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Learning Styles of the Students of Biology Department and Prospective Biology Teachers in Turkey and Their Relationship with Some Demographic Variables

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Abstract This study has been carried out with the aim of researching dominant learning styles of the students studying at the biology departments of the faculty of science or the faculty of arts and sciences as well as the dominant learning styles of the prospective biology teachers studying at the faculty of education of universities in Turkey, by taking certain demographics (department, faculty, gender and grade) as basis. In this context, the sample of this study consists of the students studying at the biology teaching departments of faculties of education from 5 universities in Turkey and the students studying at the biology department of science faculties or sciences and arts faculties from 8 universities. In this study, 1255 students in total volunteered to answer Kolb's Learning Styles Inventory (KLSI-3), which has been used as an assessment tool. Evaluating the findings of the study in a general sense, it has been detected that the learning style of most students is absorbing and discriminating and that the percentage distribution of the students whose learning styles are reviewing or reflecting is much lower. It has been understood that the difference between the learning styles of the prospective biology teachers and the learning styles of the biology department students in Turkey is not statistically significant. There is not a significant relationship among the learning styles of the students studying at the biology department based on their class levels, however, such a significant relationship is observed among the prospective biology teachers based on their class levels. It is observed that the relationship among learning styles and other demographics is not significant.

Keywords Kolb's Learning Styles Inventory, Biology Department Students, Prospective Biology Teachers

1. Introduction

As it is revealed in the results of many researches, there is a different path followed by each student in the process of obtaining and processing information. These differences determine the learning styles of the students [1]. Thus, each student participates in the learning environment with her/his own learning style, mental capacity and weakness. A student's mental capacity and weakness states that he/she is able to get the information in a easy or difficult manner. Thus, organizing the learning environment in accordance with learning styles of individuals may enable easier attainment of the purposes in the process of education. When this condition is not provided, it may cause one of the students to be successful and the other to be unsuccessful even if they have similar intelligence [2]. This is because organizing the learning-teaching environments without taking personal differences into consideration will not enable all of the students to learn in the same manner. For instance, it is a reality that some scientists, who have a significant place and reputation in the history of science, failed to be successful during their time in school, thus they were discharged from school or could not attend to the schools they desired [3].

In fact, personal differences have attracted the attention of educators for centuries, and have resulted in a number of researches conducted on this subject. One of the most important concepts related to personal differences, is the concept of learning style, which reveals the style of learning that the students enjoy. The concept of learning style, which was encountered in the Personality Types Theory of Carl Jung (1927) for the first time, has been defined in various forms by many educational scientists [Op. cit., 4]. For instance, while Felder and Silverman [5] define learning styles as characteristic strengths and preferences of the individuals in obtaining, keeping and processing the information, Gregorc [6] inteprets it as learning conditions that the individuals form as per their perception capacities. Moreover, learning style is defined by Kolb [7] as a personally preferred method in perceiving and processing information. Davidson [8] and DeBello [9] define learning styles as the manner in which an individual

obtains, processes, and keeps information, whereas; Dunn and Dunn [10] interprets it as a path which differs according to each individual and starts with the individual's concentration on the new and difficult information and continues with the process of obtaining the information and placing it in mind. James and Gardner [11] defines learning styles as conditions in which what is intended to be learned by the learners is perceived, processed, kept and recalled in the most efficient and effective manner, and as a complex behavior style. Based on these definitions, we can specify that everyone has a different thinking and learning manner, that the beneficial learning style for each student is her/his own learning style, and that the student's learning style determines his/her perception, his/her relations with other people and his/her learning.

In literature, it is observed that many models have been developed on learning styles. The ones that are used the most are the models developed by Kolb, McCarthy, Within, Jung, Dunn and Dunn, Reid and Grasha. And as per each model, the nature of learning styles and manners of distinction of learning styles are different from each other. Thus, within the scope of these models, many different measuring tools have been developed in order to reveal these differences in the learning process of the students [5, 12, 13, 7, 14]. In some studies performed, it is claimed that learning styles developed by David Kolb, and Kolb's Empiric Learning Theory, which is based on the referred learning styles, are one of the most well known learning theories in higher education [15, 16, 17, 18, 19]. Kolb, while forming the experiential learning theory, was affected by the learning models of Dewey, Lewin and Piaget. Many studies [20, 21] have been performed and are still being performed for the implementation and improvement of the theory [7] that was first stated in 1971. Kolb has developed a simple scale called as Learning Style Inventory (LSI), in order to assess the personal tendencies about learning. This scale has gained acceptance in many fields, and was translated in to many languages including Turkish [22, 23, 24, 25].

