| AE+RO | Female | 30 | 3.27 | 7.492 | 1.049 | 48 | .299 |
| | Male | 20 | .80 | 9.047 | | | |

**Table 3.** $\chi^2$ test results for the difference of the learning styles of physics pre-service teachers according to the type of motivation.

| | | | Learning style | | | | Total |
|---|---|---|---|---|---|---|---|
| | | | Diverging | Accommodating | Assimilating | Converging | |
| Type of motıvatıon | External | N(%) | 7 (41.2) | 4(23.5) | 4(23.5) | 2(11.8) | 17(100.0) |
| | Internal | N(%) | 19(57.6) | 7(21.2) | 1(3.0) | 6(18.2) | 33(100.0) |
| | Total | N(%) | 26(52.0) | 11(22.0) | 5(10.0) | 8(16.0) | 50(100.0) |

$X^2$=5.611, df=3, p=0.132.

and vertical dimensions or not. Before starting the analysis, we tested the assumption of the equivalence of variances. As a result of the Levene test (p>.05), the variances were determined to have a homogeneous distribution (Table 2).

Even though there is a difference between the average scores; AC+CE(t(50) = -1.366, p > 0.05, r = 0.19), AE+RO(t(48) = 1.049, p > 0.05, r = 0.15) are not statistically significant. In other words, as a result of the Independent Samples t-Test, it was determined that the independent variable of gender did not have a significant effect on the the score averages of horizontal and vertical dimensions. As a consequence, it was accepted that the population averages in scores being obtained did not show any difference according to gender.

## Differentiation of the learning styles of physics pre-service teachers according to the type of motivation

According to the type of motivation, 41.2% of physics pre-service teachers with an external motivation have a Diverging learning style, 23.5% Accommodating, 23.5% Assimilating and 11.8% Converging; whereas 52% of pre-service physics teachers with an internal motivation have a Diverging learning style; 22% Accommodating, 10% Assimilating and 16% Converging (Table 3). Accordingly, the physics pre-service teachers who participated in the study and preferred both external and internal motivation mostly have the Diverging (41.2-57.6%) learning style. While pre-service teachers with an external motivation have the Assimilating learning style at minimum (3%).

The results of the Chi-square test regarding whether there is a significant relationship between the learning styles of physics pre-service teachers and the type of motivation or not (Table 3). There is no statistically significant relationship between the learning styles and motivation ($\chi^2(3) = 5.611$, p>0.05) (Table 3). In the light of the data being obtained, it could be asserted that the learning styles of pre-service teachers do not show any difference according to the type of motivation.

## Differentiation of the learning styles of physics pre-service teachers according to ınformation and communication technologies skills

In order to examine the information and communication technologies (ICT) skills of physics pre-service teachers in terms of variables, we primarily performed the Kolmogrov-Smirnov test to determine the tests to be conducted and tested the convenience of scores for normalcy.

According to Büyüköztürk (2007), it is seen that the value p of the scores of information and communication technologies skills is smaller than .05 in the Kolmogrov-Smirnov normalcy test, which signifies that scores show a significant (excessive) deviation from the normal distribution at this significance level (Table 4). Thus, we performed the Kruskall-Wallis test, which is among the non-parametric tests, in order to examine the effect of different variables on the information and communication technologies skills.

We questioned whether the learning styles of pre-service physics teachers varied according to the lower

**Table 4.** Normalcy test of ICT skill scores.

| | Kolmogorov-Smirnova | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistics | df | Sig. | Statistics | df | Sig. |
| ICT skill | .193 | 50 | .000 | .868 | 50 | .000 |
| Information technologies | .166 | 50 | .002 | .902 | 50 | .001 |
| Communicatıon technologies | .166 | 50 | .001 | .877 | 50 | .000 |
| Mobile technologies | .357 | 50 | .000 | .546 | 50 | .000 |

a. Lilliefors Significance Verification.

**Table 5.** The effect of the experience of using computer on information and communication technologies skills.

| Variable | Experience of using computer | N | Order average | sd | $\chi^2$ | p |
|---|---|---|---|---|---|---|
| Skill | Diverging | 21 | 20.95 | 3 | 3.774 | . 287 |
| | Accommodating | 10 | 29.55 | | | |
| | Assimilating | 7 | 25.21 | | | |
| | Converging | 7 | 17.57 | | | |
| Mobile technologieS | Diverging | 21 | 21.74 | 3 | 2.527 | . 470 |
| | Accommodating | 10 | 25.65 | | | |
| | Assimilating | 7 | 29.36 | | | |
| | Converging | 7 | 16.64 | | | |
| Communication technologies | Diverging | 21 | 20.90 | 3 | 3.956 | . 266 |
| | Accommodating | 10 | 27.65 | | | |
| | Assimilating | 7 | 23.57 | | | |
| | Converging | 7 | 22.07 | | | |
| Information technologies | Diverging | 21 | 20.83 | 3 | 4.413 | . 220 |
| | Accommodating | 10 | 28.60 | | | |
| | Assimilating | 7 | 26.29 | | | |
| | Converging | 7 | 18.21 | | | |

