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Enhancing Preservice Teachers' Understanding of Circulation System Concepts, Attitude and Motivation

Nazlı Gökben ATILBOZ*

***Abstract*:** The purpose of this study is to investigate the effectiveness of the learning cycle instruction on preservice elementary teachers' understanding of human circulatory system concepts, attitudes towards biology and motivations. The Human Circulatory System Concepts Test, Attitude Towards Biology Scale, Science Process Skills Test and Motivated Strategies for Learning Questionnaire were used to collect data. The test was administered to preservice elementary teachers in control and experimental groups. The quasi-experimental design was used as research design. The analysis of covariance revealed a statistically significant difference in favor of the experimental group after treatment. The learning cycle instruction was more effective when compared with teacher-centered instruction in eliminating the students' misconceptions about the circulatory system. There was no significant effect of the learning cycle instruction on students' attitudes towards biology and motivation. Students' prior knowledge and science process skills were related to students' science achievement. Teacher educators should provide preservice teachers with different opportunities of experiencing the learning cycle as a teacher in teacher education programs.
Keywords: Biology education, Circulatory system, Learning cycle, Preservice teacher.

Öğretmen Adaylarının Dolaşım Sistemi Kavramlarını Anlamaları, Tutum ve Motivasyon

***Öz*:** Bu çalışmanın amacı, öğrenme halkasına dayalı öğretimin öğretmen adaylarının insanda dolaşım sistemi konusunu öğrenmeleri, biyoloji dersine karşı tutumları ve motivasyonları üzerine olan etkisini incelemektir. İnsanda Dolaşım Sistemi Kavram Testi, Bilimsel İşlem Beceri Testi, Öğrenmede Güdüsel Stratejiler Anketi ve Biyoloji Dersi Tutum Ölçeği deney ve kontrol gruplarına veri toplama aracı olarak uygulanmıştır. Araştırma deseni olarak ön-test son-test kontrol gruplu desen kullanılmıştır. Analiz sonuçlarına göre, öğrencilerin insanda dolaşım sistemi konusunu öğrenmeleri üzerine öğrenme halkası modelinin öğretmen merkezli öğretim yöntemlerine göre daha etkili olduğu ortaya çıkmıştır. Öğrenme halkasına dayalı öğretim insanda dolaşım sistemi konusundaki kavram yanılgılarının giderilmesinde daha etkili olmuştur. Biyoloji dersine karşı tutum ve motivasyonları üzerine anlamlı bir etkisi olmadığı sonucuna varılmıştır. Öğrencilerin önceki bilgileri ve bilimsel süreç becerilerinin öğrenci başarısı ile ilişkili olduğu gösterilmiştir. Öğretmen adaylarına öğretmen eğitimi programlarında öğrenme halkasına dayalı etkinliklerle farklı öğrenme deneyimleri yaşatılmalıdır.
Anahtar Kelimeler: Biyoloji eğitimi, Dolaşım sistemi, Öğrenme halkası, Öğretmen adayları.

* Ph.D., Gazi University, Gazi Faculty of Education, Division of Biology Education ORCID: 0000-0002-6798-3078, e-mail: gokben@gazi.edu.tr

Introduction

The technological advancements and global changes in the world have increased the importance of responsibilities and goals of science education to develop scientific literacy and scientific inquiry skills in recent years. Therefore, it is expected from teachers more innovative roles and responsibilities to provide quality in science education. More recent studies in science education focused on the understanding of how students learn, students' and preservice teachers' alternative conceptions. Science understanding of preservice teachers is important to teach science effectively and for promoting conceptual learning in their students. The definition of misconception can be defined that mental representation or understanding of a concept existing in the real world which does not correspond to the scientific explanation of the event (Modell, Michael & Wenderoth, 2005). Teachers' subject-matter knowledge and teachers' knowledge of student misconceptions play important role in student learning and implementing effective lessons (Sadler & Sonnert, 2016). Teachers' misconceptions about science concepts can lead to develop unscientifically concepts in their students and transmit to their students (Schoon, 1993; Yates & Marek, 2014; Yip, 1998). The number of studies has determined that preservice and inservice teachers' misconceptions of biology concepts and inadequate science content knowledge (Brown & Schwartz, 2009; Kumandaş, Ateşkan & Lane, 2018; Kurt, 2013; Tekkaya, Çapa & Yılmaz, 2000; Yakışan, 2013). Preservice teachers should be adequately prepared to teach it to be more confident, because of conceptual understanding and success learning science as critical elements for preservice teacher training (Bleicher & Lindgren, 2005). Garcia-Carmona, Criado & Cruz-Guzman (2017) that preservice teachers have limited scientific knowledge and teaching skills in science education; therefore, they don't have sufficient skills to teach science through inquiry-based activities. Menon and Sadler (2016) emphasized that preservice teacher education programs must provide new training and positive changes to encourage the improvement of conceptual understanding and science self-efficacy beliefs because science conceptual understandings are related to science teaching efficacy beliefs. It can be critical to implement new practices for preservice teachers' learning cycle and inquiry-based instruction for our instruction and developing activities based on the learning cycle as a teacher in teacher education programs (Hanuscin & Lee, 2008; Kazempour, Amirshokoohi & Blamey, 2020).

