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An Experimental Study About The Applicatıon Of Kolb's Learning Cycle On Biology Lesson[1]

Kolb'un Öğrenme Döngüsü'nün Biyoloji Dersinde Uygulanmasıyla İlgili Deneysel Bir Çalışma

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Abstract

In this study, which was conducted through the application of Kolb's learning cycle on biology lesson, individual learning styles of prospective teachers were determined by means of Kolb's Learning Style Inventory (KLSI) and 76 prospective teachers participated. While in the control group the lessons were practiced traditional teaching, in experimental group were instructed after being configured in accordance with Kolb's learning cycle. The data was obtained through the application of achievement test, which was related to cell division, as pretest and posttest; and the point averages comparison of achievement test and learning styles of the prospective teachers in both experimental and control groups. In conclusion, it was determined that the experimental group was more successful than the control group.

Keywords: *Kolb's learning styles, experiential learning theory, cell division,*

Özet

Kolb'ün öğrenme döngüsünün biyoloji dersinde uygulanmasıyla gerçekleştirilen bu çalışmada öğretmen adaylarının bireysel öğrenme stilleri Kolb'un Öğrenme Stilleri Envanteri (KÖSE) ile tespit edilmiştir. Çalışmaya toplam 76 öğretmen adayı katılmıştır. Kontrol grubunda geleneksel öğretim yapılırken, deney grubunda dersler Kolb'un öğrenme döngüsüne uygun bir şekilde yapılandırılarak işlenmiştir. Veriler hücre bölünmesi konusuyla ilgili geliştirilen başarı testinin ön test ve son test olarak uygulanmasıyla ve deney - kontrol grubundaki öğretmen adaylarının öğrenme stilleri ile başarı testi erişi puan ortalamalarının karşılaştırılması ile elde edilmiştir. Çalışma sonunda uygulama yapılan deney grubunun, geleneksel öğretim yöntemiyle öğrenim gören gruba göre daha başarılı olduğu saptanmıştır.

Anahtar kelimeler: *Kolb öğrenme stilleri, deneyimsel öğrenme kuramı, hücre bölünmesi,*

1. This study includes one of the results of an experimental study conducted within the scope of a scientific research project supported by Ondokuz Mayıs University

1. Introduction

It is a known fact that some scientists, who possess a significant place and prestige in the history of science, were not successful in their school life, therefore were expelled from school or were not able to continue their education in the schools they desired (Feldman & Ford, 1983). Indeed, another outstanding point in the process of education is the fact that the students with same or similar levels of intelligence do not achieve the same level of success, which suggests the existence of other significant points that should be taken into consideration. Marshall (1990) emphasizes the necessity to teach students in a way they could learn, if they are not able to learn by the current way the teacher instructs them. On the other hand, Lukow (2002) states that each individuals' way of learning is different, thus the method and technology used throughout the process of learning-teaching do not enable every student to positively develop; and explains this situation by focusing on the individual differences. These differences determine the learning styles of students (Felder, 1996).The concept of learning style, which is a characteristic innate to individuals and affects individuals' success, was first discussed by Rita Dunn in 1960. Rita Dunn defines learning styles as ''the students' unique and different ways, which they use during the process of getting ready to learn, learning, and remembering new information'' (Boydak, 2001).

Taking the individual differences among students into account, we are faced with a question: how equally students will benefit from the activities applied throughout the process of traditional teaching? If we accept that individual differences constitute an opulence in learning environment (Gencel, 2007); it is possible to say that being aware of the learning styles of both students and teachers could make significant contribution in terms of enabling students to actively participate in their own learning processes, as well as directing teachers to use different approaches, methods, and techniques while organizing learning-teaching environments and activities. Dunn (1990) claims that when learning is carried out through approaches and methods, which are appealing to the learning styles, the students could learn every subject and will no longer be unsuccessful. Biggs (2001) states that if learning style, which has an important place in human life, is recognized the individual will activate this style in the process of learning, thus will learn more easily and quickly; which will mostly likely enable the individual to become successful in the process of learning. Veznedaroğlu and Özgür (2005) discuss that a learning-teaching process, which is eligible to the learning style, will not only increase the academic success of students; but also will enable them to develop tolerance for those different from them, to become more disciplined, and to have a positive attitude towards education. Moreover, Bradbeer (1999) and Leigh (2011) emphasize in their study that determining the learning styles will provide the students with the opportunity to better get to know themselves, as well as enable the creation of a wide application area for various classroom activities.