dimensions and total scores of the scale of “Information and Communication Technologies Skills” (ICT) or not (Table 5). Examining the analysis results that were obtained according to the variable of experience of using computer, it was determined that there was no significant difference between the ICT skills of physics pre-service teachers ($\chi^2(3) = 3.774$, $p>.05$), mobile technologies ($\chi^2(3) = 2527$, $p>.05$), communication technologies ($\chi^2(3) = 3.956$, $p>.05$), and information technologies ($\chi^2(3) = 4.413$, $p>.05$) (Table 5).

As a consequence, according to the Kruskall-Wallis test, the variable of ICT skills and its lower dimensions have no significant effect on the learning style. In other words, we have accepted that the population averages in scores being obtained do not show any difference according to ICT skills.

Evaluating the score averages in the scale within the categories of “Strongly disagree (1.00-1.79)”, “Disagree (1.80-2.59)”, “Undecided, (2.60-3.39)”, “Agree (3.40-4.19)”, “Strongly agree (4.20-5.00)”, it was determined that they had a very high level of ICT skills at a rate of 70% and a high level of ICT skills at a rate of 30%.

In order to test whether there was a significant relationship between the learning styles of physics pre-

**Table 6.** Distribution of the learning styles of pre-service physics teachers according to their levels of ICT skills.

| | | Learning style | | | | Total |
|---|---|---|---|---|---|---|
| | | Converging | Diverging | Assimilating | Accommodating | |
| Very high | f | 3 | 14 | 5 | 10 | 32 |
| | % | 9.4 | 43.8 | 15.6 | 31.3 | 100.0 |
| High | f | 4 | 8 | 2 | 0 | 14 |
| | % | 28.6 | 57.1 | 14.3 | 0.0 | 100.0 |
| Total | f | 6 | 7 | 22 | 7 | 46 |
| | % | 12.0 | 15.2 | 47.8 | 15.2 | 100.0 |

$X^2$=7.110, df=3, p=0.068.

**Table 7.** Academic achievements of physics pre-service teachers according to the learning style.

| Learning Style | N | Academic achievement status | Ss |
|---|---|---|---|
| Diverging | 26 | 2.36 | .43 |
| Accommodating | 11 | 2.56 | .87 |
| Assimilating | 5 | 1.96 | .36 |
| Converging | 8 | 2.50 | .53 |
| Total | 50 | 2.39 | .57 |

service teachers and ICT skill levels or not, we applied the Chi-square test as the learning style and ICT skill level were among categorical variables (Table 6). There is no statistically significant relationship between the learning styles and ICT skill levels ($X^2_{(3)}$ =7.110, p>0.05). In the light of the data being obtained, it could be asserted that the learning styles of physics pre-service teachers do not show any difference according to the ICT skill level.

## Differentiation of the learning styles of physics pre-service teachers according to the academic achievement

The academic achievement status of physics pre-service teachers according to the learning style (Table 7). According to the learnnig style, the achievement averages were found as assimilating $\bar{x} = 1.96$, converging $\bar{x} = 2.50$, accommodating $\bar{x} = 2.56$ and diverging. While the physics pre-service teachers with the accommodating learning style have the highest average scores, the physics pre-service teachers with the assimilating learning style have the lowest average scores.

In order to examine the learning styles of physics pre-service teachers in terms of the variable of achievement, we primarily performed the Shapiro-Wilk test to determine the tests to be conducted and tested the convenience of scores for normalcy (Table 8).

It is seen that the value p of the scores of academic achievement is smaller than .05 in the Shapiro-Wilk test, which signifies that scores do not show a significant (excessive) deviation from the normal distribution (Table 8). Thus, we performed the One Way-Anova to determine the differences of the learning style regarding the academic achievement. Before the One Way-Anova, we tested the assumption of the equivalence of variances. As a result of the Levene test (p=.071, p>.05), the variances were determined to have a homogeneous distribution.

The results of the One Way-Anova test regarding the achievement status of students according to the learning style (Table 9). It is seen that physics pre-service teachers with the accommodating and converging learning style have higher academic grade averages than physics pre-service teachers with the assimilating and diverging learning styles and according to the results of the One Way-Anova test, the difference between them is not significant (F(3,46)=1.427, p=0.247). As a result of the One Way-Anova test, it was determined that the variable of academic achievement of pre-service physics teachers did not have a significant effect on the learning style. In other words, it was accepted that the population averages in scores being obtained did not show any difference according to the academic achievement.

