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Investigation of the Effects of a Peer-Led Team Learning Instructional Model (PLTL) in Teaching the Simple Electrical Circuits Subject on the Seven Principles for Good Practice

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Abstract

(11 Punto, 1,5 line spacing, align justify, before 6pt, after 6pt) The aim of this study was investigated the effects of applying a Peer-Led Team Learning Instructional Model (PLTL) to the prospective primary school teachers in teaching the simple electrical circuits subject on the seven principles for good practice. This study used the three-group Solomon Experimental Design. The study participants were sophomore level prospective teachers from the Department of Primary School Teaching at a state university. The control group (CG) was applied close-ended experimental method, while the experimental groups (EG1 and EG2) was applied the PLTL. The data collection tool of the study was used "Seven Principles Opinion Scale for Good Practice" (SPOS) developed by Bishoff (2010). The SPOS was used for the pre-test of EG1 and CG, and for the post-test of EG1, EG2 and CG. According to the post-test, The experimental groups applying the PLTL were better than the control group in the "Encouraging Student-Faculty Contact", "Encouraging Cooperation among Students", "Respecting Diverse Talents/Ways of Learning", "Encouraging Active Learning", and "Giving Prompt Feedback" principles. The PLTL is effective in attaining the objectives of the seven principles for good practice. It is recommended that further studies on PLTL should be conducted in order to contribute to the relevant literature by investigating the teaching experience that leaders gain in applying the principles necessary for a good education.

Keywords: Peer-Led Team Learning Instructional Model, Seven Principles For Good Practice, Science Education, Simple Electrical Circuits Subject.

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Introduction

Today, instead of teaching and learning methods focused on providing uniform knowledge and skills in learning environments for quality education; students are actively involved in the process, open to all communication in the classroom atmosphere, and students are preferred to teaching and learning methods and approaches that help develop and demonstrate their own ideas and skills (Beyer, 2001; Prensky, 2008).

The Peer-Led Team Learning Instructional Model (PLTL) is one of these new approaches. PLTL was first introduced by Woodward, Gosser and Weiner (1993) as a social learning instrument to facilitate an active learning experience directed towards improving negotiation and creative problem-solving skills (Gosser, Roth, Gafney, Kampmeier, Strozak, Varma-Nelson & Weiner, 1996; Quitadamo, Brahler & Crouch, 2009). PLTL is currently being implemented as a structured form of the cooperative learning model. PLTL involves small teams composed of six to eight individuals who learn together, and these groups are led by peers who have already reached the determined objectives at an earlier time (Gosser & Roth, 1998; Tien, Roth & Kampmeier, 2004; Wilson & Varma-Nelson, 2016; Johnson, Robbins & Loui, 2015). Peer leaders can be individuals who have received previous training on the topic for which this method would be implemented or successful individuals, who have been trained on the academic topic in advance, from among the learners. The leaders fulfill the function of being a bridge between teachers and students and help them acquire higher order thinking skills, such as finding creative solutions to problems, increasing their motivation, increasing their class performances, and acquiring the ability to think critically and analytically (Quitadamo, Brahler & Crouch, 2009; Lyle & Robinson, 2003; Wamser, 2006; Woodward, Gosser & Weiner, 1993).

According to Gosser (2011), the arrangements governing the education environment under PLTL (team size, noise level, time, place, etc.) should have the quality of supporting productive discussions. In order to train future generations to meet the needs required by the current century, it is of primary importance that the education environment be properly organized by considering certain key elements. Studies on student participation and interaction revealed that students' active participation in small teams is critical (Chinn, O'Donnell & Jinks, 2000; Draskovic, Holdrinet, Bulte, Bolhuis & Van Leeuwe, 2004; Pazos, Micari & Light, 2010; Veenman, Denessen, Akker & Rijt, 2005; Webb, Farivar & Mastergeorge, 2002). Small team work has been recognized as a best practice in undergraduate education for almost thirty years and is now considered as necessary for good practice in education (Chickering, Gamson & American Association for Higher Education, 1989). However, many other components, along with small group work, should be considered, and the quality of education should be improved continuously for a successful undergraduate education. Chickering and Gamson (1987) proposed seven principles for good practice, which are considered to be the most commonly applied standards around the world, in order to institute a successful undergraduate

education (Şimşek, Aydoğdu & Doymuş, 2012). These seven principles include "Encouraging student faculty contact", "Encouraging cooperation among students", "Encouraging active learning", "Giving prompt feedback", "Emphasizing time on task", "Communicating high expectations", and "Respecting diverse talents/ways of learning" (Chickering & Gamson, 1987). These are among the education principles, which serve as a guide for teachers and students and contribute to a higher quality education by improving performance in education (Zorlu, Zorlu & Sezek, 2013). Applied comprehensively, these principles can especially be helpful in creating a good learning-teaching environment in undergraduate education (Chickering, 2000; Chickering & Gamson, 1987). According to Cousins (2012), conducting an education process in accordance with these seven principles creates positive perceptions and contributions. Moreover, applying these principles in the learning environments enables a more effective application of the teaching program by improving its effectiveness in action. Specifically, the current situation can be better understood through the feedback received after the application, and thereby more effective learning environments can be created.