There are many models developed on learning styles, most frequently used of which are those of Kolb, McCarthy, Within, Jung, Dunn and Dunn, Reid, and Grasha (Hall, 1993). Each model has its own way of distinguishing the learning styles and natures of learning styles. In fact, various tools of measure were developed in order to reveal those differences in the students' process of learning (Myers-Briggs, 1980; Grasha & Reichmann, 1982; Kolb, 1984; Felder & Silverman, 1988). Some researchers comparatively have analyzed the studies conducted in the field of learning styles and claimed that the learning styles developed by Kolb and Kolb's Experiental Learning Theory which is based on those aforementioned learning styles, are one of the best known learning theories for higher education (Given 1996; Lemire 1996; Cassidy ,2004; Coffield, Moseley, Hall & Ecclestone, 2004; Hadfield 2006;). Kolb was inspired by the learning models of Dewey, Lewin, and Piaget while constructing his own experiential learning theory. There have been many studies aiming towards applying and improving this theory (Kolb & Kolb, 2011; Kolb & Kolb, 2012), which was first introduced in 1971 (Kolb, 1984). With the aim of evaluating individual tendencies towards learning, Kolb has developed a simple scale called Learning Styles Inventory (LSI), which has been accepted to a great extent in many fields (Kayes, 2002). This inventory has been translated into various languages (Yamazaki, 2005), in addition to Turkish (Aşkar & Akkoyunlu, 1993; Gencel, 2007).

In the learning styles model developed by Kolb, four learning styles are characterized, including ''concrete experience'', ''reflective observation'', ''abstract conceptualization'', and ''active experimentation''. Each learning way, which represents a learning style, is different. Learning occurs through ''feeling'' in concrete experience; ''watching and listening'' in reflective observation; ''thinking'' in abstract conceptualization; and ''doing'' in active experimentation. Each individual's learning style is a component of these four basic learning styles. These learning styles include ''diverging'', which is a component of concrete experience and reflective observation; ''assimilating'', which is a component of reflective observation and abstract conceptualization; ''converging'', which is a component of abstract conceptualization and active experience; and ''accommodating'', which is a component of concrete experience and active experience (Kolb 1984).

Kolb's theory could be applied in any lesson or throughout the whole semester for a specific course by using educational methods and techniques, which are in accordance with the four stages of learning cycle (concrete experience, reflective observation, abstract conceptualization, active experimentation) and by systematically including the students into the stages of this learning cycle. Each stage of Kolb's learning cycle addresses a different learning style, including *diverging, assimilating, converging, and accommodating.* Learning styles are in the form of a cycle, and everybody is somewhere in this cycle. According to this, divergers learn the best when they can observed and are comprehensively informed about the subject; while assimilators learn the best when they are provided with theories with solid rationality regarding the subject; convergers learn the best when they are given an environment, in which they can apply and practice the theories and conceptions related to the subject; while accommodators learn the best when they experiment or do the subject by themselves. It is necessary to organize learning environments by taking the learning characteristics of students with different learning styles into consideration, while applying Kolb's learning cycle in lessons (Kayes, 2005; Kolb & Kolb, 2005, Healey, Kneale, & Bradbeer, 2005; Gencel 2006) .