Empiric learning theory [7] of Kolb, which is different from other cognitive learning theories, emphasizes the role of experiences in the process of empiric learning, and defines learning as conversion of information and experiences. Hence, it is discussed that there are two dimensions in the learning process including comprehension and conversion. These two dimensions support each other despite being independent from each other. In this direction, four learning manners are defined in the learning style model developed by Kolb. These learning manners are "concrete experience", "reflective observation", "abstract conceptualization" and "active experience". The paths of learning that represent each learning manner are different from each other. Learning by "feeling" is in subject for concrete experience, learning by "watching, listening" is for reflective observation, learning by "thinking" is for abstract conceptualization and learning by "doing" is for active experience. The learning style of each individual is a component of these four basic learning manners. These learning styles are "diverging", which isthe combination of concrete experience and reflective observation learning manners, "assimilating", which is the combination of reflective observation and abstract conceptualization learning manners, "converging", which is the combination of abstract conceptualization and active experience learning manners, and "accommodating", which is the combination of concrete experience an active experience learning manners [7].

According to this theory of Kolb, learning styles are in the form of a cycle, and everyone is at a point of this cycle. Thus, in the whole education process or at any part of it, this theory may be implemented by using suitable teaching methods and techniques in the four stages of learning cycle including concrete experience, reflective observation, abstract conceptualization, active experience and by systematically involving students in the stages of this learning cycle. Each stage of Kolb's learning cycle addresses different learning styles (diverging, assimilating, converging, accommodating). According to this, the ones adopting diverging learn the best when they are extensively informed and when they are able to perform observation on the subject to be learned; the ones adopting assimilating learn the best when theories having a concrete logic regarding the subject are presented to them; the ones adopting converging learn the best when environments in which they can implement the concepts and theories regarding the subject are provided them; and the ones adopting accommodating learn the best when they experience the subject to be learned or do it in person. In this context, while implementing the learning cycle of Kolb in the courses, it is required to organize the learning and teaching environments by taking into account of the learning characteristics of the students with different learning styles [26, 27, 28, 29].

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 [30, 31, 32, 33, 34]. Kolb, Boyatzis and Mainemelis [35] 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. Moreover, by specifying in their studies that the professions of the individuals affect their dominant learning style, they state that the ones involved in engineering prefer converging learning style; the ones involved in professions relevant to education prefer assimilating learning style; the ones in professions relevant

to administration prefer accommodating learning style, and the ones dealing with professions relevant to literature / art prefer diverging learning style.

This study has been conducted in order to investigate the dominant learning styles of prospective biology teachers studying at faculties of education of universities in Turkey, and those of the biology students studying at biology departments of faculties of science and literature or faculties of science of universities in Turkey. Within the frame of this overall purpose, for the answers to the following questions were sought:

1. What are the dominant learning styles of biology students?
2. Do the learning styles of biology students differ significantly based on the variables of department, faculty, grade and gender?

2. Method

2.1. Sample

The study has been conducted with the survey model [36]. In accordance with this, the students studying at the biology departments and the prospective biology teachers studying at the biology teaching departments consist of the sample of this study. While selecting the sample, it was paid attention to select universities or biology departments from various geographical regions of Turkey. In this context, the sample of this study consists of the students studying at the biology teaching departments of faculties of education from 5 universities in Turkey (Ondokuz Mayis University, Ataturk University, Gazi University, Karadeniz Technical University, Marmara University) and the students studying at the biology department of science faculties or sciences and arts faculties from 8 universities (Ondokuz Mayis University, Cumhuriyet University, Ataturk University, Gazi University, Marmara University, Adnan Menderes University, Canakkale Onsekiz Mart University, Kafkas University). In this study, 1255 undergraduate students have volunteered to respond to the Kolb's Learning Styles Inventory (KLSI-3), which was used as the assessment tool. Moreover, 40% of the students in the sampling were studying at the biology teaching departments of faculties of education, and 60% of them were studying at the biology departments of faculties of science and literature or faculties of science during the time of the study. Besides, students from each grade were included in the sampling, and 25% of them had consisted of male students, and 75 of them had consisted of female students. As observed in Table 1, which also covers the demographical properties of the sample, the proportional distribution of the biology students participating in the study to the biology departments, where the study was held, is close to each other.

