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Full Length Research Paper

A comparison on the learning styles of chemistry students and chemistry education students in universities in Turkey

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ABSTRACT

The aim of the study is to compare learning styles of students in the department of chemistry education in education faculties and learning styles of students in the department of chemistry in faculties of science or faculties of arts and sciences in Turkey. The study group of the study is comprised of 1291 undergraduate students in total from the chemistry departments in eight universities and from Chemistry Education departments in 5 universities located in different geographical regions in Turkey. Data was obtained using Kolb Learning Style Inventory. When the entire study group is considered, it is observed that chemistry undergraduate students have diverging learning style as the dominant and that the assimilating learning style as the second among their learning style preferences. It is concluded that chemistry students have assimilating learning style while chemistry education students have diverging learning style as the dominant one according to the departments.

Keywords: Turkey, chemistry students, chemistry education students, Kolb's learning styles.

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INTRODUCTION

Individuals process information in different ways using different information sources due to having different personality traits, learning methods and styles, and this leads an individual's learning requirements to be different (Riding and Rayner, 1998). An individual should be successful at solving problems he/she faces in order to make his/her life efficient. Becoming an active problem solver as an individual could be realized by knowing one's learning style (Fidan, 1986). An individual knowing his/her own learning style will activate this style during the learning process (Biggs, 2001). Learning styles are being differences in information processing (Snyder, 2000) and play an important role in students' ability to structure information in an efficient manner (She, 2005). Learning styles which are observable and distinguishable includes behavior giving clues about an individual (Kaplan and Kies, 1995). There are different definitions of learning styles in the literature. Kolb (1984) stated that learning style was the method personally selected by an individual in terms of grasping and processing information.

Kolb regarded the learning process as a cycle and defined four types of learning styles in this cycle. These learning styles are (Aşkar and Akkoyunlu, 1993):

- Concrete experience – (CE)
- Abstract conceptualization – (AC)
- Active experience – (AE), and
- Reflective observation – (RO).

Among these four learning styles, one of them is prioritized for individuals. It is also inevitable to undergo this cycle countlessly in a learning experience (Hasırcı, 2006). Learning ways in these learning styles are different from each other. The learning way for these different learning styles are feeling for concrete

experience, thinking for abstract conceptualization, doing for active experience, and watching for reflective observation (Kolb 1984; Cassidy, 2004).

Every individual's learning style is the combination of two learning styles among these four (Gencel, 2006; Kolb, 2000):

- The combination of concrete experience and reflective observation is diverging,
- The combination of reflective observation and abstract conceptualization is assimilating,
- The combination of abstract conceptualization and active experience is converging,
- The combination of active experience and concrete experience is accommodating.

In the literature review of Learning Styles in national and international studies, it was noted that the learning styles inventory developed in line with Kolb's Experiential Learning Theory was used efficiently and accepted in this field (Köseoğlu, 2009; Kural, 2009). It is required that learning environments be arranged considering students' learning characteristics and different learning styles while applying Kolb's learning cycle in classes (Kayes, 2005; Kolb and Kolb, 2005; Healey et al., 2005; Gencel, 2006).

By some studies, it was concluded that it is possible to learn more easily and rapidly if the learning styles are concentrated on student's means of getting, processing and recalling information in the learning process. Moreover, it is believed that this condition could enable the students to be more efficient in the courses and that they will be able to generate solutions for the problems in a faster way; and that it will enable them to feel confident and to be able to develop a positive attitude for the courses and school by decreasing the level of uneasiness (Fidan 1986; Entwistle et al., 2001; Biggs, 2001; Güven, 2004). Kolb, Boyatzis and Mainemelis (2001) emphasize that the effects of personality types, early specialization in education, professional life, role of the individual in the job and applicable competences on the learning styles have recently been examined.

Individual differences play an important role in individuals' learning process. Boydak (2007) lists these individual differences as traits such as learning style, learning strategies, prior knowledge level, personality structure, gender, age and etc. In this context, the aim of the study is to examine dominant learning styles of chemistry teacher candidates studying in education faculties in Turkish universities and chemistry students studying in faculties of arts and sciences or of sciences. The following questions were asked within the framework of this general purpose:

1. What are the dominant learning styles of undergraduate chemistry students in Turkey?
2. Is there a significant relationship between the dominant learning styles of undergraduate chemistry students in Turkey and the variables of university, department, gender, class, and age?