Even though, there has been many studies conducted on Kolb's learning styles and learning cycle in Turkey (Aşkın, 2006; Kolb ve Kolb, 2012), as it has been in other countries; it is observed that especially in the biology lessons in higher education, the number of studies examining Kolb's Experiential Learning Theory is limited. This study was conducted by focusing on the subject of Cell Division within the scope of General Biology I Laboratory lesson, which is one of the compulsory lessons of the Department of Science Education in the Primary Education department in the Faculty of Education in Turkey, as a part of the scientific research project supported by Ondokuz Mayıs University. The lesson plan of the chosen subject was prepared according to Kolb's learning cycle and the questions, to which answers were sought, are as follows:

1. What are the dominant learning styles of prospective teachers in the experimental and control group?
2. Are there any differences between the pretest scores for the achievement test of the experimental and control group?
3. Are there any differences between the pretest scores for the achievement test according to learning styles of the prospective teachers?
4. Are there any significant effects of teaching based on Kolb's experiential teaching theory and traditional teaching on the posttest scores of the achievement test of the prospective teachers?
5. Is there a significant effect of learning styles on the pretest and posttest scores of the achievement test of the prospective teachers in the experimental group?

2. Methodology of Research

Research Model

In this research, descriptive and experimental methods, which are amongst the quantitative research methods, were used together. The descriptive aspect of the research is constituted by determining the students' levels of achievement on the subject of Cell Division, and learning styles in General Biology I Laboratory lesson. This aspect of the study lies behind the relational screening model, which is one of the screening models and aims at determining the existence or level of change between two or among multiple variables altogether (Karasar, 2000). Moreover, the test model with pretest and posttest control group was applied so as to examine the effect of lesson design based on Kolb's experiential learning theory, in General Biology I Laboratory lesson (Table 1). In this model, two groups are created through random assignment, one of which is used as the experimental group, while the other one is used as the control group (Karasar, 2000). In the study, the learning styles and the averages of achievement test scores of the students in the experimental and control groups were compared.

Table 1. Research Pattern

Group Name	Pre-Experiment	Method	Post-Experiment
Experimental Group	CDAT KLSI	The Laboratory Method Supported by Activities Eligible with Kolb's Experiential Learning Theory	CDAT
Control Group	CDAT KLSI	Traditional Laboratory Method	CDAT

Study Group

The study group consists of the students, who are in their second year studying at the Science Teaching Department of the Faculty of Education in Ondokuz Mayıs University and take General Biology I Laboratory lesson. The distribution of the students in the experimental and control group based on a gender nd learning styles are displayed in table 2 and 3.

Table 2. Distribution of Students in Study Group Based on Gender

Characteristic	Experimental Group		Control Group		Total	
Sex	N	%	N	%	N	%
Male	7	18.4	12	31.6	19	25.0
Female	31	81.6	26	68.4	57	75.0

Table 3. Learning Styles of the Students in Study Group

Learning Styles	Experimental Group		Control Group		Total	
	N	%	N	%	N	%
Diverging	6	15.8	7	18.4	13	17.1
Assimilating	14	36.8	12	31.6	26	34.2
Converging	12	31.6	13	34.2	25	32.9
Accommodating	6	15.8	6	15.8	12	15.8
Total	38	100	38	100	76	100

Data Collection Tools and Data Analysis

The third edition of Kolb's Learning Style Inventory (KLSI-3) developed by David Kolb and was used in order to determine the dominant learning styles of the prospective teacher participating in the research. The studies examining the reliability level of Kolb's inventory, which was first introduced to the literature by Kolb in 1976 (Kolb, 1984), pointed out the necessity of the renewal of the inventory by building a new style and score system in 1985 (Kolb & Kolb, 2005). This second version of the inventory consisted of 12 fill in items. In order to make the items more understandable, sentences was used instead of words written in the first edition and the expressions were made more concrete. The researches indicated that the reliability coefficient and internal consistency of the inventory increased by a considerable amount and the inventory could be used for determining the learning styles of individuals. This second edition of the inventory was translated into Turkish by Aşkar and Akkoyunlu (1993), and its validity and reliability was investigated. The results of the aforementioned studies suggest that the reliability coefficients (Cronbach α) of four dimensions of the inventory varied from 0.73 to 0.83. According to this, the reliability coefficients were found satisfactory, and KLSI were found applicable in Turkey.