Table 1. The distribution of biology students and prospective teachers of the sample to the universities as per their genders and departments.

No	University	City	Faculty		Gender		Total	
					M	F	T	%
1	Ondokuz Mayis University	Samsun	Faculty of Education		29	74	103	8
5	Atatürk University	Erzurum	Kazim Karabekir Faculty of Education		31	64	95	7
7	Gazi University	Ankara	Gazi Faculty of Education		15	79	94	8
9	Karadeniz Technical University	Trabzon	Fatih Faculty of Education		21	76	97	8
11	Marmara University	Istanbul	Ataturk Faculty of Education		24	90	114	9
			Sum of Faculty of Education		**120**	**383**	**503**	**40**
2	Ondokuz Mayis University	Samsun	Faculty of Science and Literature		16	73	89	7
4	Cumhuriyet University	Sivas	Faculty of Science		22	78	100	8
6	Atatürk University	Erzurum	Faculty of Science		34	67	101	8
8	Gazi University	Ankara	Faculty of Science		10	89	99	8
12	Marmara University	Istanbul	Faculty of Science and Literature		27	55	82	7
14	Adnan Menderes University	Aydin	Faculty of Science and Literature		29	68	97	8
16	Canakkale Onsekiz Mart University	Canakkale	Faculty of Science and Literature		18	80	98	7
18	Kafkas University	Kars	Faculty of Science and Literature		36	50	86	7
			Sum of Biology Department		**192**	**560**	**752**	**60**
			General Total	**T**	**312**	**943**	**1255**	**100**
				%	**25**	**75**	**100**	

2.2. Data Collection Method

A personal information form has been used in order to determine the demographical properties (gender, age and grade level) of biology students participating in the research, moreover the third edition of Kolb Learning Style Inventory (KLSI-3) developed by David Kolb, has been used in order to determine the dominant learning styles of the students. Learning Style Inventory, which has been used as measuring tool in the study, was initially contributed to the literature in 1976 by Kolb. In the first edition of the inventory, four words included in each of the nine indexes, were listed so as to reveal the learning preferences of the individuals [7]. Validity and reliability studies required the inventory to be revised in 1993, 1996 and 2005 [28, 29]. In the third edition of the inventory (KLSI-3) in 1996, certain changes was made for materializing the statements. But the most significant difference of KLSI-3 from the previous editions is in the assessment and coding operations. Moreover, in the final form of the scale, the style names were changed as diverging, assimilating, converging and accommodating [37]. Kayes [28], in his study on the validity and reliability of KLSI-3, found the scores regarding the scale's dimensions to be at an acceptable level. Gencel [26], in his study on the applicability of KLSI-3 in Turkey and the reliability of the scale, found out that the reliability coefficients of the learning style dimensions of the inventory vary from 0.71 to 0.80.

2.3. Analysis of Data

The chi square analysis examined whether there was a significant relationship between the learning styles of the students included in the sample, and the students' population, departments, genders and grades. This technique tests whether there is a significant relationship between two rated (categorical) variables, or not. Having a relationship between the two variables indicates that responses on the levels of a variable differs according to the levels of the other variable "Reference [38]".

3. Findings

The findings obtained from the research have been interpreted under the headings that are formed according to the sub-problems of the study.