METHODOLOGY

Research model

This study was designed according to relational screening model. The relational screening model is a research model aimed at determining the presence and/or degree of change among two and more variables (Karasar, 2006).

Study group

The study group is comprised of 1291 students including 789 students who are studying in the department of Chemistry in 8 different universities in Turkey in the 1st, 2nd, 3rd, and 4th classes, and 502 students who are studying in the department of Chemistry Education in 5 different universities in Turkey in the 1st, 2nd, 3rd, 4th and 5th classes. While selecting universities for the study, the fact that the sample size would be sufficient and that there would be students in each year of education was the main factor. The distributions of students in the study group according to university, faculty, and gender are presented in Table 1.

Data collection tools

Personal information form was used in order to determine demographic traits (gender, age, and year of study) of students in the study while the third version of Kolb Learning Style Inventory (LSI-3), developed by David Kolb was used in order to determine dominant learning styles. Gencel (2006) stated that Turkish adaptation of LSI-3 and reliability of the scale was between the reliability coefficients of 0.71 to 0.80. There are four statements in each of 12 items in LSI-3. The first one of these statements is about concrete experience, the second about reflective observation, the third about abstract conceptualization, and the fourth about active experience. Four statements in each item are scored between 1 and 4. The lowest score of the scale is 12 whereas the highest score is 48 (Kolb, 1985; Aşkar and Akkoyunlu, 1993).

Data analysis

Data obtained in the study was analyzed using SPSS package program, and whether there was a significant relationship between frequency and two variables (between students' learning styles and their universities, departments, gender, year of study, and age) was analyzed using chi-square test.

Table 1. The distributions of students in the study group according to university, faculty, and age.

Department	No	University	City	Faculty	Gender		N
					Female	Male	
Chemistry	1	Ondokuz Mayıs	Samsun	Arts and Sciences	55	47	102
	2	Cumhuriyet	Sivas	Sciences	72	30	102
	3	Atatürk	Erzurum	Sciences	59	36	95
	4	Gazi	Ankara	Sciences	77	22	99
	5	Marmara	İstanbul	Arts and Sciences	78	20	98
	6	Adnan Menderes	Aydın	Arts and Sciences	61	38	99
	7	Çanakkale Onsekiz Mart	Çanakkale	Arts and Sciences	63	34	97
	8	Kafkas	Kars	Arts and Sciences	55	42	97
				Total	520	269	789
				%	65.9	34.1	
Chemistry Education	1	Ondokuz Mayıs	Samsun	Education	54	46	100
	2	Atatürk	Erzurum	Kazım Karabekir Education	54	46	100
	3	Gazi	Ankara	Gazi Education	67	33	100
	4	Karadeniz Technical	Trabzon	Fatih Education	66	36	102
	5	Marmara	İstanbul	Atatürk Education	63	37	100
				Total	304	198	502
				%	60.6	39.4	
				General Total	824	467	1291
				General %	63.8	36.2	

RESULTS

The dominant learning styles of undergraduate Chemistry students in Turkey, based on their university and departments, are given in Figure 1 and Table 2.

When the sample is considered as a whole, it was found that:

- 36.7% of undergraduate chemistry students had converging,
- 33.4% of them had assimilating,
- 20.2% of them had diverging,
- 9.7% of them had accommodating learning style.

When the departments were analyzed separately, it was found that all four learning styles were present; however, there were some discrepancies:

- 37.1% of chemistry students taking part in the study had assimilating, and
- 33.8% of them had converging learning style as the dominant learning style, whereas
- 41.2% of chemistry education students had converging, and
- 27.5% of them had assimilating learning style as the dominant learning style.

When the chemistry departments of universities were analyzed, it was noted that:

- In Kafkas (46.4%), Adnan Menderes (38.3%), Gazi (37.3%), and Ondokuz Mayıs (36.3%) universities, majority of students had converging learning style,
- In Cumhuriyet (48%), Çanakkale Onsekiz Mart (42.3%), and Marmara (39.8%) universities, majority of students had assimilating learning style, and
- In Atatürk University (37.9%), majority of students had diverging learning style.

When the chemistry education departments of universities were analyzed, it was concluded that:

- In Gazi (52%), Marmara (42%), Ondokuz Mayıs (41%), and Karadeniz Technical (38.2%) universities, majority of students had converging learning style, and
- In Atatürk University (39%), majority of students had diverging learning style.