The reliability and validity studies required the inventory to be revised in 1993, 1996, and 2005 (Kayes, 2002; Kolb & Kolb, 2005). In the third edition of the inventory in 1996 (KLSI-3), a set of changes were conducted in order to make the statements more concrete. However, the most distinct differences KLSI-3 bears from its previous editions are its evaluation and coding operations. Moreover, in the last edition of the scale, the names of the styles were changed to diverging, assimilating, converging, and accommodating. In his study on the reliability and validity of KLSI-3, Kayes (2005) states that the scores of scale sizes are at an acceptable level Gencel (2006) analyzed KLSI-3's reliability of the scale and its adaptation to Turkish in his study, and mentioned that the reliability coefficients levels of inventory's learning style varied from 0.71 to 0.80.

The knowledge levels of students on cell division subject were calculated through multiple-choice knowledge achievement test, consisting of 22 questions developed by the researchers. The pilot application of Cell Division Achievement Test (CDAT), consisting of 30 questions at first, was carried out on 137 students. In this test, the correct answers of students were coded as 1; while the incorrect or blank answers were coded as 0. The questions, whose discrimination level was not satisfactory, were excluded. The KR-20 reliability coefficient of the knowledge achievement test, made up of 22 questions in total, was calculated as 0.67. In accordance with the sub-problems of the research, the collected data were analyzed via arithmetic average, standard deviation, t-test, and Kruskal-Wallis H test. Shapiro-Wilks values of the collected data were examined, so as to determine which statistical analysis to use on them, furthermore; it was observed that their CDAT pretest and posttest scores were homogenous. T-test was applied based on this result; and Kruskal-Wallis H tests were employed according to the sampling size.

Experimental Study Plan

While teaching the subject of Cell Division (mitotic and meiosis division), included in the lesson content of General Biology Laboratory I; lesson and study plans, which were based on Kolb's Learning Cycle, were prepared. The content of the lessons and lesson plans were prepared by paying attention to the curriculums of the departments, at which students studied. The students were informed about the experimental study, before the application started. The experimental group, consisting of 38 prospective teachers, was divided into two and each group taught their lessons at different times. The phases of this study, which lasted for 3 weeks for 2 hours a week, are summarized as the following:

1st lesson: 45+45=90 minutes: Subject: Cell division and its significance; the types of cell division (mitotic and meiosis division); prophase, metaphase, anaphase, and telophase of mitotic division; and cytokinesis.

1. Phase (Concrete Experience-CE): The lesson started off by showing students original color photographs and drawings about the phases of mitotic division. No information was given and no comments were made while students, whose attention was drawn to the subject, were examining the materials demonstrated to them. Afterwards, a silent animation was displayed to the students. Meanwhile, all of the basic concepts (cell division, interphase, prophase, metaphase, anaphase, telophase, cytokinesis, chromosome, chromonema, chromatid, sister chromatid, isochromatid, DNA, aster and spindle fibre, nuclear, nuclear membrane, nucleolus, centriole, centromere, metaphase surface, diploid chromosome, haploid chromosome, amitosis division), which were to be mentioned in the lesson, were written on the board. By drawing students' attention to the subject, it was aimed to enable them to think, feel the situation, and see the phases taking place in the event; so that they would have an experience, equal to concrete experience.

2. Phase (Reflective Observation-RO): First of all, two voluntary students were chosen as clerk. Afterwards, by paying regard to the concepts written on the board, the photographs and figures they viewed, the animations they watched; the student were promoted to brainstorm in order to make them find and understand the concepts about the subject and the events taking place in the phases of mitosis division. The clerks wrote the thoughts of the students, which were later discussed, on the board. Meanwhile, no information about the subject was revealed and no comments and directions were given. In this phase, in which the teacher pretends to be the moderator, the activities had the intention to promote students to develop a different perspective and more deeply think about the experience, which was supposed to be acquired by the students in the previous phase called concrete experience.

3. Phase (Abstract Conceptualization-AC): The subjects, including cell division and its significance, types of cell division, and the phases of mitosis division, were taught by the teacher by using a computer. Afterwards, animations about the subject were displayed out loud. The concepts, mentioned while discussing mitosis division, and the phases of mitosis division, were explained and later the slides of the mitosis division phases, were distributed to the students and were individually examined by them on the microscope. During their examinations, the students were asked to answer the previously determined questions; and they were individually talked to while they were in front of the microscope. Thereby, in this phase, theoretical information regarding the subject was transformed to the students in a specific order.