3.1. Dominant Learning Styles of the Biology Students

The proportional distribution of the dominant learning styles of the biology students participating in the study, based on the universities and departments they study at, is displayed in Table 2. As the table suggests, when the sample is assessed as a whole, 43% of 1255 biology students prefer the assimilating learning style, which refers to perceiving the information through abstract conceptualization as well as processing it through reflective observation. It stands out that 33% of the biology students participating in the study have converging learning style, which refers to processing the information through active experiences or in other words by doing along while also perceiving the information through abstract conceptualization as the ones having assimilating learning style. According to this assessment, it is understood that two learning styles are dominant among the biology students, and that 75% of the students prefer either the assimilating or the converging learning style. On the other hand, the biology students who prefer the diverging learning style (16%) and the accommodating learning style (25%) consist only 25% of the sample. 39% of the prospective teachers studying at the biology teaching departments of faculties of education included in the sample, prefer the assimilating learning style, and 35% of them prefer the converging learning style. Moreover, 45% of the students from the sample of the study, who study at biology departments of faculties of science and literature and faculties of science prefer the assimilating learning style, and 315 of them prefer the converging learning style. Among the learning styles preferred by the prospective biology teachers, the diverging learning style ranks the third by 18%, and the accommodating learning style ranks the fourth by 8%. And it is understood that 15% of the students studying at the biology department have the diverging learning style, and 9% of them prefer the accommodating learning style.

Based on the universities, it is observed that the assimilating learning style ranks the first among the learning styles preferred by the prospective biology teachers studying at the faculties of education of Ondokuz Mayis (44%), Ataturk (44%), and Marmara (38%) Universities. On the other hand, the converging learning style (36%) ranks the first by a slight difference and the assimilating learning style (35%) ranks the second among the dominant learning styles preferred by the prospective biology teachers studying at the Faculty of Education of Gazi University. And another significant finding obtained from the study is that the only department, in which the converging learning style (41%) ranks the first among the learning styles preferred by the students, is the biology teaching department of Fatih Faculty of Education of Karadeniz Technical University from among 13 biology departments included in the sample of the study. Among the learning styles preferred by the prospective teachers participating in the study from the aforementioned department, the assimilating learning style (33%) ranks the second, and when the departments in the sample are put in an order by taking into account of the biology students who prefer the assimilating learning style, it is observed that biology teaching department of Fatih Faculty of Education ranks the last.

Table 2. Dominant learning styles of biology students and the prospective teachers as per faculties and departments

	Kolb's Learning Styles							
	Diverging		Assimilating		Converging		Accommodating	
University / Faculty	T	%	T	%	T	%	T	%
Ondokuz Mayis University Faculty of Education	12	12	45	44	36	35	10	10
Ataturk University, Kazim Karabekir Faculty of Education	12	13	42	44	34	36	7	7
Gazi University Faculty of Education	18	19	33	35	34	36	9	10
Karadeniz Technical University, Fatih Faculty of Education	16	17	32	33	40	41	9	9
Marmara University,Ataturk Faculty of Education	35	31	43	38	31	27	5	4
Total	**93**	**18**	**196**	**39**	**174**	**35**	**40**	**8**
University / Faculty								
Ondokuz Mayis University Faculty of Science and Literature	8	9	45	51	30	34	7	8
Cumhuriyet University Faculty of Science	9	9	53	53	29	29	9	9
Ataturk University Faculty of Science	14	14	39	39	35	34	13	13
Gazi University Faculty of Science	22	22	42	42	32	32	3	3
Marmara University Faculty of Science and Literature	24	29	31	38	19	23	8	10
Adnan Menderes University Faculty of Science and Literature	14	14	41	42	31	32	11	11
Canakkale Onsekiz Mart University Faculty of Science and Literature	8	8	51	52	30	31	9	9
Kafkas University Faculty of Science and Literature	15	17	35	41	27	31	9	11
Total	**114**	**15**	**337**	**45**	**233**	**31**	**68**	**9**
All Universities	***207***	***16***	***533***	***43***	***407***	***32***	***108***	***9***

The biology departments, in which the majority of the students prefer the assimilating learning style, are Cumhuriyet University Faculty of Science (53%), Canakkale Onsekiz Mart University Faculty of Science and Literature (52%) and Ondokuz Mayis University Faculty of Science and Literature (51%). Moreover, in the sample of Gazi University Faculty of Education, the proportion of the students with the assimilating learning style (35%) and the proportion of those with the diverging learning style (36%) are very close to each other. The diverging learning style is the dominant learning style of 32% of the biology students participating in the study. On the other hand, while the diverging learning style is the dominant learning style of 41% of the prospective biology teachers studying at Fatih Faculty of Education of Karadeniz Technical University, it ranks the second among the dominant learning styles of the prospective teachers studying at Kazim Karabekir Faculty of Education of Ataturk University (36%), the Faculty of Education of Gazi University (36%) and the Faculty of Education of Ondokuz Mayis University (35%). The converging learning style comes in the third place among the dominant learning styles of only the prospective teachers participating in the study from Ataturk Faculty of Education of Marmara University.