Teaching approaches and various instructional methods are crucial in science for improving meaningful learning and can be used to overcome these problems eliminating misconceptions. The learning cycle is one of the methods, centralizing on students' conceptual understandings using inquiry-based teaching by activating students in learning. The learning cycle teaching procedure was originated by Karplus as it was first developed, the 1960s. The teaching procedure developed by Karplus and Their in 1967, was the learning cycle and these phases were named, as described "exploration", "term introduction" ve "concept application" (Marek & Cavallo, 1997). The three stages have been extended into five known as the 5E learning cycle: Engagement, Exploration, Explanation, Extension, and Evaluation, by some researchers refined over the years (Bybee & Landes, 1990; Trowbridge, Bybee & Powell, 2000). It was emphasized the 5E learning cycle instructional model used by the Biological Sciences Curriculum Study (BSCS) to evidence of the development of 21st century skills (Bybee, 2009). The learning cycle's derivation from Piagets' model of mental functioning. The intelligence model of Piaget is the learning and development theory that is the foundation of the learning cycle. Students must use materials that they can touch, feel, hear, and observe; they must use every sense possible. Students are simply exploring the materials on their own or by following teacher-provided directions. The Exploration phase of the learning cycle and discovery of the materials promotes assimilation. If students are assimilating, the exploration phase fosters assimilation and disequilibrium. Term introduction provides for accommodation or the construction of the new mental structures. The new intellectual structures allow for the understanding and the student is reequilibrated. The concept application phase of the learning cycle is designed to recognize students to reveal their new concept to other concepts or to apply this new concept in other situations. Concept application corresponds to the process of organization in Piagets' model of mental functioning (Marek & Cavallo, 1997). Many studies have reported that the learning cycle instructional model about several biology concepts had positive effects on students' academic achievement and also improved students' conceptual understanding (Arslan, Geban & Sağlam, 2015; Atay, 2006; Gök, 2014; Yılmaz, Tekkaya & Sungur, 2011).

Other components impacting students' learning in science education are attitude towards science and motivation besides the cognitive dimensions. The effects of these variables have an important role in developing actively involved in the learning process. Pintrich, Marx and Boyle (1993) stated attitudinal and motivational variables were related to the learner's conceptual change process. Some research studies in science education have been examined attitude and its relationships with academic achievement and argue that attitude towards science is related to success and reported significantly affects their success in science (Akpınar, Yıldız, Tatar & Ergin, 2009; Atay, 2006; Çakıcı, Arıcak & Ilgaz, 2011; Rogayan, 2019). In addition, teaching pedagogies could impact students' attitudes (Almasri, Hewapathirana, Ghaddar, Lee & Ibrahim, 2021). Therefore, some researchers investigated the effect of instructional approaches on students' attitudes toward science (Rabgay, 2018; Rybczynski & Schussler, 2013). The important factors are that teachers' features and instructional strategies used in science courses significantly affect students' attitudes toward biology in science education (Osborne, Simon & Collins, 2003; Prokop, Tuncer & Chudá, 2007). Students' motivation is a vital component of learning biology because it affects the learning-teaching process of the teacher and student (Özbaş, 2019; Partin et al., 2011). Motivation take an important role in influencing success in science students' conceptual change process (Tuan, Chin & Shieh, 2005). It was stated that the relationship between their motivation towards science and students' achievement in science in some studies about students' motivation (Bryan, Glynn & Kittleson, 2011; Chow & Yong, 2013; Madden, 2011; Partin et al., 2011; Walters, 2014; Yenice, Saydam & Telli, 2012). Some research indicated that motivation can be affected by teaching strategies used during the lesson (Tuan & Chin, 2000; Uzezi & Jonah, 2017). Some research provided the learner to develop positive changes attitudes towards science (Bıyıklı & Yağcı, 2015, Özbudak & Özkan, 2014) and motivations (Ceylan, 2008; Çetin-Dindar, 2012). Therefore, this study also is examined the effects of learning cycle instruction on students' attitudes toward biology, motivation and is extended results of previous research.