4. Phase (Active Experience-AE): The students were asked to draw what they saw in the microscope. Later, those drawings were investigated and existing errors were corrected and students were made to collect those drawings. The pre-prepared study papers were distributed and completed, examined and given back to the students after correcting the errors. Next, the students were asked to examine those study papers and put them in their folders. The groups, which were constituted according to the learning styles in the class, were asked to study in groups;prepare models or posters irrelevant to the lesson based on their own preferences; and bring them to the next lesson. By doing so, it was intended to enable students to apply the information, they acquired in the previous phases, on other situations.

2nd lesson: 45+45=90 minutes: Subject: Meiosis division and its importance, the phases of meiosis division, phase I of meiosis and its prophase I (leptotene, zygotene, pachytene, diplonema, diakinesis), and metaphase I, anaphase I, and telophase I stages.

1. Phase (Concrete Experience-CE): The posters and models, which were brought to the class and conducted on phases of mitosis division mentioned in the previous lesson, were examined, discussed; and existing errors were corrected. Later, they switched to the subject of the day. Firstly, original photographs and drawings of meiosis division's meosis I phase, prophase I (leptotene, zygotene, pachytene, diplonema, diakinesis), metaphase I, anaphase I, and telophase I stages, were demonstrated to the students. Then, a silent animation was displayed. Meanwhile, all of the basic concepts (cell division, interphase, prophase I, metaphase I, anaphase I, telophase I, cytokinesis, chromosome, chromonema, chromatid, sister chromatid, isochromatid, homolog chromosome DNA, aster and spindle fibre, nuclear, nuclear membrane, nucleolus, centriole, centromere, metaphase surface, diploid chromosome, haploid chromosome, zygotene, pachytene, diplonema, diakinesis, synapsis, tetrathe, diathe, chiasma, crossingover), which were to be mentioned in the lesson, were written on the board. By drawing students' attention to the subject, it was aimed to enable them to think, feel the situation, and see the phases taking place in the event; so that they would have an experience, equal to concrete experience.

2. Phase (Reflective Observation-RO): By paying regard to the concepts written on the board, the photographs and figures they viewed, the animations they watched; the student were promoted to brainstorm in order to make them find and understand the concepts about the subject and the events taking place in the prophase I of meiosis I stage of meiosis division (leptotene, zygotene, pachytene, diplonema, and diakinesis), as well as in metaphase I, anaphase I, and telophase I stages. The clerks wrote the thoughts of the students, which were later discussed, on the board. Meantime, no information about the subject was revealed and no comments and directions were given. In this phase, in which the teacher pretends to be the moderator, the activities had the intention to promote students to develop a different perspective and more deeply think about the experience, which was supposed to be acquired by the students in the previous phase called concrete experience.

3. Phase (Abstract Conceptualization-AC): The leptotene, zygotene, pacythene, diplonema, and diakinesis occurring in the prophase I of meiosis I stage; and metaphase I, anaphase I, and telophase I stages were demonstrated to the students via computer. Afterwards, animations about the subject were displayed out loud. The concepts, mentioned while explaining all stages of Meiosis I, were explained; and later the slides of the phases of meiosis I, which were distributed to the students, were individually examined by the students on the microscope. During their examinations, the students were asked to answer the previously determined questions; and they were individually talked to while they were in front of the microscope. Thereby, in this phase, theoretical information regarding the subject was transformed to the students in a specific order.

4. Phase (Active Experience-AE): The students were asked to draw what they saw in the microscope. Later, those drawings were investigated and existing errors were corrected and students were made to collect those drawings. The pre-prepared study papers were distributed and completed, examined and given back to the students after correcting the errors; furthermore, the students were asked to put them in their folders. The groups, which were constituted according to the learning styles in the class, were asked to study in groups; prepare models or posters irrelevant to the lesson based on their own preferences; and bring them to the next lesson. By doing so, it was intended to enable students to apply the information, they acquired in the previous phases, on other situations.