## DISCUSSION AND CONCLUSION

In this study, we performed Kolb's Learning Style Inventory, which was developed by Kolb (1999) and adapted into Turkish and tested in terms of its validity and reliability by EvinGencel (2007), on pre-service physics teachers (N=50). The study investigated the distribution of the learning styles of physics pre-service teachers and whether the learning styles showed a difference according to the variables of gender, motivation, information and

**Table 8.** Normalcy test of academic achievement scores.

| Normalcy Test | | | | | | |
|---|---|---|---|---|---|---|
| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
| | Statistics | df | Sig. | Statistics | df | Sig. |
| Academic achievement | .094 | 50 | .200* | .973 | 50 | .312 |

a. Lilliefors significance verification.

**Table 9.** The effect of academic achievement on the attitude regarding the learning style.

| Resource of variance | Sum of squares | Sd | Average of squares | F | p |
|---|---|---|---|---|---|
| Intergroup | 1.375 | 3 | .458 | 1.427** | .247 |
| Intragroup | 14.771 | 46 | .321 | | |
| Total | 16.146 | 49 | | | |

communication technologiesskills and academic achievement or not.

At the end of the research, it is seen that 10% of pre-service physics teachers have the assimilating learning style, 22% accommodating, 16% converging and 52% diverging. While the rate of physics pre-service teachers with the diverging learning style is very high, the rate of those with the assimilating learning style is low. The order of the learning styles of pre-service physics teachers who participated in the study is as follows: diverging, accommodating, converging and assimilating. According to these results, it is possible to assert that a large part of students (52%) choosing the department of physics teaching have the diverging learning style when they learn something.A review of the related literature reveals the results of the studies that provided findings partially similar to this finding of the present study. Okur et al. (2011) found out in their studies that the learning styles of students were determined respectively as accommodating, diverging, converging and assimilating. This result shows a parallelism with the findings of this study, which was conducted for the arrangement of the first two accommodating and diverging learning styles. In another study by Ekici (2013) that was performed with totally 297 pre-service teachers receiving education in different departments of the Faculty of Technical Education, it was determined that students mostly had the diverging learning style (44%). In Cavas's (2010) study, it appears that 40.4% of six hundred six pre-service teachers from elementary science, mathematics and class teacher program have diverging teaching style.

The results of the study showed that the pre-service physics teachers are most commonly Diverging learners. Considering this finding, it is observed that this study is different from the studies in literature. In pre-service elementary school teachers studies reported a predominant trend of assimilating learning style (Şengül et al., 2013; Okur et al., 2011; Genç and Kocaaslan, 2013). In Kahyaoğlu's (2011) study, 32.8% of prospective teachers from teaching science department have assimilating teaching style. Chang et al.'s (2011) showed that the highest percentage, at about 42.91% of MBA and EMBA program students, was for the Assimilating learning style. Can (2011) identified that 39.9% of the prospective teachers who participated in the research have assimilating. Çaycı and Ünal (2007) studied together with 194 prospective classroom teachers and it appeared that 59.8% of prospective classroom teachers who participated in the research have assimilating teaching style. Karademir and Tezel (2010) found out in their studies that prospective classroom teachers mostly prefer assimilating teaching style. As Peker and Mirasyedioğlu (2008) also asserted that pre-service elementary school teachers are mostly from the assimilator learners (55.5%). On the other hand; as a result of a study that was performed with totally 443 participants from the Classroom Teaching, Physical Training and Sports Teaching, Science Teaching, Primary School Math Teaching and Turkish Teaching (Bahar et al., 2009), it was determined that students mostly preferred the converging learning style. Bahar and Sülün (2011) also found out in their studies that 39.7% of prospective teachers from teaching science department have converging teaching style. In studies where the sample consists of students receiving education in the departments of Computer and Instructional Technologies Education, science teaching and classroom teaching, the assimilating learning style (Kılıç, 2002; Karakış, 2006; Kaf, 2006; Çaycı and Ünal,2007; Can, 2011) and converging learning style are observed to be dominant (Bahar et al., 2009; Bahar and Sülün, 2011; Mutlu, 2008). When the literature is taken into consideration, prospective teachers generally prefer 'assimilating' and 'converging' learning style. Kolb et al. (1999) also

asserted that research over the years has shown that social service (i.e., psychology, nursing, social work, public policy) and arts and communications professions (i.e., theater, literature, design, journalism, media) comprise people who are heavily or primarily Diverging in their learning style. Professions in the sciences (i.e., biology, mathematics, physical sciences) and information or research (i.e., educational research, sociology, law, theology) have people with an Assimilating learning style.