And in the biology department, the rate for the diverging learning style varies between 34-31% except for the Faculty of Science and Literature of Marmara University. The converging learning style ranks the second following the assimilating learning style among the dominant learning styles of biology students from Marmara University. Although the rate of this learning style varies among the universities, it is understood that it is the dominant learning style of about 16% of all of the biology students (185 of the prospective teachers, 15% of the biology students) participating in the study.

The dominant learning style that is observed the least among the biology students participating in the study is the assimilating learning style with a rate of 9%. This learning style has been found to be the least dominant learning style of the students of Faculty of Science of Gazi University (3%) and Ataturk Faculty of Education of Marmara University (4%), and the highest dominant learning style of the students of Faculty of Science of Ataturk University (13%). It is remarkable that this learning style is preferred by 7-11% of the biology students at all of the other universities.

3.2. The Relationship between the Learning Styles of Biology Students & Prospective Biology Teachers and Variables of Department, Grade and Gender

The frequency and proportional distribution of learning styles of the students participating in the study which is formed according to the variables of department, grade and

gender, are displayed in Table 3. The table suggests that when the learning styles of the students of biology department and biology teaching department are compared to one another, they seems to indicate similar values. In both departments, the most preferred learning style among the students is the assimilating learning style, and the least preferred learning style is the accommodating learning style. In the same manner, the converging learning style is the second most preferred learning styles, and the diverging learning style is the third most-preferred one in both the biology department and the biology teaching departments.

It is observed that approximately half of the students from each grade prefer the assimilating learning style, in which learning is conducted by watching and listening. And when the percentage distribution is considered, the converging learning style ranks the second. Similar rates are available also among the students of biology teaching department. And in a general sense, it is observed that the students prefer the assimilating and converging learning style the most, and that the percentage distribution of the ones choosing the diverging and the accommodating learning style is lower (Table 3).

Considering the sample as a whole, it is remarkable that the distribution of dominant learning styles at all grades is similar to one another. However, when the departments are examined individually, it is seen that there are clear differences in biology teaching departments, while the distribution of learning styles at each grade at biology departments does not display much change. While the assimilating, the converging and the diverging learning styles display values that are quite close to each other among the learning styles of prospective biology teachers at the first grade, the converging learning style ranks the first with a rate of 38% at the last grade, and the assimilating learning style decreases to the second rank with a rate of 36% at the last grade. While the rate of diverging learning style is 30% at the first grade, it is decreases down to 12% in the last grade, and while the rate of accommodating learning style is 85% at the first grade, it increases up to 15% in the last grade. Based on the variable of gender, it is observed that the distribution of dominant learning styles in both the biology and the biology teaching departments indicate proportionally similar results.

Table 3. Learning styles of biology students and the prospective teachers of the sample as per demographical properties

Demographical properties	**Kolb's Learning Styles**								**General total**	
	Diverging		Assimilating		Convergin		Accommodating			
	T	**%**	**T**	**%**	**T**	**%**	**T**	**%**	**T**	**%**
Biology teaching										
Male	26	22	51	43	34	28	9	8	120	
Female	67	18	145	38	140	37	31	8	383	
Grade										
1	28	30	29	31	28	30	8	8	93	
2	19	21	38	42	30	33	4	4	91	
3	14	12	52	48	38	35	5	5	109	
4	20	18	41	38	40	37	8	7	109	
5*	12	12	36	36	38	38	15	15	101	
Total	**93**	**19**	**196**	**39**	**174**	**35**	**40**	**8**	**503**	**40**
Biology										
Male	38	20	83	43	51	27	20	10	192	
Female	76	14	254	45	182	33	48	7	560	
Grade										
1	27	16	82	48	41	24	22	13	172	
2	35	19	68	37	63	34	17	9	183	
3	23	11	94	45	76	37	14	7	207	
4	29	15	93	49	53	28	15	8	190	
Total	**114**	**15**	**337**	**45**	**233**	**31**	**68**	**9**	**752**	**60**
All sample										
Male	64	21	134	43	85	27	29	9	312	25
Female	143	15	399	42	322	34	79	8	943	75
Grade										
1	55	21	111	42	69	26	30	11	265	21
2	54	20	106	39	93	34	21	7	274	22
3	37	12	146	46	114	36	19	6	316	25
4	49	16	134	45	93	31	23	8	299	24
5*	12	12	36	36	38	38	15	14	101	8
General total	**207**	***17***	***533***	***43***	***407***	***33***	***108***	***9***	**1255**	**100**