3rd lesson: 45+45=90 minutes: Subject: Prophase II, metaphase II, anaphase II, and telophase II i occurring the meiosis II stage of meiosis division; and the comparison of meiosis division; and cell cycle.

1. Phase (Concrete Experience-CE): The posters and models, which were brought to the class and conducted on prophase I, metaphase I, anaphase I and telophase I of the meiosis I phase of meiosis division mentioned in the previous lesson, were examined, discussed; and existing errors were corrected. Afterwards, they switched to the subject of the day. Firstly; original photographs and drawings about prophase II, metaphase II, anaphase II, and telophase II occurring in the meiosis II stage of meiosis division, were demonstrated and a silent animation was displayed. In the meantime, all of the concepts, that were to be mentioned in the lesson,, were written on the board. By drawing students' attention to the subject, it was aimed to enable them to think, feel the situation, and see the phases taking place in the event; so that they would have an experience, equal to concrete experience.

2. Phase (Reflective Observation-RO): By paying regard to the concepts written on the board, the photographs and figures they viewed, the animations they watched; the student were promoted to brainstorm in order to make them find and understand the concepts about the subject and prophase II, metaphase II, anaphase II, and telophase TI stages of meiosis II stage of meiosis division; as well as the events occurring in the comparison of mitosis and meiosis division; and cell cycle. The clerks wrote the thoughts of the students, which were later discussed, on the board. Meanwhile, no information about the subject was revealed and no comments and directions were given. In this phase, in which the teacher pretends to be the moderator, the activities had the intention to promote students to develop a different perspective and more deeply think about the experience, which was supposed to be acquired by the students in the previous phase called concrete experience.

3. Phase (Abstract Conceptualization-AC): The subjects including prophase II, metaphase II, anaphase II, and telophase II occurring in the meiosis II stage of meiosis division; and the comparison of meiosis division to mitosis division; and cell cycle were explained by the teacher via computer. Afterwards, animations about the subject were displayed out loud. The concepts, mentioned while explaining the subjects, and afterwards; the slides of the phases of meiosis II, which were distributed to the students, were individually examined by the students on the microscope. During their examinations, the students were asked to answer the previously determined questions; and they were individually talked to while they were in front of the microscope. Thereby, in this phase, theoretical information regarding the subject was transformed to the students in a specific order.

4. Phase (Active Experience-AE): The students were asked to draw what they saw in the microscope. Later, those drawings were investigated and existing errors were corrected and students were made to collect those drawings. The pre-prepared study papers, which were about the stages of meiosis II, cell cycle, and the comparison of mitosis divison to meiosis division; were distributed and completed, then examined to be given back to the students after correcting the errors; furthermore the students were asked to put them in their folders. The groups, which were constituted according to the learning styles in the class, were asked to study in groups; prepare models or posters irrelevant to the lesson based on their own preferences; and bring them to the next lesson. By doing so, it was intended to enable students to apply the information, they acquired in the previous phases, on other situations.

Lesson Plan of Control Group

While teaching the subject of Cell Division (mitotic and meiosis division), included in the lesson content of General Biology Laboratory I lesson; the content of the lesson and application plan were prepared by taking the curriculum of the department, at which students studied, into account. The control group, consisting of 38 prospective teachers, was divided into two and each group taught their lessons at different times. The subject was initially taught by the teacher in a traditional fashion for 3 weeks for 2 hours per week. Afterwards; the students were made to examine the slides of the subject through a microscope. Later they were asked to draw what they saw during their examination on the report book.

3. Results of Research

Findings on Pretest Results

In order to test whether the learning setting, which was organized according to Kolb's learning cycle in the teaching of subjects related to cell division included in the lesson content of General Biology Laboratory I lesson, had an effect on the academic success; cell division achievement test (CDAT) and Kolb's learning style inventory were applied on both the experimental and control group, prior to the study. The analysis of the answers prospective teachers in the experimental group gave to KLSI-3 suggests that there were two dominant learning styles, assimilating and converging. The prospective teachers with diverging and accommodating learning styles were low in number. As indicated in Table 3, there are prospective teachers, who have all of the four learning styles, both in the experimental and the control group. According to pretest results, the difference between CDAT scores of the experimental and control group is not significant. As displayed in Table 4, considering their mean ranks; the mean rank of the experimental group is a little higher than that of the control group, which, however, does not statistically cause a significant difference.