Some studies have focused misconceptions of the circulatory system in different levels and have expressed that one of the subjects that students have the most misconceptions about biology is the circulatory system (Alkhawaldeh, 2007; Arnaudin & Mintzes, 1985; Kurt, Ekici, Aksu & Aktaş, 2013; Özgür, 2013; Pelaez, Boyd, Rojas & Hoover, 2005; Sungur, Tekkaya & Geban, 2001; Yip, 1998). In another study that focused on teachers' misconceptions of the circulatory system, it was found that teachers hold misconceptions about relationships between flow rate, blood pressure, and vessel diameter, features of capillaries, the role of construction and exit of tissue fluid in the capillaries and system of exchange of materials between blood and body cells (Yip, 1998). The undergraduate students find circulatory system concepts more difficult to learn (Michael et al., 2002). To understand concepts like blood pressure, vessel diameter, and resistance to blood flow and relationships these concepts, students need to think interdisciplinary and to use physics, chemistry knowledge (Yip, 1998). Students' understanding of the circulatory system affects their comprehending other biology subjects about concepts of the body system, homeostasis that based on the concepts related to human circulatory system (Sungur et al, 2001). There are not enough studies about how the learning cycle affects preservice teachers' understanding in the human circulatory system and need to more research is required. Therefore, in this study learning cycle instruction is applied in human circulatory system subjects and is focused on preservice teachers. Teacher training has great significance from the aspect of improving understanding of the human circulatory system of teachers and improving their motivation skills and attitudes towards the biology of student teachers. In an attempt to promote inquiry-based teaching science, the purpose of this study was to investigate the effectiveness of the learning cycle on preservice elementary teachers' on the understanding of human circulatory system concepts, their attitudes toward biology and motivation when compared to traditionally designed biology instruction.

Method

Research Design

The quasi-experimental design was employed in the current study (Fraenkel & Wallen, 2006). In the pretest-posttest control group model, the experimental group and control group of the classes from the same faculty were randomly designated. While the lessons in the experimental group were educated by the learning cycle method, lessons in the control group were only educated through the teacher-centered methods. At the beginning of instruction, Human Circulatory System Concepts Test, the Attitude Toward Biology Scale and Science Process Skills Test were administered to the experimental and control groups of students of the study. They were given Human Circulatory System Concepts Test, the Attitude Toward Biology Scale and the Motivated Strategies for Learning Questionnaire after receiving instruction.

Study Group

The sample of the study comprised a total of 67 first year preservice elementary teacher education students enrolled in two sections of general biology course at a Turkish university. Each of the two classes was designated as the experimental group and the other class as the control group. The experimental group included 35 participants while the control group included 32 participants.

Data Collection Tools

Data collection tools for this study were the Human Circulatory System Concepts Test, the Attitude Toward Biology Scale, Science Process Skills Test and Motivated Strategies for Learning Questionnaire.

Human Circulatory System Concepts Test

The test is consists of a 16-item multiple-choice test developed by Sungur et al. (2001). It was used to evaluate preservice teachers' understanding of the human circulatory system concepts in the control and experimental groups as pre-tests and post-tests. The main concepts included in the test were blood, heart, blood vessels, and homeostasis. The reliability coefficient was determined to be 0.72 for this test.

The Attitude Toward Biology Scale

It is composed of 15-items, 5-point Likert type scale developed by Geban, Ertepınar, Yılmaz, Altın and Şahbaz (1994) to determine students' attitudes toward biology as a school subject. Each item contained the choices of strongly agree, agree undecided, disagree, and strongly disagree. The reliability of the test was estimated to be 0.92. This scale was implemented in both groups as pre-tests and post-tests.

Science Process Skill Test

The test was established by Okey, Wise and Burns (1982) and adopted by Geban, Aşkar and Özkan (1992). This test is composed of five subsets and 36 multiple choice questions. The reliability of the instrument was calculated to be 0.81. This test aims to assess students' scientific process abilities for identifying variables, identifying and stating a hypothesis, operationally defining, designing investigations and graphing and interpreting data. This test was given to both groups before the treatment.