The literature review showed that there were studies investigating the PLTL and STEM (Carlson, Celotta, Curran, Marcus & Loe, 2016; Reisel, Jablonski, Munson & Hosseini, 2014; Wilson & Varma-Nelson, 2016), with most of them focusing on their application in the courses of chemistry, physics, anatomy, biology, physiology, and mathematics and investigating their effect on student success (Baez-Galib, Colon-Cruz, Resto & Rubin, 2005; Finn & Campisi, 2005; Gosser, Strozak & Cracolice, 2006; Keenan, 2014; Peteroy-Kelly, 2007; Reisel, Jablonski, Munson & Hosseini, 2014; Snyder, Carter & Wiles, 2015). In general, the results of these studies showed that the model increased academic success. However, although the importance of PLTL has received more and more attention, there aren't studies the extent to which the model is effective on the seven principles for good practice in the PLTL. Based on literature, it is important to determine the most effective way to apply new methods to increase the qualifications in education.

The electricity has been an indispensable part of our lives today for computers that we use to charge our phone and wash laundry and dishes, not spoil our food, read as many books in the evenings, research or communicate (Kayacan, 2018; p 179). The electricity we use in most places in our daily lives has a different place in science subjects (Yılmaz & Eren, 2014). Given the location and importance of simple electrical circuits in daily life, it is necessary to know the subject effectively. However, in the researches on the subject of simple electrical circuitry, which has such an important place in our daily lives, the results of the fact that the subject is difficult to understand and the concept misconceptions have been reached (Engelhardt & Beichner, 2004; McDermott & Shaffer, 1992; Sencar, Yılmaz & Eryılmaz, 2001; Shipstone, von Rhöneck, Jung, Karrqvist, Dupin, Joshua & Lieht, 1988). Therefore, the necessity of making applications using different learning methods has been recommended in order to better teach the subject of simple electrical circuit (Ateş & Polat, 2005;

Kanlı, 2007; Küçüközer, 2003; Yılmaz & Eren, 2014; Yılmaz & Huyugüzel Çavaş, 2006; Ültay, Ültay & Dönmez-Usta, 2018).

The subject of simple electrical circuits is a science subject that is further elaborated at each level of education after the basic is established at primary school level. In this context, in order for students to establish a good basic, the subject of primary school-level teachers needs to be trained qualified. In this context, in order for students to establish a good basic, the subject of primary school-level teachers needs to be trained qualified. The subject of simple electrical circuits is handled within the scope of the Science and Technology Applications course in the curriculum of primary school teacher. In this context this study was aimed to investigate the effects of applying the PLTL to the prospective primary school teachers in the subject of simple electrical circuits on the seven principles for good practice.

Research Question

Are there effects of applying the Peer-Led Team Learning Instructional Model (PLTL) to the prospective primary school teachers in teaching the simple electrical circuits subject on the seven principles for good practice?

Method

Research Design

The Solomon experimental design allows for deeper comparisons and protects studies' internal and external validity and, control for the effect of the pretest (Braver & Braver, 1988; Harwell, 2011; Karasar, 2016; Solomon & Lessac, 1968). The Solomon experimental design provides the opportunity to compare the effects of applying the PLTL aimed for this study on the seven principles for good practice with the experimental and control groups that were administered pretest and were not administered pretest, and to serve to reveal the results more validly and reliably. The design of the study was determined as the Solomon experimental design considering its features and benefits.

The Solomon experimental design requires at least three or four groups (Braver & Braver, 1988; Harwell, 2011; Karasar, 2016; Solomon & Lessac, 1968). This study was used the Solomon's three-group experimental design to aim at determining the impact of the PLTL on seven principles for good training was used in to minimize the impact of pretest applications and to conduct further analysis using two experimental groups. Thus, research problem are aimed at more valuable and reliable findings with the Solomon's experimental design. Two experimental groups and one control group were used to ensure strong internal validity and to control for the effect of the pretest (Figure 1). The students were randomly assigned to the groups, which were designated as experimental group-1 (EG1), experimental group-2 (EG2), and control group (CG). “Seven Principles Opinion Scale for Good Practice” (SPOS) was administered to the EG1 and CG groups as pretest, while no pretest was

administered to EG2. The control group (CG) was applied with the close-ended experimental method, while the experimental groups (EG1 and EG2) was applied the Peer-Led Team Learning Instructional Model (PLTL). Seven Principles Opinion Scale for Good Practice (SPOS) was administered to find out the effects of the PLTL applying in teaching the simple electrical circuits on the seven principles for good practice by Gamson and Chickering (Figure 1).