In the present study, it is also shown that most of the students with balancing learning style integrate AC and CE and RO. When the concrete experience (CE) score was high, learning activity on the horizontal axis of learning cycle shifted towards assimilating learning by low values of reflecting score (RO). It is preferred by only 10% pre-service physics teacher. It is concluded that they perceive knowledge through the concrete experience method and process it through the reflective observation method.Lu (2007) presented that one with a high score in CE indicated that s/he was more oriented towards peers and benefited most from discussions. Richmond and Cummings (2005) highlighted that divergent learners are considered “brainstormers”, prefer to observe rather than act, are emotionally-oriented and tend to be very creative. Pre-service physics teachers may be particularly adept at viewing a situation or problem from many perspectives and developing imaginative solutions.

The fact that pre-service teachers mostly have the Diverging learning style is associated with the fact that the study group consists of pre-service physics teachers. Because pre-service physics teachers are required to use the learning style preferring learnings in the laboratory environment, which is supported by concrete materials. According to Ekici (2013), studies prove that psychological traits/types, specialized field in education, occupations; capabilities such as adjustment and working based on their administrative, technical, individual and communicativeness are effective. These occupational areas use styles focusing on concrete learnings more. Considering the fact that every branch requires specific applications and skills. Özgür (2013) emphasizes that it is natural for the learning styles of individuals making an effort to be teachers in these branches to correspond to the requirements of the branches. Secondly, It is also important that Turkish higher educational system be based on traditional instruction method. It can be explained the reason why the higher rate of Diverger that Traditional instruction method was negatively correlated with their active experimentation (AE) and positively correlated with their reflective observation (CE) scores. Some study findings revealed that divergent learners find traditional methods suitable for their learning (Peker, 2003; Peker, Mirasyedioğlu, 2008; Cavas, 2010). According to Manochehr (2006) Diverger (these learn best through brainstorming and logs) received better results with traditional instructor-based learning. Kablan and Chia (2014) showed that accommodating students had significantly higher self-evaluation scores than diverging and assimilating students on constructivist teaching. It is seen that all these studies are supported with this study.

According to another finding obtained from the study, the learning styles of pre-service teachers differentiate according to gender. It is possible to encounter with similar and different results in the relevant literature. As a result of the study of Genç and Kocaaslan (2013) that was performed with 117 participants receiving education in the programs of Classroom Teaching, Science Teaching, Social Sciences Teaching and Religious Culture and Moral Knowledge Teaching; the study of Karademir and Tezel (2010) that was performed with 381 students; the study of Bahar and Sülün (2011) that was performed with totally 184 pre-service teachers (98 male, 86 female students) receiving education in the program of Science Teaching; and the study of Özgür (2013) that was performed with 101 BOTE students, it was determined that the learning styles of pre-service teachers did not change according to the variable of gender. These results show a parallelism with study findings. On the other hand, in his study on the effect of the thinking styles of pre-service teachers upon their preference of learning styles, Çubukçu (2005); and in his study on the examination of the learning styles of pre-service classroom teachers according to various variables, Çaycı and Ünal (2007) indicate that gender is effective upon the preference of the learning style, which shows a difference from this study.

As a result of the evaluation that was performed according to the general academic achievement levels, we determined no significant difference between the academic achievement status according to the learning styles of pre-service physics teachers. The state of the pre-service teacher to have a converging, diverging, assimilating oraccommodating learning style does not affect her/his academic achievement status. This results could signify that the academic achievement of pre-service physics teachers is not a determining factor. This finding is consistent with some study findings asserting that the learning style does not have a significant effect upon the academic achievement (Topuz and Karamustafaoğlu, 2013; Bahar and Sülün, 2011; Kılıç and Karadeniz, 2004; Bahar et al., 2009). However, in contrast to the findings obtained in literature, there are many studies presenting the statistically significant effect of the academic achievement on the learning styles of individuals (Okur et al., 2011; Ekici, 2013)

Another finding of the study is that the variable of information and communication technology skills and its lower dimensions do not have any effect upon the learning styles of pre-service physics teachers. However, we evaluated the score averages in the scale within the categories of “Strongly disagree (1.00-1.79)”, “Disagree (1.80-2.59)”, “Undecided, (2.60-3.39)”, “Agree (3.40-

4.19)", "Strongly agree (4.20-5.00)" and determined that the ICT skill levels being obtained did not show any difference according to the learning levels. These findings that are not involved in literature are thought to be very important.

## Suggestions

The following suggestions can be made for future research in line with the findings obtained in the present study. It has been identified that most (52%) of pre-service physics teachers have the learning style of diverging. This finding which has been obtained from a small group should be taken into consideration. Notwith-standing the limitation of this study, the findings have important implications for teacher training.Integrative studies can be performed through comparing the results by qualitative research data. In addition,Future studies might involve traditional instruction method and construc-tivist teaching used in the learning or teaching period for the effect on pre-service physics teachers learning styles. Generalisable results on the topic can be achieved by performing similar studies with different samples.

This study was carried out by using Kolb Learning Style Inventory. A research can be suggested a contrastive study by using other learning style inventories.