Motivated Strategies for Learning Questionnaire

This instrument is developed by Pintrich, Smith, Garcia and McKeachie (1991) to investigate students' motivational orientations and different learning strategies and is translated and adapted into Turkish by Sungur (2004). Two sections of Motivated Strategies for Learning Questionnaire were the motivation section and a learning strategies section. The motivation section of this scale was used in this study. This section was a seven point Likert scale and consisted of six factors for 31 motivation items. Intrinsic Goal Orientation, Extrinsic Goal Orientation, Task Values, Control of Learning Beliefs, Self-Efficacy for Learning and Performance, and Test Anxiety were the factors of this part. The reliability coefficients values for motivation part's factors of MSLQ were found to be 0,54 between 0,89. This test was given to both groups at the end of the treatment in both the experimental and control group.

Treatment

This study was administered over a four weeks. A total of 67 first year preservice elementary teachers from two general biology classes were engaged in the study. The instruction for both groups was conducted by the same instructor and exposed to equivalent content. Students from both groups examined the topic of human circulatory systems in the meanwhile the same period of time in two distant directions. While the experimental group was educated using 3E learning cycle instruction, the control group accepted a teacher centred instruction.

In the exploration stage of the learning cycle, teachers ask students and provide opportunities for students to assimilate the concept, encourage student discovery and construct knowledge through classifying, comparing, evaluating, and interfering. In the term introduction, the students debate each other in groups the results of the exploration activity and constructed understanding of the concept in their own words related to scientific terminology. In the final phase, concept application practices support students expand their knowledge using concepts in new circumstances associate with daily life experiences (Bybee, 2009; Marek & Cavallo, 1997). The students in the experimental group were educated with learning cycle instruction. For the learning cycle group, four instructional activities were used. The learning cycle plan was developed for the topics of elements of the circulatory system and structure of the heart, how the heart works, blood vessels and blood circulation. For example, the first learning cycle plan was planned for the topics of elements of the circulatory system and structure of the heart. In the first phase, exploration, the students' interest and motivation were increased by inquiring the questions about the human circulatory system. The exploration phase, the students dissected the heart of the mammal and answered the questions in the worksheet. Exploration phase was developed to permit students practical activities and experiences. They explored new materials and new ideas with minimal guidance. In this phase, students worked in small groups, maintained hands-on activities, discussed their observations and ideas with their peers. For example, the students discussed the results of the dissection conducted in the exploration phase. The students dissected the heart of a mammal and answered the questions in the worksheet. They studied as a group. A heart of a sheep or a cow, a dissection set, a dissection tray. The purpose of the phase was to apprehend students' power o create in mind. In this phase, for example, the teacher asked several questions to activate the students' prior knowledge and stimulate their thinking such as; "What is the aim of the circulatory system?" "What are the elements of the circulatory system?". The teacher requested the students to argue the asking for answers with their peers. The students were asked to examine in contrast the wall of the left ventricle, try to find all parts. Compare the arteries and the veins. They explored the internal structure of the heart by dissecting heart and finding the parts and write its name. In the second phase, term introduction, after the dissection, the teacher asked the answer questions such as; "How many chambers are there in the heart of a mammal?" "How does the blood circulate in these chambers?" "Which chambers can blood go through between?" "The wall of arteries is thicker than the wall of veins. Why?". The teacher explained concepts of topics of elements of circulatory system and structure of the heart. The teacher lectured about the structure of the heart and circulation of the blood in the heart, explained the concepts and showed the related pictures by using the powerpoint program. The next phase, elaboration, provide the students with the the opportunity to expand their knowledge to other situations. Students' understandings were determined by inquiring open-ended questions about the human circulatory system in the evaluation phase as a final part.

In the control group, the teacher-centred instruction was utilized lecture and discussion methods to teach the human circulatory system concepts. Teaching strategies and methods based on teacher explanation and textbooks by transferring knowledge to the students. The number of textbook chapters assigned in the two instructional approaches was similar. After the participants studied the textbooks on their own before learning, the instructor explained the concepts associate with human circulatory system. These concepts were the heart, blood flow in the heart, types and structure of vessels, blood flow rate and blood pressure, exchanges between blood and cells, the systemic circulation and pulmonary system. After instructor explanation, the human circulatory system concepts were debated through teacher-directed questions.

Data Analysis

The data were analyzed by using the SPSS 21.0 packaged software. Descriptive and inferential statistics were performed for interpreting the data. The analysis was tested on the significance level of $\alpha=0.05$. The variables were checked for the assumptions. ANCOVA was computed to determine the effectiveness of treatment on their understanding of human circulatory system concepts using their pre-test, attitudes towards biology and science process skills test scores as covariates. ANOVA was used for attitude towards biology. MANOVA was used for motivation. In this analysis, the dependent variable was participants' achievement of the human circulatory system concepts assessed by post-test scores; the independent variable was treatment. Pearson correlation analysis was computed to investigate the relationships among the variables of the study for experimental and control groups (Pallant, 2016).