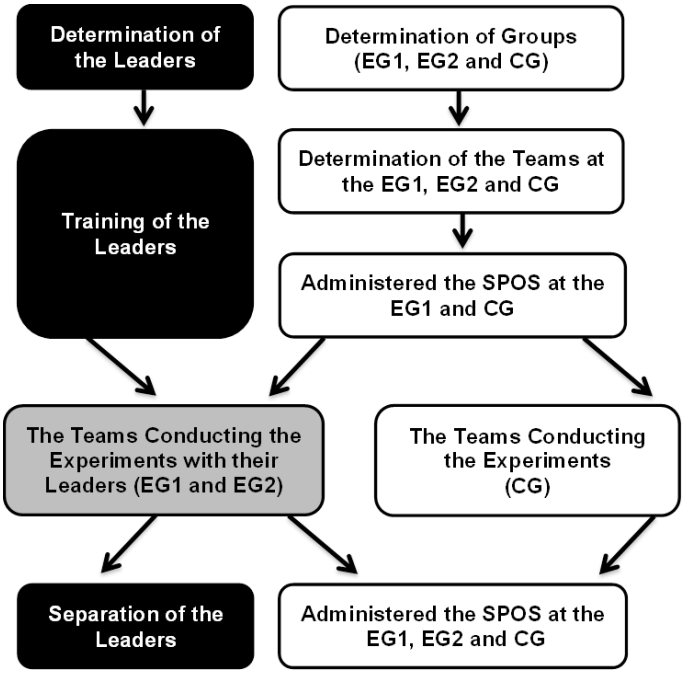

Figure 1. Design of the research

Application of Experimental and Control Groups

Within the scope of the study, 12 closed-ended experiments were used to the teaching of simple electrical circuits (Table 1) (Kesmez, 2011). The final forms of the experiments which were designed considering the subtopics were performed for five weeks in a laboratory environment as part of the Science and Technology Applications course (two class hours each week).

Table 1. Distribution of the experiments by week

Application Week		Experiments
First	1	Connecting of ampere meter and measurement of current
	2	Connecting of voltmeter and measurement of voltage
Second	3	Resistance of a Conductor, Ohm's Law
Third	4	Investigation of I, V and R in a Serial Resistor Circuit
	5	Investigation of I, V and R in a Parallel Resistor Circuit
Fourth	6	Investigation of light intensity of lamps in connecting serial
	7	Investigation of light intensity of lamps in connecting parallel
	8	Investigation of light intensity of lamps in connecting mixed
Fifth	9	Connecting serial of battery
	10	Connecting parallel of battery
	11	Connecting the same poles of two battery
	12	Connecting parallel of two non-identical batteries

Application of Experimental Groups (EG1 and EG2)

For the selection of those who would be leader students in the application, seven students who voluntarily agreed to take on this role were picked from among the students who had completed the Science and Technology Applications course the year before and had proven to be successful compared to their peer. After the leaders were designated, they received four hours of training. In the training, the leaders did to experiments for review of the topics after the leaders were given information about their tasks by the researchers. In this training, the leader was given feedback about the tasks and experiments by the researchers and the lack of the leaders were eliminated. The two experimental groups were placed into heterogeneous teams with 6-8 students each to the academic grade point averages. Three teams were formed in EG1 and four teams in EG2. A set of experiment equipment was provided for each team, along with one experiment worksheet. The teams conducted the experiments related to the topics with their leaders. The researcher's role in the course was to guide the students. The teams first consulted with their leaders on any issues they had, and if the leaders could not provide a solution, they then consulted the researcher. The researcher communicated with the teams after first communicating with the leaders. Following the completion of the experiments conducted each week, the teams selected at random informed other teams about their works. The selected experiments were conducted for five weeks. After the experiments, SPOS was administered to all the students, and the data were collected.

Application of Control Group (CG)

The close-ended experimental method was applied with the control group (CG). The teams at the control group were formed to by the students. A set of experiment equipment was provided for each team, along with one experiment worksheet. The students conducted the experiments with the teams. At the end of the experiment, they wrote the information they acquired and submitted it to the research. The researcher who participated in the study gave a presentation on the topic and the experiment to the teams, and answered any questions the prospective primary school teachers had to ensure that they had a clear understanding of everything presented. The experiments were conducted within five weeks. Afterwards, SPOS was administered to all the students, and the data were collected.