Studies can be conducted to compare the learning styles of students with respect to the motivation type, information and communication technology skills. Besides, integrative studies can be performed through comparing the results of similar studies conducted on evaluation techniques that students prefer with respect to their learning styles

Today, taking into account the students' learning styles has become a necessity for teachers to organize student-centered activities.It can be useful for pre-service physics teachers to be informed about learning style and the learning style they have.The main responsibility belongs to the teachers and to the educators of the teachers.Instructors must be aware of all learning styles and the teacher's roles according to the learning styles. Therefore, the current study suggested that some regula-tions should be performed on pre-service education programs so that they provide information about the learning styles as literature (Evin and Köse, 2011).A variety of learning tasks should be assigned in order to make the different learning styles in the class interesting and attain learning goals.Learning style in the instructors' learning environments can be utilized. Taking these views into consideration, instructors or moderators of courses should provide a variety of learning modules for students and help them learn how to switch between learning styles in order to take advantage of these choices.We believe that such thoughtful course design will not only improve the quality of course delivery but also will enhance students' learning.

## Conflict of Interests

The author has not declared any conflict of interest.

## REFERENCES


Açıkgöz K (1996). Etkili Öğrenme ve Öğretme. İzmir: Kanyılmaz Press.

Arslan B, Babadogan C (2005). Relationships between Learning Style Preferences and Gender, Age and Success Level at /th and 8th Grade, Eurasian J. Educ. Res. 21:35–48.

Bahar HH, Sülün A (2011). The learning styles of prospective science teachers, the correlation between learning styles and gender and academic achievement by learning styles. Kastamonu Educ. J. 19(2):379-386.

Bahar HH, Özen Y, Gülaçtı F (2009). An Investigation On Academic Achievement And Learning Styles As To Branches And Gender From Faculty Of Educaiıon Students', Ankara University*, J. Faculty Educ. Sci.* 42(1):69-86.

Büyüköztürk Ş (2007). Sosyal bilimler için veri analizi el kitabı (8. Baskı). Ankara: PagemA Printing

Can Ş (2011). Investigation of The Relationships Between the Learning Styles of Preservice Elementary Teachers and Some Variables. *Hacettepe Üniversity J. Educ.* 41:70-82.

Can Ş (2010). Determination of the learning styles of the pre-school teacher candidates. Procedia Social and Behavioral Sci: 2:4137-4141.

Canfield AA, Lafferty JC (1970). Learning Styles Inventory. Detroit: Humanics Media (Liberty Drawer).

Cavas B (2010). A Study on Pre-service Science, Class and Mathematics Teachers' Learning Styles in Turkey. Sci. Educ. Int. 21(1):47-61,

Chang HM, Wen LY, Chen CH (2011). The Learning Style of MBA Students. 2011 2nd International Conference on Education and Management Technology, IPEDR, .13 , IACSIT Press, Singapore

Claxton CS, Ralston I (1978). Learning styles: Their impact on teaching and administration. Washington DC: National Institute of Education.

Currie G (1995). Learning theory and the design of training in health authority. *Health Manpower Manage.* 21(2):13-19.

Çaşkurlu SK, Baykara K (2011). Learning styles of technical sciences college students. Journal of the Hasan Ali Yucel Faculty Educ. 15(2011–1):95–110.

Çaycı B, Ünal E (2007). Sınıf Öğretmeni Adaylarının Sahip Oldukları Öğrenme Stillerinin Çeşitli Değişkenlere Göre İncelenmesi (Investigation of The Learning Styles of Preservice Elementary Teachers In Terms Of Some Variables). *Üniversite ve Toplum: Bilim, Eğitim ve Düşünce Dergisi (University and Society),* 7(3), http://www.universitetoplum.org/pdf/pdf -UT-328.

Çelenk S, Karakış Ö (2007). Bazı Yükseköğretim Kurumlarında Öğrenim Gören Öğrencilerin Farklı Öğrenme Stillerine Sahip Olma Düzeyleri. XVI. National Educational Sciences Congres, Gaziosmanpaşa Üniversity Education Faculty, Tokat.

Çubukçu Z (2005). Öğretmen Adaylarının Düşünme Stillerinin Öğrenme Biçimlerini Tercih Etmelerindeki Etkisi, Çağdaş Eğitim Dergisi. 30(234):22-32.

Demirbaş OO, Demirkan H (2007): Learning Styles of Design Students and the Relationship of Academic Performance and Gender in Design Education. *Learning Instructions*. 17:345-359.

Dunn R (1983). What is your learning style? Early Years, 13(5).