The distribution of learning styles of undergraduate chemistry students in Turkey according to gender, year of study, and age variables is presented in Tables 3, 4 and 5.

It was concluded that the majority of female students

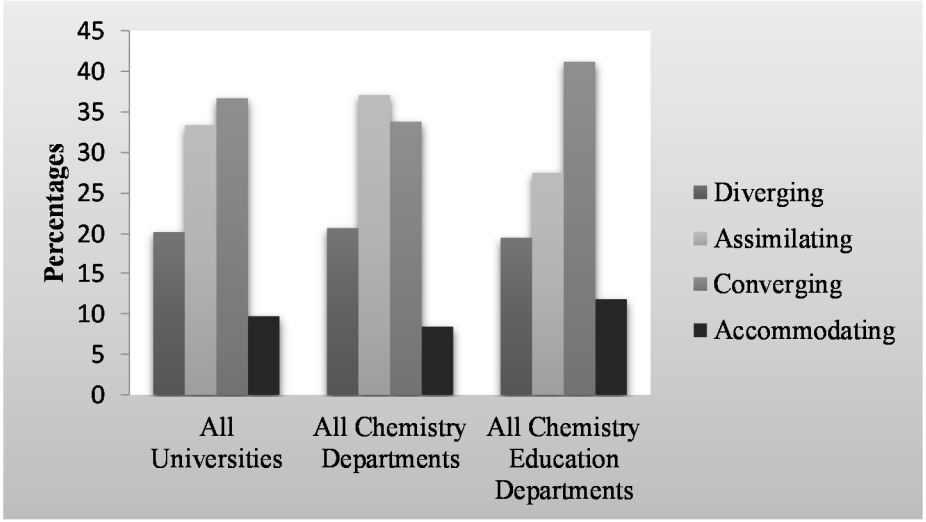

Figure 1. Undergraduate chemistry students' preferences according to Kolb's learning styles in the study group.

Table 2. Learning styles of undergraduate chemistry students in the study group on university basis

Department	University	Kolb's Learning Styles								N
		Diverging		Assimilating		Converging		Accommodating		
		f	%	f	%	f	%	f	%	
Chemistry	Ondokuz Mayıs University	20	19.6	36	35.3	37	36.3	9	8.8	102
	Cumhuriyet University	15	14.8	49	48.0	29	28.4	9	8.8	102
	Atatürk University	36	37.9	32	33.7	19	20.0	8	8.4	95
	Gazi University	16	16.2	34	34.4	37	37.3	12	12.1	99
	Marmara University	23	23.5	39	39.8	30	30.6	6	6.1	98
	Adnan Menderes University	17	17.2	37	37.4	38	38.3	7	7.1	99
	Çanakkale Onsekiz Mart University	21	21.6	41	42.3	32	33.0	3	3.1	97
	Kafkas University	15	15.5	25	25.8	45	46.4	12	12.3	97
	Total	163	20.7	293	37.1	267	33.8	66	8.4	789
Chemistry Education	Ondokuz Mayıs University	13	13.0	29	29.0	41	41.0	17	17.0	100
	Atatürk University	39	39.0	15	15.0	33	33.0	13	13.0	100
	Gazi University	11	11.0	29	29.0	52	52.0	8	8.0	100
	Karadeniz Technical University	15	14.7	35	34.3	39	38.2	13	12.8	102

Table 2. Continues.

	Marmara University	20	20.0	30	30.0	42	42.0	8	8.0	100
	Total	98	19.5	138	27.5	207	41.2	59	11.8	502
General Total		261	20.2	431	33.4	474	36.7	125	9.7	1291

Table 3. The distribution of learning styles of undergraduate chemistry students in the study group according to gender.

Kolb's Learning Styles										
Department	**Gender**	**Diverging**		**Assimilating**		**Converging**		**Accommodating**		**N**
		f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	
Chemistry	Female	100	19.2	184	35.4	187	36.0	49	9.4	520
	Male	63	23.4	109	40.5	80	29.7	16	6.3	269
	Total	163	20.7	293	37.1	267	33.8	66	8.4	789
Chemistry Education	Female	51	16.8	91	29.9	132	43.4	30	9.9	304
	Male	47	23.7	47	23.7	75	37.9	29	14.6	198
	Total	98	19.5	138	27.5	207	41.2	59	11.8	502

Table 4. The distribution of learning styles of undergraduate chemistry students in the study group according to year of study.