Study Group

Primary school is a sensitive and important level in terms of teaching science subjects (Yılmaz & Eren, 2014). Accordingly, the prospective primary school teachers are very important that especially in subjects which are considered difficult to understand and teach, being in learning environments that effective model method is used and, have a good undergraduate education. The subject of simple electrical circuits is handled within the scope of Science and Technology Applications course in the curriculum of primary school teacher. For this reason, since the Science and Technology Applications course is in the second year, the study was carried out with the prospective

primary school teachers who studied in the second year department of the primary school teaching. Peer leaders took charge for the application in the experimental group of the study, and they are prospective primary school teachers who studied these subjects a year ago and successfully completed the course.

The participants of this study were sophomore level prospective primary school teachers studying in the Department of Classroom Teaching at a state university. The prospective primary school teachers who participated in the study were in the age range 19-22. Before the study, the sophomore prospective primary school teachers were assigned to either the control group (CG) or one of the two experimental groups (EG-1 and EG-2). Experimental group 1 (EG-1) included 22 prospective primary school teachers, 8 of whom were male and 14 of whom were female, while experimental group 2 (EG-2) included 27 prospective primary school teachers, 10 of whom were male and 17 of whom were female. The control group (CG) included 23 prospective primary school teachers, 7 of whom were male and 16 of whom were female. The study included 7 leaders, 4 of whom were female and 3 of whom were male, and these leaders were prospective primary school teachers in their junior year.

Data Collection Tool

Seven Principles Opinion Scale for Good Practice (SPOS)

Seven Principles for Good Practice were created by Chickering and Gamson (1987). Seven Principles Opinion Scale for Good Practice (SPOS) was developed by Bishoff (2010) to assess views on the Seven Principles for Good Practice. This scale includes 70 items, where there are 10 items under each of the seven principles. The seven principles are “Encouraging Student-Faculty Contact (P1)”, “Encouraging Cooperation among Students (P2)”, “Encouraging Active Learning (P3)”, “Giving Prompt Feedback (P4)”, “Emphasizing Time on Task (P5)”, “Communicating High Expectations (P6)” and “Respect Diverse Talents/Ways of Learning (P7)”. The scale was translated and adapted into Turkish by Aydoğdu, Doymuş and Şimşek (2012). For the adaptation of the scale, two faculty members from the Department of Turkish Teaching investigated the appropriateness of items translated into Turkish in terms of meaning and expression. The recommended revisions were carried out to bring the scale items into compliance with the grammar regarding meaning and structure. Additionally, the scale was further investigated by two more faculty members, one from the Department of English Language Teaching and the other from the Department of Science Teaching, in terms of its conformity with the original version in English, and once the recommended revisions were made, the scale was finalized. SPOS uses a 5-point Likert-type scale including the responses, “very often”, “often”, “usually”, “rarely”, and “never”. The reliability coefficient of the SPOS was calculated that the Cronbach’s Alpha value was .68 (Aydoğdu, Doymuş & Şimşek, 2012). This study, reliability coefficient of the SPOS was calculated that the Cronbach’s Alpha value was .94

Data Analysis

The statistical analysis of the research data was performed using the SPSS software. The independent *t*-test and one-way analysis of variance (ANOVA) were performed on the data.

Results

The SPOS (pre-test and post-test) was administered to the prospective primary school teachers after the application the Peer-Led Team Learning Instructional Model (PLTL). The findings obtained from the scale are given in Table 2.

Table 2. Descriptive Statistical Results for SPOS (pre-test and post-test)

Groups	Pre-test			Post-test	
	N	$\bar{X}$	SD	X	SD
EG1	22	251.77	31.69	274.41	38.010
EG2	27	-	-	284.44	33.492
CG	23	240.65	28.90	249.17	35.859

As seen from Table 2, to pre-test the mean scores of the students in EG1 were higher than the mean scores of the students in CG. To post-test, the mean scores of the students in EG1 and EG2 were higher than the mean scores of the students in CG. To tests whether this differences were statistically significant, analysis were carried out. The results of this analysis are shown in Table 3.