Table 4. Study Groups' Independent t Test Results Based on their Pretest Scores of CDAT

Test	Groups	N	X	SS	Sd	t	p
Pretest	Experimental	38	9.11	2.01	74	-.21	.834
	Control	38	9.00	2.34			

The pretest results suggest that the CDAT scores of the experimental and the control groups do not display a significant difference in terms of learning styles (Table 5). Based on the whole of the sampling, the mean rank values of the students with assimilating and converging learning styles are close to those of the students with diverging and accommodating. However, considering the whole of the sampling, the difference in the distribution of the CDAT pretest scores is not significant. Likewise, when the mean ranks of the experimental and the control groups are individually evaluated, the analysis results of both groups indicate that the difference is not of significance.

Table 5. CDAT Pretest Scores' Results of Kruskal Wallis-H Test

Groups	Learning Styles	N	Mean Rank	sd	X^2	p
Control	Diverging	7	18.79	3	2.54	,46
	Assimilating	12	16.92			
	Converging	13	23.35			
	Accommodating	6	17.17			
Experimental	Diverging	6	15.25	3	2.56	,46
	Assimilating	14	18.14			
	Converging	12	23.33			
	Accommodating	6	19.25			
Total	Diverging	13	33.81	3	4.61	,20
	Assimilating	26	34.73			
	Converging	25	46.16			
	Accommodating	12	35.79			
Total		76				

Findings on Posttest Results

In order to test the effect different teaching methods in the experimental and the control groups has on the teaching of cell division subject; CDAT was applied as posttest to the students in both groups for four weeks for two hours per week. Table 6 indicates the standard deviation values and mean ranks of the pretest and posttest scores the experimental and the control group obtained from CDAT, based on posttest results. While the arithmetic mean of CDAT pretest scores of the prospective teachers in the experimental group was found as 9.11; the arithmetic mean of their posttest scores was 17.84. The arithmetic mean of CDAT pretest scores of the prospective teachers in the control group was found as 9.00; while the arithmetic mean of their posttest scores was 12.87.

Table 6. Arithmetic Mean and Standard Deviation Values of CDAT

Group	Pretest			Pretest		
	N	X	SS	N	X	SS
Experimental	38	9.11	2.01	38	17.84	2.44
Control	38	9.00	2.34	38	12.87	2.31

It was observed that the arithmetic mean of CDAT posttest scores of the prospective teachers from both groups was higher than that of their pretest scores; however, the increase in the scores of the prospective teachers in the experimental group was higher than that of the prospective teachers in the control group. The data was tested through dependent t test, so as to find out whether this difference was statistically significant or not (Table 7, Table 8). The results of the test point out that the difference between the pretest and posttest scores of the groups is of significance.

Table 7. Dependent Sample t-Test Results of Control Group's CDAT Pretest and Posttest Scores

	N	X	SS	sd	t	p
Pretest-Posttest	38	9.00	2.34	37	-22.29	.00
	38	12.87	2.31			

Table 8. Dependent Sample t-Test Results of Experimental Group's CDAT Pretest and Posttest Scores

	N	X	SS	sd	t	p
Pretest-Posttest	38	9.11	2.01	37	-31.61	.00
	38	17.84	2.44			

The data was tested through independent t test, so as to find out whether the difference between the CDAT scores of the experimental and the control groups, based on posttest results, was statistically significant or not (Table 9). According to independent t- test results, the difference between the posttest scores of the groups is significant.

Table 9. Independent Sample t-Test Results of Experimental Group's CDAT Pretest and Posttest Scores

Test	Groups	N	X	SS	sd	t	p
Posttest	Experimental	38	17.84	2.44	74	-9.10	.00
	Control	38	12.87	2.31			

Whether the CDAT posttest scores of the prospective teachers displayed a significant difference according to their learning styles was analyzed through Kruskal Wallis-H test. The results of this analysis (Table 10) suggest that the CDAT scores of the experimental and the control groups do not display a significant difference in terms of learning styles.