* In Turkey, faculties of education are providing undergraduate study for five years, and biology departments are providing undergraduate study for four years. For this reason, the values of only the students of faculty of education are available at the level of 5th grade.

Table 4. Chi square analysis results of biology students and the prospective teachers in the sample

Chi square analysis results	X^2	P	Ho assent / dissent
Biology teaching education			
All learning styles at all the faculties	21,67	0,01*	Assent
All learning styles as per gender	3,19	0,13	Dissent
All learning style as per grade	25,61	0,00*	Assent
Biology department			
All learning styles at all the faculties	37,43	0,79	Dissent
All learning styles as per gender	5,96	0,23	Dissent
All learning style as per grade	18,08	0,70	Dissent
All sample			
All learning styles at all the universities	65,37	0,19	Dissent
All learning styles as per gender	7,76	0,06	Dissent
All learning styles as per departments	6,08	0,69	Dissent
All learning style as per grade	29,52	0,05	Dissent

Whether the learning styles of biology students participating in study significantly differ based on the variables of faculty, department, gender and grade has been tested through chi square analysis. As the Table 4 which includes the results of this analysis, suggests the results of the analysis show that there is no significant relationship between the variables of faculty and department when the sample is evaluated as a whole. On the other hand, it is understood that the Cronbach Alpha significance value is equal or close to 0.5 as per variables of gender and grade. When the biology and biology teaching departments are examined individually, while no significant relation is determined by the results of analysis in terms of all the variables in biology departments, it can be concluded that this difference is significant as per learning styles of the prospective teachers at biology teaching departments and the faculties where they study as well as their grades.

4. Discussion and Results

There are two significant differences in how we learn information. The first difference is how we perceive the information; and the second one is how we process the perceived information. Each of us perceives the reality in a different manner; we place them in our minds through different methods. Some of us realize the reality through our feelings, some through watching, some through thinking, and some through doing [39, 40]. Thus, when the learning style, which has a significant place in the life of the individual, is known by the individual, he/she will activate this style in the learning process. By doing so, one will learn both more easily and faster will possibly succeed in the learning process [30].

Biology, which is a positive science, is also a scientific field that is the most prone to human nature. In terms of learning and teaching, although this condition is a chance for both the learner and teacher, the students deem biology as a course to be memorized during courses, in which the students do not participate and only listen to the teacher and they display an uninterested and unwilling attitude for the course [41]. And this results in failure and unability to reach the determined purposes. When teaching is conducted with a directly teacher centered instruction method, when the tools are rarely used during the course, when the applied studies are not sufficiently included and when the roles of the students in the class are limited to only listening and taking notes, the students tend towards rote learning and the course becomes boring [42, 43, 44].

According to the literature review, it is remarkable that most of the studies performed in Turkey on the learning styles pertains to a limited number of prospective teachers. For this reason, it is necessary to carry out dimensional studies, which examine the effect of undergraduate studies of prospective teachers on their learning styles and which have samples from different branches of different universities. Thus, this study has been conducted on this deficiency, and the findings of this research, in which the learning styles of biology department students and that of the biology teaching department students in Turkey are compared to each other, suggest the following results.