Kolb's Learning Styles										
Department	**Year of study**	**Diverging**		**Assimilating**		**Converging**		**Accommodating**		**N**
		f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	
Chemistry	1	34	17.3	77	39.1	68	34.5	18	9.1	197
	2	43	21.5	65	32.5	74	37.0	18	9.0	200
	3	36	18.3	71	36.0	70	35.5	20	10.2	197
	4	50	25.7	80	41.0	55	28.2	10	5.1	195
	Total	163	20.7	293	37.1	267	33.8	66	8.4	789
Chemistry Education	1	22	22.0	28	28.0	42	42.0	8	8.0	100
	2	27	27.0	29	29.0	28	28.0	16	16.0	100
	3	11	11.0	33	33.0	48	48.0	8	8.0	100
	4	17	16.7	25	24.5	48	47.0	12	11.8	102
	5	20	20.0	23	23.0	42	42.0	15	15.0	100
	Total	98	19.5	138	27.5	207	41.2	59	11.8	502

Table 5. The distribution of learning styles of undergraduate chemistry students in the study group according to age groups.

Department	Age groups	Kolb's Learning Styles								N
		Diverging		Assimilating		Converging		Accommodating		
		f	%	f	%	f	%	f	%	
Chemistry	≤ 20	48	18.0	99	37.1	92	34.4	28	10.5	267
	21-22	66	18.5	134	37.5	126	35.3	31	8.7	357
	23-24	38	26.2	54	37.3	47	32.4	6	4.1	145
	≥ 25	11	55.0	6	30.0	2	10.0	1	5.0	20
	Total	163	20.7	293	37.1	267	33.8	66	8.4	789
Chemistry Education	≤ 20	29	20.3	40	28.0	62	43.3	12	8.4	143
	21-22	30	17.9	52	31.0	66	39.2	20	11.9	168
	23-24	28	20.1	31	22.3	59	42.5	21	15.1	139
	≥ 25	11	21.1	15	28.9	20	38.5	6	11.5	52
	Total	98	19.5	138	27.5	207	41.2	59	11.8	502

studying in the department of chemistry in universities included in the study (36.0%) had converging learning style whereas the majority of male students (40.5%) had assimilating learning style. The majority of female (43.4%) and male students (37.9%) who were studying in the department of chemistry education had converging learning style as the dominant learning style (Table 3).

It was found that the majority of students who were studying in their second year, in the department of chemistry in universities included in the study had converging learning style (37.0%) whereas the majority of students in other years had assimilating learning style. On the contrary, it was found that the majority of students who were studying in their second year, in the department of chemistry education (29.0) had assimilating learning style whereas the majority of students in other years had converging learning style (Table 4).

It was noted that the majority of students who were in the ≥25 age group (55.0%) and who were studying in the department of chemistry in universities included in the study had diverging learning style whereas the majority of students in other age groups had assimilating learning style (Table 5). It was also observed that the majority of students in all age groups, studying in the department of chemistry education, had converging learning style.

Chi-square results on the correlation between the learning styles of undergraduate chemistry students in Turkey and university, department, gender, age, and year of study variables are presented in Table 6.

When Table 6 was examined, it was found that:

- When undergraduate chemistry students were taken as a whole, there was a significant relationship between learning styles and department whereas there was not a significant correlation between learning styles and gender, age, and year of study age groups,
- There was a significant relationship between learning styles of students in the department of chemistry and age variable whereas there was not a significant correlation between learning styles and gender and year of study variables,
- There was not a significant relationship between learning styles of students in the department of chemistry education and gender, age, and year of study variables.

Table 6. Chi-square results on the correlation between the learning styles of undergraduate chemistry students and some demographic variables

Chi square tabulation	X^2	p
All learning styles all universities	83.89	.000*
All learning styles all departments	16.95	.001*
All learning styles gender	9.43	.398
All learning styles age	6.53	.089
All learning styles year of study	18.45	.103
Chemistry Departments		
All learning styles gender	6.835	.077
All learning styles age	24.159	.004*
All learning styles year of study	12.318	.196
Chemistry Education Programs		
All learning styles gender	7.873	.049
All learning styles age	5.688	.771
All learning styles year of study	22.134	.036

*There is a significant relationship when $p < .05$.