Table 10. CDAT Posttest Scores' Results of Kruskal Wallis-H Test

Groups	Learning Styles	N	Mean Rank	sd	X²	p
Control	Diverging	7	16.86	3	3.17	.36
	Assimilating	2	17.00			
	Converging	3	23.88			
	Accommodating	6	18.08			
Experimental	Diverging	6	15.25	3	1.09	.77
	Assimilating	4	20.14			
	Converging	2	20.46			
	Accommodating	6	20.33			
Total	Diverging	13	31.42	3	1.80	.61
	Assimilating	26	38.90			
	Converging	25	41.38			
	Accommodating	12	39.29			
	Total	76				

4. Discussion and Conclusions

Kolb, who is the founder of Experiential Learning Theory, claims that organizing the learning setting by taking the characteristics of the students with different learning styles into consideration, will positively affect learning outputs (Kolb, 1984). When teachers instruct the lesson generally based on their own learning styles, intended only for a specific learning style without paying regard to the fact that students have different learning styles, all student might not be able to understand the subject to the same extent, and thus their levels of success might be low. All student might learn, but not to the same extent. If students are not able to learn by the way the teacher teaches, then they should be taught in a way they could learn. In other words, it is a necessity to teach students in whatever way they can learn or enable them to learn. Considering the fact that everyone has a different way of thinking and learning and thus each student has a different learning style; of course, there is not only one learning style, which is suitable for all students. For this matter, after determining each student's learning style; constructing a plan, organizing a learning-teaching setting, which will be suitable for all learning styles, will not only positively affect learning but also increase students' level of success (Claxton & Murell, 1987; Marshall, 1990; Dunn, 1990; Cano & Garton, 1994; Given, 1996; Ayersman, 1996; Callon, 1997; Biggs, 2001; Burke & Dunn, 2002; Aruilommi, Nurmi & Aunola, 2002; Şimşek, 2002; Mutlu & Aydoğdu, 2003; Kopsovich, 2003; Güven, 2003; Uzuntiryaki, Bilgin & Geban 2003; Özbek, 2006; Hasırcı, 2006). The data collected from this study, indeed, support the data obtained from the previous studies. According to the results of the study, it is possible to say that the prospective science teachers in the experimental group are more successful than those in the control group, after being instructed the cell division subject within the scope of the lesson plan prepared in accordance with Kolb's learning cycle. This is because the t test results, in which posttest scores of the experimental and control group were put in comparison, indicate that the prospective teachers in the experimental group are more successful than the prospective teacher in the control group ($t=9.10$, $p > 0.000$), (Table 9).

Besides that, it is expected that if the learning methods and techniques, which could enable each student to effectively learn, are applied in a cycle step by step; there should be no differences in terms of their learning styles, for students' academic success. Some previous studies suggest that when students are taught according to their learning styles they learn better and more easily; remember what they learned better; display a positive attitude towards the teaching method; show increase in their academic success, however, this success does not vary based on their learning styles (Mathews, 1994; Johns, 1999; Kılıç, 2002; Nichols, 2003; Gencel, 2006; Kaya, 2007). As a matter of fact, the results of this study support the results of those previous studies; furthermore the academic success of the students in either the experimental or the control group do not present a significant difference based on their learning styles (Table 10).

As Alvin Toffler states in his quote; ''The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn'', all of those aforementioned results indicates the significance of making students aware of their learning styles and organizing learning-teaching settings accordingly. The individual differences of students, in fact, are important characteristics, which enrich the process of teaching, moreover; it is of high significance that this characteristic should be benefited from. As a matter of fact, more attention has lately and intensively been paid to discovering how to reveal personal potential competencies of each student and how to design a learning-teaching setting, which would be competent to the different learning and thinking styles of students. It is no doubt that more detailed studies will be conducted in future, within the framework of discovering new ways and strategies to enable learners to become eager to learn.

5. Kaynakça

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