Results

Descriptive and the inferential statistics concerning the results are presented. Descriptive statistics with respect to the human circulatory systems achievement pre-post test scores, attitude scale toward biology pre-post test scores, motivated strategies posttest scores and science process skill test scores for both experimental and control groups were analyzed. These scores reveal normally distributed, values of skewness and kurtosis were in the range between -2 and +2. These statistics are presented in Table 1.

Table 1
Descriptive Statistics

Group	Test	N	Min	Max	Mean	SD	Skewness	Kurtosis
Control Group	Preach	32	1.00	8,00	4.500	1.703	-.021	-.568
	Postach	32	2.00	10.00	3.971	1.98	.649	-.104
	Preatt	32	24.00	68.00	48.68	10.89	-.554	-.103
	Postatt	32	21.00	71.00	46.50	10.97	-.420	.494
	Postint	32	4.00	28.00	15.15	4.85	-.029	1.377
	Postext	32	13.00	28.00	19.37	4.20	.634	-.281
	Posttask	32	6.00	40.00	25.87	8.77	-.468	.161
	Postcon	32	12.00	28.00	20.65	4.10	-.118	-.240
	Postself	32	21.00	56.00	36.43	8.87	.319	-.886
	Posttest	32	6.00	29.00	19.15	5.51	.085	.349
	Spskill	32	14.00	30.00	24.40	3.50	-.534	1.196
Experimental Group	Preach	35	1.00	10.00	4.77	2.04	.45	-.060
	Postach	35	2.00	12.00	6.34	2.05	.38	.488
	Preatt	35	37.00	69.00	51.11	7.91	.44	-.161
	Postatt	35	33.00	70.00	49.45	9.02	.021	-.484
	Postint	35	8.00	28.00	18.08	4.93	.280	-.243
	Postext	35	5.00	27.00	20.20	4.79	-1.148	1.758
	Posttask	35	12.00	40.00	28.60	6.80	-.459	.200
	Postcon	35	11.00	28.00	19.82	3.52	-.272	.167
	Postself	35	18.00	54.00	37.02	7.74	-.270	.279
	Posttest	35	11.00	30.00	19.97	5.23	.384	-.519
	Spskill	35	17.00	33.00	25.05	4.10	.146	-.661

* Preach: Human circulatory system concept pre-test scores, Postach: Human circulatory system concept post-test scores, Preatt: Attitude scale pre-test scores, Postatt: Attitude scale post-test scores, Postint: Intrinsic goal post-test scores, Postext: Post extrinsic goal orientation scores, Posttask: Task value post-test scores, Postcon: Control of learning beliefs post-test scores, Postself: Self-efficacy for learning and performance post-test scores, Posttest: Test anxiety post-test scores, Spskill: Science process skills test scores.

The Independent Samples t-test was conducted to test whether or not the difference between the students in the experimental and control groups in terms of human circulatory systems achievement, attitude towards biology and science process skills before treatment. Therefore, there were not any statistically significant differences between scores before treatment of experimental and control groups in terms of human circulatory systems achievement ($t=.587$, $p=.559$), attitude scale toward biology ($t=1.049$, $p=.298$) and science process skills ($t=.695$, $p=.490$).

The analysis of variance (ANCOVA) was conducted to test whether or not significant difference between the human circulatory systems achievement post-test scores of students experiencing learning cycle instruction and the students experiencing teacher centred instruction. The assumptions of ANCOVA were tested. It was seen that assumptions were met. The result of Levene's Test of Equality test [$F(1,65)=1.645$, $p>.05$]. Because the result shows a significant correlation between students' achievement posttest scores and science process skill test scores, assumption of correlation was met ($r=.260$, $p<.05$). There were the students' human circulatory system achievement posttest scores and pre-achievement test scores ($r=.352$, $p<.01$). Participants' science process skills test scores, human circulatory system achievement pretest scores, and attitude toward biology as a school subject pretest scores are controlled as covariates. The results revealed that there was a significant difference between post-test mean scores of the students educated with learning cycle instruction and those educated with teacher centred instruction in terms of achievement in favor of the experimental groups [$F(1,62)=5.793$, $p=0.019<.05$]. The mean scores of achievement of students in the experimental group were significantly higher than the control group showed a significant treatment effect in favor of the experimental groups [(EG)=6.34, (CG)=3.971]. Students in the experimental group who were taught with the learning cycle instruction displayed better accomplishment over the students in control group who were taught with teacher-centered instruction. Table 2 contains the summary of ANCOVA statistics.