It has been determined that the four learning styles of Kolb are available among the students of biology department and the biology teaching department, which consist of the sample of the research. Hence, in line with these results, it is remarkable that similar results have been obtained also in the studies relevant to Kolb Learning Styles, which deal with the students studying at different departments of various faculties of some universities in Turkey. According to some of these studies, it is observed that Kolb's four learning styles can also be found in the prospective teachers studying at departments that are related to fields such as science [45, 46, 47], biology [48], physics [49] and chemistry [50]. Moreover, in some of the

previous studies, it observed that the same results have been obtained in the prospective teachers from departments of mathematics [51, 52, 53], computer education and teaching technologies [54, 55, 56], class teaching [57, 58, 59, 60, 61, 62, 63, 64, 65], geography from different universities in Turkey [66], social sciences [37], music [67, 68], and physical education [69].

When the sample of this research is assessed as a whole, it is understood that 76% of the biology students choose the assimilating learning style (43%) or the converging learning style (33%). Also, the studies carried out on Kolb's Learning Styles in the students studying at different departments of various faculties of universities in Turkey regarding have gathered various results. For instance, one of the results indicates that the dominant learning style of the prospective teachers studying at departments relevant to certain fields such as science [45, 47], biology [48], physics [49] and chemistry [50] is the diverging learning style. In some other studies, it has been detected that the converging learning style is the dominant learning style of the prospective science teachers [46], of the prospective mathematics teachers [51, 52, 53], of the prospective teachers studying at the department of computer education and instructional technologies [54, 55, 56], whereas; the dominant learning style of the prospective classroom teacher is either the assimilating or the converging learning style [57, 58, 59, 60, 61, 62, 63, 64, 65]; the dominant learning style of the prospective geography teachers is the converging and the assimilating learning styles [66, 70]; the dominant learning style of the prospective social sciences teachers is also the assimilating and the converging learning styles [37]; that the dominant learning style of majority of the prospective physical education teachers is either the diverging or the assimilating [69]. In two studies examining the learning styles of prospective music teachers, it was found that the dominant learning style of the majority of the prospective music teachers is either the diverging and the accommodating [68] or the assimilating and the diverging learning style [67]. The studies conducted by Çelik et al. [71], which focus on the prospective teachers studying at different departments of faculties of education, it was determined that the prospective teachers prefer the assimilating learning style the most, and the accommodating learning style the least.

In his study conducted with prospective teachers studying at different teaching fields such as primary education, computer education and instructional technologies, science education, arts education, social fields and Turkish teaching at different grades, Kazu [72] specifies that the dominant learning styles of the prospective teachers include the assimilating learning style and the converging learning style. Hence, Kolb [7, 20, 21, 29] also states that concrete experience and active experience are dominant in disciplines such as social services, education, educational psychology and educational administration. In another research carried out on the learning styles of undergraduate students in Australia, Nulty and Barrett [73] have concluded that accommodating learning style is the dominant learning style in the field of education. As similar to the results in the field of education [74], Kruzich, Barbara and Dorothy have revealed through their studies that the dominant learning style of undergraduate students of the social services is the accommodating learning style. Both this study and other studies conducted on the learning styles of the prospective teachers in Turkey indicate that dominant learning style of the majority of the prospective teachers is the assimilating learning style. And in the dimensional study performed by Ozdemir et al. [75] on the prospective social sciences teachers, it was found that undergraduate education did not cause a significant difference in the perception (concrete experience-abstract conceptualization) and processing (reflective observation-active experimentation) ways in the learning styles of prospective teachers and similar results were found when the variable of gender was taken as the basis. However, the researches performed abroad on this subject suggest that the dominant learning style of the ones involved in the profession of teaching is the accommodating learning style [35, 76, 77]. Hence, as a result of his study, Kolb also emphasizes that the ones working in the field of education are required to have the accommodating learning style, which is the combination of concrete experience and active experience learning ways. Because according to the experiential learning theory of Kolb, perceiving the information through concrete experiences and processing the perceived information through active experiences is a suitable learning manner for the prospective teachers. In this context, it is being expected for the faculties of education to prepare the curriculums aimed at perception and processing of information by the prospective teachers , and to provide education aimed at bringing in skills conforming to the requirements of the profession of teaching.