Dunn R (1984). Learning style: State of the science. Theory into Practice, 23(1), 10-19. (Taylor & Francis Group) Stable URL: http://www.jstor.org/stable/1476733

Dunn R, Dunn K (1972). Practical approaches to individualizingin struction.E nglewood Cliffs, NJ: Par-ker Division of Prentice-Hall

Dunn R, Dunn K (1993). Teaching Secondary Students Through Their

Individual Learning Styles Practical Approaches for Grades 7-12. Massachusetts: Allyn and Bacon.
Dunn R, Beudury J, Klavas A (1989). Survey of Research on Learning Styles, *Educ. Leadership*. s. 50-57
Dunn R, Bruno J, Sklar RI, Beaudry J (1990). Effects of matching and mismatching minority developmental college students' hemispheric preferences on mathematics scores. J. Educ. Res. 83(5):283–288.
Ekici G (2003). Öğrenme Stiline Dayalı Oğretim ve Biyoloji Dersi Oğretimine Yonelik Ders Planı Örnekleri (1. Press). Ankara: Gazi Bookstore.
Ekici G (2013). The analysis of learning styles of prospective teachers in terms of general academic achievement and gender according to Gregorc and Kolb learning style inventories. Educ. Sci. 38(167):211-225.
Evin Gencel İ, Köse A (2011). Relationship between the prospective science teachers' learning styles, learning and study strategies and self-efficacy beliefs in science teaching. J. Theory Practice Educ. 7(2):311-333. http://eku.comu.edu.tr/index/7/2/iegencel_akose.pdf
Evin Gencel İ (2006). Öğrenme stilleri, deneyimsel öğrenme kuramına dayalı eğitim, tutum ve sosyal bilgiler program hedeflerine erişi düzeyi. Yayımlanmamış Doktora Tezi, DEU Eğitim Bilimleri Enstitüsü, İzmir
Evin-Gencel İ (2007). Kolb'un Deneyimsel Öğrenme Kuramına DayalıÖğrenme Stilleri Envanteri III'ü Türkçeye Uyarlama Çalışması. *Dokuz Eylul University Journal of Graduate School of Social Sciences*, 9(2), 120-139
Felder RM, Felder GN, Dietz EJ (2002). The effects of personality type on engineering student performance and attitudes. *J. Eng. Educ*. 91(1):3-17.
Felder RM, Brent R (2005) "Understanding Student Differences." J. Engr. Educ. 94(1):57-72.
Felder RM (1993). Reaching the second tier: Learning and teaching styles in college science education. Journal of College Sci. Teach. 23(5):286-90.
Felder RM (2010). Are Learning Styles Invalid? (Hint: No!). On-Course Newsletter, September 27.
Genç M, Kocaarslan M (2013). The Investigatıon Of Prospective Teacher's Learning Styles In Terms Of Various Variables: Bartın Universıty Sample. *TSA*, 17(2):327-344.http://www.tsadergisi.org/Makaleler/952024708_18-165(327-344).pdf
Gregorc AF (1982). Gregorc Style Delineator. Maynard, MA: Gabriel Systems.
Gregorc AF (1979). Learning/teaching styles: Their na-ture and effects. In Student learning styles: Diag-nosing and prescribing programs. Reston, VA:National Association of Secondary School Principals. 19-26.
Grillo G (2012). Varying Curricula to Meet Physics Students' Learning Styles. Celebration of Undergraduate Scholarship, Paper 149.
Guastello EF (1998). Reliability and concurrent validity of global learningstyle assessment for elementary school students (Grade 2-5). Unpublished doctoral thesis. St. John's University, New York
Haznedar Ö (2012). The Investigatıon Of Undergraduate Students' Information and Communication Technology Skills And Attitudes To E-learning In Terms Of Different Variables. (Unpublished master's thesis). *Dokuz Eylul University Educational Science Institute*, İzmir.
Hunt DE (1979). Learning style and student needs: An introduction to conceptual level. In Student learning styles: Diagnosing and prescribing programs. Reston VA: National Association of Secondary School Principals, 27-38.
Kaf Hasırcı Ö (2006). Learning Styles of Prospective Primary School Teachers: Çukurova University Case. Journal of Theory and Practice in Uducation, *Çanakkale Onsekiz Mart University Faculty Educ. Res. J.* 2(1): 15-25
Kahyaoğlu, M. (2011). The correlation between learning styles of prospective teachers and self-suffiencies in teaching environment. J. Educ. Sci. Res. 1(2):67-82.