Table 2
ANCOVA Summary

Source	SS	df	F	p
Science Process Skill	5.221	1	1.424	0.237
Pre-Attitude	1.093	1	0.298	0.587
Pre-test	21.696	1	5.917	0.018
Treatment	21.241	1	5.793	0.019*
Error	227.333	62		

*p=0.019<0.05

An analysis of variance (ANOVA) was conducted to test the hypothesis that there were not any significant differences between the attitude scale toward biology post-test scores of students training learning cycle instruction and the students training teacher centred instruction. The assumptions of ANOVA were met. The result of Levene's Test of Equality test [F(1,65= .125; p>.05)]. The result of the analysis revealed that there was no statistically significant difference between experimental and control group in terms of attitude scale toward biology post-test scores (F=0.279; p=0.599>0.05).

MANOVA was conducted to test whether or not there was any significant difference in methods of teaching on motivation orientations. The results of MANOVA illustrated that significant difference exists between learning cycle instruction and teacher-centred instruction on motivation variables (Wilks' Lambda=0.856; F=1.601; p=0.164>0.05).

Pearson correlation analysis was performed to investigate the relationships that might exist among students' prior knowledge, science process skills, motivational strategies in two different types of instruction for each group. According to the results of the Pearson correlation analysis, there was a positive relationship between post student understanding of the human circulatory system and their prior knowledge (r=.55, p=.001), also science process skills (r=.44, p=.009) in learning cycle classrooms. Science process skills was related to prior knowledge (r=.46, p=.005). Post attitude towards biology was related to prior attitude towards biology (r=.71, p=.000), post intrinsic goal orientation (r=.53, p=.001), post task value (r =.75, p= .000), post self efficacy (r=.35 p=.03). Prior attitude towards biology was related to post task value (r=.70, p=.000). This results suggested that students' understanding of human circulatory system was related to their prior knowledge and science process skills. It is deduced that students possessing a higher prior knowledge scores and high science process skills had better understanding of the human circulatory system in learning cycle classroom. Students' attitude towards biology was related to intrinsic goal orientation, task value and self-efficacy. As a result of these, it is inferred that a higher attitude towards biology scores had better intrinsic goal orientation, task value and post self-efficacy scores in learning cycle classroom. According to the results in teacher-centered classroom, post attitude towards biology was related to prior attitude towards biology (r=.808, p=.000), post intrinsic goal orientation (r=.658, p=.002), post task value (r=.824, p= .000), post self-efficacy (r=.579, p=.001). Prior attitude towards biology was related to post intrinsic goal orientation (r=.649, p=.001), post task value (r=.860, p=.000), post self-efficacy (r=.519, p=.000). Students' attitude towards biology was related with intrinsic goal orientation, task value and self-efficacy. It is concluded that students having higher attitude towards biology scores had better intrinsic goal orientation, task value and post self-efficacy scores in teacher-centered classrooms.

Table 3
Correlation Coefficients among Variables for Each Group

Group		Preach	Postach	Preatt	Postatt	Postint	Postext	Postask	Postcon	Postsself	Posttest	Spskill
Experimental Group	Preach	-	.551**	-.116	.027	-.117	-.109	-.195*	-.226	-.141	-.168	.465**
	Postach		-	-.241	-.311	-.139	-.088	-.257	-.194	-.057	-.245	.437**
	Preatt			-	.714**	.324	-.126	.694**	.285	.309	.046	-.357*
	Postatt				-	.534**	-.265	-.746	.234	.355*	-.050	-.176
	Postint					-	-.007	.628**	.246	.499*	.204	-.148
	Postext						-	-.089	.023	.002	.429*	-.007
	Posttask							-	.240	.389*	.211	-.256
	Postcon								-	.481**	.079	.031
	Postself									-	-.210	.094
	Posttest										-	-.226
	Spskill											-
Control Group	Preach	-	.071	-.050	-.024	-.174	-.041	-.170	-.251	-.175	.026	.024
	Postach		-	-.013	.070	.129	.165	.067	-.051	.228	-.092	-.006
	Preatt			-	.808**	.649**	.338	.860**	.047	.519**	.205	-.009
	Postatt				-	.658**	.170	.824**	.199	.579**	.131	-.031
	Postint					-	.199	.668**	.262	.706**	.317	-.201
	Postext						-	.414**	.193	.392*	.608**	-.028
	Posttask							-	.243	.632**	.374*	-.191
	Postcon								-	.450**	.139	-.162
	Postself									-	.334	-.291
	Posttest										-	-.177
	Spskill											-

** Correlation is significant at the .01 level *Correlation is significant at the .05 level

Analysis of the results revealed that learning cycle instruction promoted preservice elementary teachers understanding. In additional to, students in experimental and control groups have many misconceptions about the human circulatory system comparing each item. Table 4 shows most common students' alternative conceptions about human circulatory system.

