Turkish pre-service physics teachers’ preferred learning styles

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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 technologies.

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
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 study. 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 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 (Açıkgoz, 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 to Veznedaroğlu 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.

**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 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 Tekavčiحة (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 Tekavčiحة, 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; Çayci 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 (Evincengel, 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 Hasirci, 2006; Mutlu, 2008; Çayci and Ünal, 2007). There are also studies on mathematics pre-service teachers ( Genç and Kocaaslan, 2013; Peker and Yalin, 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

**Highlights**

1. We determine the learning styles of physics pre-service teachers
2. We examined the learning 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.
Participants of this study from these grades were randomly selected for Grade 3, 24% for Grade 4 and finally 40% for Grade 5.

The section contained 14 items. This was followed by respondents such as name, gender, age, academic achievement. The percentages of pre-service teachers are 26% for Grade 2; 10% for Grade 1; 30% for Grade 3; 40% for Grade 4.

"Information and Communication Technologies Skills" (ICT skills) were 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 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.

| Gender | Learning style | N(%) | Total |
|--------|----------------|------|-------|
|        | Diverging      | 14(46.7)| 30(100.0)|
| Female | Accommodating | 7(23.3) | 11(36.7) |
| Male   | Assimilating   | 2(6.7)  | 5(16.7)  |
| Male   | Converging     | 7(23.3) | 12(40.0) |
| Male   | Total          | 26(52)  | 50(100.0)|

\( \chi^2=3.825, \text{df}=3, p=0.281. \)

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 Saracoğlu, 2009; Kaf, 2006; Çelenk and Karakış, 2007; Özbek, 2007; Oluk et al., 2007; Çayci 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 (\( \chi^2_{(3)} = 3.825, p>0.05 \)). 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   | $\bar{x}$ | 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.

| Type of motivation | External | N(%) | Diverging | Accommodating | Assimilating | Converging | Total |
|--------------------|----------|------|-----------|---------------|--------------|------------|-------|
|                    | Internal | N(%) | 7(41.2)   | 4(23.5)       | 4(23.5)      | 2(11.8)    | 17(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 information 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.

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

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 | χ²   | p   |
|-------------------------------|------------------------------|-----|---------------|----|------|-----|
| ICT 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 (χ²(3) =3.774, p>.05), mobile technologies (χ²(3) = 2527, p>.05), communication technologies (χ²(3) = 3.956, p>.05), and information technologies (χ²(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  |       |

| Levels          | f  | %  |
|-----------------|----|----|
| Very high       | 3  | 9.4|
|                 | 14 | 43.8|
|                 | 5  | 15.6|
|                 | 10 | 31.3|
|                 | 32 | 100.0|
| High            | 4  | 28.6|
|                 | 8  | 57.1|
|                 | 2  | 14.3|
|                 | 0  | 0.0 |
|                 | 14 | 100.0|
| Total           | 6  | 12.0|
|                 | 7  | 15.2|
|                 | 22 | 47.8|
|                 | 7  | 15.2|
|                 | 46 | 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 learning 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.

|                | Kolmogorov-Smirnov | 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 technologies skills 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 Kahyaoglu’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. Çayci 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. Cherry 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; Çayci 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, Mirasyedioglu, 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 or accommodating 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-
also will enhance students’ learning.

Conflict of Interests
The author has not declared any conflict of interest.

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