Karademir E, Tezel Ö (2010). Investigation of Primary Teacher Candidates' Learning Styles by Demographic Variables. *Pamukkale Üniversity J. Educ.* 28:129-145.
Karakış Ö (2006). "Bazı Yüksek Öğretim Kurumlarında, Farklı Öğrenme Stillerine Sahip Öğrencilerin Genel Öğrenme Stratejilerini Kullanma Düzeyleri", AİBÜ, Sosyal Bilimler Enstitüsü.
Kazu IY (2010) "Learning styles of teacher candidates: A sample of Firat University" African Journal of Business Management, 4(15), 3265-3276, Available online at http://www.academicjournals.org/article/article1380697833_Kazu.pdf
Keefe JW (1979). Learning Style: An overview in student learning styles: Diagnosing and prescribing program, Reston. VA: National Association of Secondary School Principals, U.S.A.
Keefe J, Monk J (1988). Learning style profile examiner's manual. Reston, VA: National Association of Secondary School Principles.
Kılıç E, Karadeniz Ş (2004). The Effects of Gender and Learning Style on Navigation Strategy and Achievement. *Gazi University J. Gazi Educ. Faculty (GUJGEF).* 24 (3):129-146.
Kılıç E (2002). The Effect of The Dominant Learning Style on Learning Activities Preference and Academic Achievement. *Educ. Sci. Practice*, , 1(1):1-15.
Kolb D (1999). The Kolb Learning Style Inventory, Version 3. Boston: Hay Group.
Kolb DA (1984). Experiential learning: Experience as the source of learning and development, Upper Saddle River, New Jersey: Prentice Hall.
Kolb DA (1971). Individual learning styles and the learning process. Working Paper, 535-71, Sloan School of Management, Massachusetts Institute of Technology.
Kolb DA (1985). Learning Style Inventory: Self scoring inventory and interpretation booklet. Boston: McBer and Company.
Kolb DA, Boyatizis RE, Mainemelis C (1999) Experiential Learning Theory: Previous Research and New Directions. http://www.learningfromexperience.com/html/research_library.html.
Larkin-Hein T, Budny DD (1999) Teaching to Students' Learning Styles: Approaches That Work. Frontier in Education Conference 12c 1-7
Larkin-Hein T, Budny D (2000). Styles and Types in Science and Engineering Education, Proceedings 2000 International Conference on Engineering and Computer Education, Session 1, 1-6, Sao Paulo, Brazi.
Larkin-Hein T, Budny DD.(2003). Learning Styles in the Physics Classroom: A Research- Informed Approach. In the Proceedings of the 2003 American Society for Engineering Education Annual Conference and Exposition, Session 2480: 1-14. American Society for Engineering Education.
Larkin-Hein T (2000). Digital video, learning styles, and student understanding of kinematics graphs. Journal of SMET Education: Innovations Res. 1(2):17–30.
Larkin-Hein T, Budny DD (2001). Research on learning style: Applications in the physics and engineering classrooms. IEEE Transactions on Educ. 44(3):276–281.
Lenehan MC, Dunn R, Ingham J, Murray W, Signer B (1994). Learning style: Necessary know-how for academic success in college. J. College Student Devel. 35:461–466.
Lu H, Jia L, Gong SH, Clark B (2007). The Relationship of Kolb Learning Styles, Online Learning Behaviors and Learning Outcomes. Educ. Technol. Society 10(4):187-196.
Malik S, Janjua F (2011) Learning Styles and Teaching Strategies: Creating a Balance. Language In Indİa Strength for Today and Bright Hope for Tomorrow. 11( 2):268-278.
Manochehr NN (2006). The influence of learning styles on learners in e-learning environments: An empirical study. Computers in Higher Educ. Econ. Rev. 18(1) (2006):10–14.
Manolis C, Burns DJ, Assudani R, Chinta R (2013). Assessing experiential learning styles: A methodological reconstruction and validation of the Kolb Learning Style Inventory. *Learning Individual Differences*. 23:44-52.
Mutlu M (2008). The Learning Styles of Education Faculty Students. *J. Kâzım Karabekir Educ. Faculty*. 17:1-21.
Novin AM, Arjomand LH, Jourdan L (2003). An investigation into the preferred learning styles of accounting, management, marketing, and general business majors. *Teach. Learn*. 18(1):24-31.
O'Banion T (1997). A learning college for the 21st century. Phoenix: American Council on Education Oryx Press.