Table 4
Most Common Students' Alternative Conceptions about Human Circulatory System

1	Fat is not found in plasma.
2	Under normal physicological conditions, all plasma proteins help material transport across capillaries.
3	Serum is plasma to which necessary nutrients for a patient are added.
4	Veins have the lowest blood pressure compared to other blood vessels because veins have the thinnest walls.
5	Low blood velocity in capillaries is due to material exchange through capillaries.
6	Low blood velocity in capillaries is due to their small diameter.
7	In systemic circulation, percent of blood volume in the arteries, capillaries and veins is equal.
8	If blood pressure in capillaries increased above normal level, tissues would get fewer nutrients.
9	Contraction of the heart is one of the factors that help blood return to the heart.
10	When environmental temperature increases, skin takes a red apperance because blood pressure increases.
11	The thick and elastic wall of arteries helps maintain high blood pressure.

In the item that related to the substances found in plasma, while 48.6% of students in the experimental group answered correct response, 40.6% of students in control group selected this correct response as "bile pigments are not found in plasma" after the treatment. However, 28.1% of students in control group had this alternative conception which was stated as “fat is not found in plasma” (Misconception 1). After the implementation while 45.7% of students in the experimental group chosen the correct response that “under normal physiological conditions, all plasma proteins help maintain blood pressure”, this value was 34.4%. The proportion of the most frequent misconception was 40.6% in the control group. This alternative conception was that “under normal physiological conditions, all plasma proteins help material transport across capillaries” (Misconception 2). In another item, students have requested to the true description of serum. After the treatment 91.4% of students in the experimental group chosen the correct description that “serum is the liquid remaining after blood plasma is clotted”. Only 68.8% of students in the control group marked this correct description. 28.1% of students in the control group held misconception item which was expressed as “serum is plasma to which necessary nutrients for a patient are added” (Misconception 3). While 20% of students in the experimental group answered the reason correctly that “veins have the lowest blood pressure compared to other blood vessels because vessels offer resistance to blood movement”, only 3.1% of students in the control group answered this item correctly. After the implementation, 34.4% of the students in the control group have misconception that “veins have the lowest blood pressure compared to other blood vessels because veins have the thinnest walls” (Misconception 4). In another item related with the velocity of blood in capillaries, students were inquired reasons of blood velocity is the lowest in capillaries. Whereas 57.1% of students in the experimental group selected the desired reason that “velocity of blood is the lowest in capillaries due to the high crooss-sectional area of capillaries” in this item, rate of students this correct response in the control group was only 25% after the treatment. It was seen that there existed difference among students response in the experimental and the control groups. In addition, the most widespread misconception was “velocity of blood is the lowest in capillaries due to the material exchange through capillaries”. 46.9% of the students in the control group held this misunderstanding (Misconception 5). After the implementation, another alternative concept reported in the control group (18.8% of the students) was misconception which “velocity of blood is the lowest in capillaries due to their small diameter” (Misconception 6). Another important misunderstanding was about the distribution of blood volume in vessels in systemic circulation. In this item students were requested to think the percent of blood volume in vessels comparatively. After the implementation, 54.3% of students in the experimental group answered the correct response that “in systemic circulation, percent of blood volume in the veins is highest, while the blood volume in the capillaries is the lowest”. Only 31.3% of students in the control group answered this item correctly. In addition, 34,4% of the students in the control group thought that “in systemic circulation, percent of blood volume in the arteries, capillaries and veins is equal” after the treatment (Misconception 7). The alternative conceptions detected in the control group were that “if blood pressure in capillaries increased above normal level, tissues would get fewer nutrients” (25% of the students), “contraction of the heart is one of the factors that help blood return to the heart” (31.3% of the students), “when environmental temperature increases, skin takes a red apperance because blood pressure increases” (34.4% of the students), “the thick and elastic wall of arteries helps maintain high blood pressure” (50% of the students). It can be concluded that the learning cycle instruction was more powerful about eliminating the students’ misconceptions on human circulatory system and improving understanding than teacher-centered instruction.