Comparing the 13 faculties of 9 universities located at different regions of Turkey, where this study has been carried out, it is detected that there is no statistical significant difference among the learning styles of students as per the faculties they study at. In the same manner, it is observed that there is no significant difference among the learning styles of biology students at biology teaching departments of 5 faculties of education, and at biology departments of 8 faculties of science and literature or faculties of science at these 9 universities. In other words, there is no significant difference between the dominant learning styles of the prospective biology teachers and those of the students studying at the biology department participating in the study. Hence, in his study performed with the prospective teachers studying at different teaching fields and at different grades, Kazu [72] specifies that there is no significant difference in the learning styles of the prospective teachers as per the teaching field in which they study.

Moreover, comparing the faculties of education in the sample of this study, it is detected that the dominant learning styles of the prospective biology teachers participating in the study statistically and significantly differ as per the faculties which they study at, and yet comparing the biology departments of 8 faculties in the sample of the study, it is observed that this difference is not statistically significant. Tsang [78], in his study, has applied Kolb's learning styles inventory on students studying in the social studies program of a university in Hong Kong, at four different points of their education. In this study, Tsang has determined that the dominant learning styles of the students, whose dominant learning style was the accommodating learning style at the beginning of the course, changed to the assimilating learning style by the end of their first year of being exposed to learning the academic subjects and practical subjects in the class environment. Moreover, Tsang has found out that the learning mode has transformed to the converging learning style by the end of the second year when the students combined their academic studies with their field studies.

Considering the grades of the students, it is remarkable that there is no significant relationship among the learning styles of the biology students and that there is a significant relationship among the learning styles of students at biology teaching department. In most of the studies investigating whether there exists a difference in the learning styles of the prospective teachers as per the variable of grade, it can be concluded that there is a difference in the learning styles of the prospective teachers from the first and the last grades [37, 46, 47, 53, 60, 64, 66, 69, 72, 79, 80]. In this study, the significant relationship among the learning styles of the prospective teachers studying at the biology teaching department, may be due to the fact that teaching courses that are related to education based on practice such as special teaching methods and school experience have affected the learning ways of the prospective teachers studying at the biology teaching departments.

Based on the variable of gender, the difference between the learning styles of biology students and that of the biology teaching students is not significant. This situation indicates that the undergraduate studies of the prospective teachers are not effective in causing a significant difference on the learning styles and means of perceiving and processing the information in the context of gender. Most of the studies conducted with the prospective teachers in Turkey concludes that the gender does not cause a significant difference on the learning styles [46, 49, 54, 56, 58, 65, 69, 81]. Also, in the initial studies performed by the Kolb's learning styles inventory, it is stated that there is no significant gender difference [82, 83].

Assessing the findings obtained from the study in general, it becomes apparent that there is no significant difference between the learning styles of biology department students and those of the biology teaching department students in Turkey. Considering the grades of the students, there is no significant relationship among the learning styles of biology students. On the other hand, it is observed that there is a significant relationship among the students from the biology teaching department based on grade. It can be said that the cause of this condition is due to affect the learning styles has on the students studying at the biology teaching departments as a result of the teaching education they get.

The results of both this study and the literature review suggest that the dominant learning styles of the prospective teachers differ as per the program, in which they are enrolled. However, examining the whole data indicates that the prospective teachers who prefer the accommodating, the assimilating, the diverging and theconverging learning styles can be found in all of the programs. In this context, it is required to be attentive to form programs and learning environments allowing the use of various methods and techniques and different materials in a manner that conforms to all the learning styles in the education process. In this process, if the students are informed and made aware of their own dominant learning styles, they may organize working environments that suit to their own dominant learning styles, and may make their personal studies in a more efficient manner. Moreover, this may provide an opportunity for the students to learn more easily and for removing the inequalities arising from personal differences.

The education of teachers and prospective teachers, who are responsible for the education of students, is a highly important point. For this reason, it should be indicated to teachers and prospective teachers that there are many ways to learn and to teach; each student may or may not learn in the same manner; there is no single learning style conforming to all students; there is no good or bad learning style; the important point is teaching the student with a style that suits him/her; and the personal differences of the students may enrich the learning as well as the teaching environment. Moreover, it should be ensured for the teachers and the prospective teachers to perform such practices in their professional lives.

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