DISCUSSION AND CONCLUSIONS

When the sample consisting of students from 9 universities in different regions of Turkey is considered as a whole, it was concluded that all four Kolb's learning

styles were present in undergraduate chemistry students in Turkey, and that converging learning style was dominant in 36.7% of them whereas assimilating learning style was dominant in 33.4% of them. In fact, similarly, in a study conducted with the same universities, Güneş (2018) stated that all four Kolb's learning styles were present in undergraduate biology students while Özdemir (2015) suggested that these four learning styles were present in geography students from 8 universities in different geographical regions in Turkey. It was concluded that 43% of geography (departments of geography and geography education) and biology (departments of biology and biology education) had assimilating learning style as the dominant one whereas 33% of them had converging learning style as the dominant learning style (Özdemir, 2015; Güneş, 2018).

When the departments were examined, it was concluded that the majority of chemistry students had assimilating (37.1%) and converging (33.8%) learning styles as the dominant learning style whereas the majority of chemistry education students had (41.2%) and assimilating (27.5%) learning styles as the dominant one. Similar to results obtained in this study, in studies in which comparisons of undergraduate geography and biology students were made, it was found that assimilating and converging learning styles were dominant in students in the departments of geography, biology, and biology education (Özdemir, 2015; Güneş, 2018) whereas converging and assimilating learning styles were dominant in students in the department of geography education (Özdemir, 2015). Similarly, in studies aimed at determining Kolb's learning styles of students in different departments of education faculties in Turkish universities, it was concluded that converging learning style was dominant in science (Gencel and Köse, 2011) and mathematics (Peker, 2009; Kemal, Tataroglu and Alkan, 2011; Tuna and Kaçar, 2016) teacher candidates whereas assimilating and converging learning styles were dominant in social sciences teacher candidates (Özdemir and Kesten, 2012).

It can be noted that different results are obtained in studies on Kolb's Learning Styles in students in different departments of several faculties in Turkish universities. For example, it was concluded that diverging learning style was dominant in biology (Yapıcı and Hevedanlı, 2012), physics (İngeç, 2015) and chemistry (Oskay et al., 2010) teacher candidates who are studying in departments related to physical sciences. According to the results of the study, the majority of chemistry (37.9%) and chemistry education (39%) students only in Atatürk University had diverging learning style.

It was concluded that there was not a significant relationship between learning styles of chemistry students and the gender variable. Moreover, in a study conducted by Güneş (2018) with biology students, it was stated that there was not a significant relationship between learning styles of biology and biology education students and gender. Moreover, in the early studies on Kolb's learning styles inventory, it was addressed that there was not a significant gender difference (Kolb, 1976; Kolb, 1985). In addition to these studies, when similar studies were examined where Kolb's Learning Styles Inventory was used as a data collection tool, we observed that there was not a significant relationship between the gender variable and learning styles (Demir, 2006; Foney, 1994; Gürsoy, 2008; Kaya, Özabacı and Tezel, 2009; Yoon, 2000; Özdemir and Kesten, 2012; Özdemir, 2015). Another result of this study demonstrates that there is not a significant relationship between learning styles of chemistry students and the year of study variable. The results of the study have shown that the variables of gender and year of study do not have an impact on learning styles in undergraduate students and do not cause a significant difference in information perception and processing ways.

According to the results of the study, there is a significant relationship between learning styles of chemistry students and the age variable. It is observed that the diverging learning style, which is the combination of concrete experience and reflective observation learning styles, is dominant in the ≥ 25 age group. When analyzed, similar studies in which Kolb's Learning Styles Inventory was used demonstrate that there is a significant correlation between learning styles of social sciences teacher candidates and geography students and the age variable (Özdemir and Kesten, 2012; Özdemir, 2015).

According to Kolb's experiential learning theory, learning is a cycle and one of these four learning styles take primacy for the individual at different times. In fact, when we considered results obtained in this study and results obtained from different studies after the literature review, we found out that the dominant learning styles of students varied across the enrolled program, gender, year of study, and age variables. Therefore, educators should take into account students who have different learning styles while creating education environments and should diversify their teaching strategies, methods, and techniques. Moreover, students should be informed of their own dominant learning styles in their educational process. Thus, they can arrange appropriate studying environments based on their own dominant learning style and make their individual studying more efficient.

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