Discussion, Conclusion and Suggestions

This study aimed to examine the effectiveness of learning cycle instruction on preservice science teachers’ conceptual understanding of human circulatory system concepts and students attitudes and motivation. Therefore, developing instructional strategies to overcoming of alternative conceptions for all science subject areas is very important for enhancing meaningful learning. The students in the experimental group engaged in more hands-on activities related to real-life examples and conducted based-on inquiry based activities during the learning process instead of the traditional teacher-centered method. The results of this study show that the learning cycle instruction significantly better gains of scientific circulatory system concepts than expository teaching. These findings of the current study are also supported by the results of several previous studies in that the learning cycle promote learning biology concepts (Arslan et al., 2015; Atay, 2006; Gök, 2014; Sam, Owusu & Anthony, 2018; Yılmaz et al., 2011). Research has revealed that in the learning cycle classrooms students improve success in science. The instruction based on learning cycle may enhance students' conceptual understanding of circulatory system concepts because students were actively in scientific research processes during each phase of the learning cycle. Learning cycle instruction also provides students experiences to work in groups and develop effective collaboration with peers. The students in the experimental group were constructed their knowledge by actively involved in their process of learning, engaged in their daily life around them with the constructivist approach. Because of student activities, investigations, laboratory works, collecting data and presenting their findings, interpreting information, working alone, acquiring new information, and persisting at given tasks, application of that knowledge to life situations as a unit of work based on the 5E instructional model support to develop 21st century skills such as problem solving, self development, communication, and systems thinking. Therefore using the widespread acceptance of the BSCS 5E instructional model is suggested in the development of curriculum materials for 21st century skills (Bybee, 2009).

When the significance of what the learners already know is taken into consideration, it was accepted that being aware of the students' misconceptions is crucial for in-service and pre-service teachers training. If teachers are aware of the misconceptions, this situation is a positive effect on students' science knowledge (Sadler & Sonnert, 2016). Preservice teachers should be better trained and make preparations to teach science concepts effectively in terms of science content and pedagogy instruction in order to afford quality in science education. These findings of the current study advase to teachers applying the learning cycle to eliminate their alternative conceptions and enhance students' understanding. Some studies describe providing opportunities for preservice teachers learning cycle as a model for our instruction can be important in developing a new way of teaching as a teacher (Hanuscin & Lee, 2008; Lindgren & Bleicher, 2005). Moreover, several studies emphasized that science teaching courses have a positive effect in increasing the self-efficacy of the pre-service teachers in science teaching and it is adviced to implementing more practices in these courses in teacher education (Flores, 2015; Kaygısız, Uygun & Uçar, 2020; Kazempour & Sadler, 2015). It can be critical to providing opportunities for preservice teachers learning cycle and inquiry-based instruction and to support preservice teachers in experiencing the learning cycle as a teacher in teacher education programs (Hanuscin & Lee, 2008; Kazempour et al., 2020). We as teacher educators identify biological misconceptions of preservice teacher students, develop different approaches and techniques to remediate such misconceptions to enhance understanding, and then implement in teacher education programme these strategies to help them develop preservice teacher students' self-efficacy.

The results obtained from the attitude and motivation scale in the research revealed that there are no significant differences with regard to attitude towards biology lessons and motivation between the experimental and control groups. These findings show consistency with the results of other searches on the learning cycle in the literature (Güzel, 2016; Uyanık, 2016; Yılmaz, 2007). One of the reasons for the situation can be thought that the limited time of implementation in the study can not be enough to improve students' attitude and motivation.

In the current study, prior knowledge and science process skills were related to students' science achievement in the learning cycle classroom. It is assumed that higher prior knowledge scores and high science process skills had better comprehending of the human circulatory system in the learning cycle classroom. In addition to these relations, intrinsic goal orientation, task value and self-efficacy were associated with students' attitude towards biology in the learning cycle classroom and expository classroom. It can be concluded that students having higher students' goals and value beliefs for science, their beliefs about their skills to succeed in science had better attitude towards science lessons.

In the light of the results of this research, it can be suggested that teacher education curriculums developers should also take into consideration new teaching strategies to get the chance to improve conceptual understanding and try to eliminate their misconceptions for preservice science teacher. Teachers should be informed about students difficulties, misconceptions and inquiry-based learning methods. They should implement new instructional plans according to implementation of these teaching strategies for both conceptual aspects of learning and affective dimensions. Similar studies can be designed with different biology subjects and other study groups with longer treatment periods.

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