O'Brien L (1989). Learning styles: Make the student aware. NASSP, 73. 85-89.
Okur M, Bahar HH, Akgün L, Bekdemir M (2011). The learning styles of mathemetics department students and constant anxiety and academic achievement. TSA, 15(3):123-134.
Oluk S, Sambur E, Can Ş (2007). Farklı Alanlarda Öğrenim Gören Öğretmen Adaylarının Öğrenme Stillerinin Belirlenmesi ve Karşılaştırılması (The Determination and Comparison of Studying in Different Areas of Prospective Teachers' Learning Styles). XVI. National Educational Sciences Congres, *Gaziosmanpaşa Üniversity Education Faculty*, Tokat.
Orhun N (2013).The effects of learning styles on high school students' achievement on a mathematics course. *Educ. Res. Rev.* 8(14):1158-1165.
Özbek Ö (2007). İlköğretim Öğrencilerinin Öğrenme Stillerinin İncelenmesi (The Investigation of Primary School Students' Learning Styles). XVI. National Educational Sciences Congres, *Gaziosmanpaşa University Education Faculty*, Tokat.
Özdemir N, Kesten A (2012). Sosyal bilgiler öğretmen adaylarının öğrenme stilleri ve bazı demografik değişkenlerle ilişkisi. Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi. 16(1):361-378.
Özgür H (2013). BOTE Bolumu Öğretmen Adaylarının Öğrenme Stillerinin Çeşitli Değişkenler Açısından İncelenmesi (The Investigation of CEIT Department Pre-Service Teachers' Learning Styles in Terms of Various Variables). *Pamukkale Üniversity J. Educ.* 34 (2):103-118.
Özgür H, Tosun N (2012). Öğretmen adaylarının derin ve yüzeysel öğrenme yaklaşımlarının çeşitli değişkenler açısından incelenmesi (Examination the Deep and Surface Learning Approaches of Pre-Service Teachers in Terms of Some Variables). *Mehmet Akif Ersoy University J. Educ. Faculty*. 1(24):113–125.
Peker M (2003). Öğrenme stilleri ve 4 MAT yönteminin ö8rencilerin matematik tutum ve baBarClarCna etkisi, Gazi Üniversitesi EYitim Bilimleri Enstitüsü (YayMmlanmamMN doktora tezi), Ankara.
Peker M, Yalın Hİ (2002). Matematik Öğretmenlerinin Öğrencilerin Öğrenme Stillerine Uygun Öğretim Yapma Düzeyleriyle İlgili Öğrenci Görüşleri. 5th National Congress Of Science and Mathematics Eduation, 16-18 September.
Peker, M., Mirasyedioğlu, Ş. (2008). Pre-Service Elementary School Teachers' Learning Styles and Attitudes towards Mathematics. Eurasia J. Math. Sci. Technol. Educ. 4(1):21-26
Penger S, Tekavčič M (2009). Testıng Dunn & Dunn's And Honey & Mumford's Learnıng Style Theorıes: The Case of The Slovenin Higher Education System. *Manage*. 14(2):1-20.
Ramirez M, Castaneda A (1974). Cultural democracy, bicognitive development and education. New York: Academic Press.
Ranne TM (1996). Hawthorne uncapped: The relationship of adult learning styles to the academic achievement of nursing students. (Doctoral dissertation, State University of New York, Buffalo). Dissertation Abstracts International, 57(9):3771.
Raschick M, Maypole D, Day P (1998). Improving field Instruction through Kolb learning theory. J. Social Work Educ. 34(1):31-42.
Richmond AS, Cummings R (2005). Implementing Kolb's learning styles into online distance education. *Int. J. Technol. Teaching Learn.* 1(1):45-54
Schmeck RR, Ribich F, Ramanaiah H (1977). De-velopment of a self-report inventory for assessing individual differences in learning processes. *Appl. Psychol. Measure*. 1:413-431.
Şengül S, Katrancı Y, Figen Bozkuş (2013). Learning Styles of Prospective Teachers: Kocaeli University Case. J. Educ. Instructional Stud. World. 3(2):1-12.
Şeyihoğlu Ş (2010). The source of individual differences in teaching art: dominanat learning styles. National Education, 186, 56–70.
Topuz FG, Karamustafaoğlu O (2013). Öğrenme stillerinin çeşitli değişkenler açısından incelenmesi: Fen bilgisi öğretmen adayları. Dicle Üniversitesi Ziya GökalpEğitim Fakültesi Dergisi. 21(17):30-46.
Ülgen, G. (1997). Eğitim Psikolojisi. Ankara: Alkım Publisher.
Veres JG (1991). Improving the reliability of Kolb's revised Learning Style Inventory. Educ. Psychol. Measure. 51 (1):143-150.
Veznedaroğlu RL, Özgür AO (2005). Öğrenme Stilleri: Tanımlamalar, Modeller ve İşlevleri (Learning Styles: Definitions, models and functions). İlköğretim-Online, 4(2), 1-16.http://dergipark.ulakbim.gov.tr/ilkonline/article/view/5000038369/5000037225
Wilkinson A, Roberts J, While AE (2010). Construction of an instrument to measure student information and communication technology skills, experience and attitudes to e-learning. *Computers Hum. Behavior.* 26:1369–1376.
Wlodkowski RJ (2008). Enhancing adult motivation to learn: A comprehensive guide for teaching all adults. 3rd ed. San Francisco: Jossey-Bass.
Yenice N, Saracaoğlu AS (2009). Sınıf Öğretmeni Adaylarının Öğrenme Stilleri ile Fen Başarıları Arasındaki İlişki, Yüzüncü Yıl Üniversitesi, Eğitim Fakültesi Dergisi, Cilt:V1, Sayı:I, 162-173. http://efdergi.yyu.edu.tr
Yoshitaka Y (2005). Learning style and typologies of cultural differences: a theoretical and empirical comparison. Int. J. Intercultural Relations. 29:521-548.