Table 3. Results of ANOVA and T-test for SPOS (pre-test and post-test)

Test	Groups	N	$\bar{X}$	SD	df	t	p	Different
Pre-Test	EG1	22	251.77	31.69	43	1.231	0.226	-
	CG	23	240.65	28.90				
Test	Groups	SS	df	MS	F	p	η^2	Different
Post-Test	Between Groups	16035.822	2	8017.911	6.302	**.003**	.15	EG1-CG
	Within Groups	87793.289	69	1272.367				EG2-CG
	Total	103829.111	71					

As seen in Table 3, there wasn't a significant difference between the pre-test mean scores of the students in EG1 and CG (t=1.231; p=.226). There was a significant difference between the post-test mean scores of the students in CG, EG1, and EG2 [$F_{(2,71)}$=6.302; p=.003]. The LSD test was used to determine to which groups differences in these scores applied, and its results showed that the statistically significant difference was between EG1 and CG, and between EG2 and CG (p<.05). These results suggest that the views of the students in EG1 and EG2 on the seven principles for good practice were more positive than those of the students in CG. The effect size of the implemented model was found to be .15, which means that the implemented model explained 15% of the difference between the groups on the SPOS.

To further investigate the results, each factor of post-test was examined, for which the results are given in Tables 4-5.

Table 4. Descriptive Statistical Results for Factors of Post-Test

Principles	Groups	N	$\bar{X}$	SD
Encouraging Student – Faculty Contact (P1)	EG1	22	37.95	6.03
	EG2	27	37.81	5.69
	CG	23	34.17	5.91
Encouraging Cooperation Among Students (P2)	EG1	22	42.18	5.11
	EG2	27	42.44	5.00
	CG	23	36.61	6.38
Encouraging Active Learning (P3)	EG1	22	40.32	6.14
	EG2	27	43.11	5.64
	CG	23	36.83	6.46
Giving Prompt Feedback (P4)	EG1	22	36.68	8.05
	EG2	27	39.07	6.56
	CG	23	33.00	6.13
Emphasizing Time on Task (P5)	EG1	22	39.18	6.70
	EG2	27	40.67	6.21
	CG	23	36.74	6.41
Communicating High Expectations (P6)	EG1	22	38.00	8.16
	EG2	27	39.33	6.33
	CG	23	36.87	6.20
Respect Diverse Talents/Ways of Learning (P7)	EG1	22	40.09	7.40
	EG2	27	42.00	4.40
	CG	23	34.96	7.06

As can be seen in Table 4, the students in EG1 and EG2 had higher mean scores on the post-test compared to those of the students in CG. ANOVA was conducted to test whether these differences were statistically significant. The results of this analysis are given in Table 5.

Table 5. Results of ANOVA for Factors of Post-Test

Principles	Groups	SS	df	MS	F	p	η^2	Different
Encouraging Student-Faculty Contact (P1)	Between Groups	214.945	2	107.472	3.126	**.050**	.08	EG1-CG EG2-CG
	Within Groups	2372.333	69	34.382				
	Total	2587.278	71					
Encouraging Cooperation Among Students (P2)	Between Groups	512.582	2	256.291	8.496	**.001**	.19	EG1-CG EG2-CG
	Within Groups	2081.418	69	30.165				
	Total	2594.000	71					
Encouraging Active Learning (P3)	Between Groups	490.756	2	245.378	6.680	**.002**	.16	EG2-CG
	Within Groups	2534.744	69	36.735				
	Total	3025.500	71					
Giving Prompt Feedback (P4)	Between Groups	460.695	2	230.347	4.810	**.011**	.12	EG2-CG
	Within Groups	3304.625	69	47.893				
	Total	3765.319	71					
Emphasizing Time on Task (P5)	Between Groups	193.167	2	96.584	2.342	.104		-
	Within Groups	2845.708	69	41.242				
	Total	3038.875	71					
Communicating High Expectations (P6)	Between Groups	76.002	2	38.001	0.798	.454		-
	Within Groups	3289.609	69	47.632				
	Total	3362.611	71					
Respect Diverse Talents/Ways of Learning (P7)	Between Groups	643.225	2	321.613	8.079	**.001**	.19	EG2-CG EG1-CG
	Within Groups	2746.775	69	39.808				
	Total	3390.000	71					

The examination of the results of ANOVA, as shown in Table 5, in the P1, P2, P3, P4, and P7 principles showed that there was a statistically significant difference between the CG, EG1 and EG2 groups in post-test [P1: $F_{(2,71)}$=3.126; p=.05; P2: $F_{(2,71)}$=8.496; p=.001; P3: $F_{(2,71)}$=6.680; p=.002; P4: $F_{(2,71)}$=4.810; p=.011; P7: $F_{(2,71)}$=8.079; p=.001]. LSD was performed to determine which groups showed difference. The examination of the results of the LSD test on the P1, P2, and P7 principles showed that there was a statistically significant difference between EG1 and CG, and between EG2 and CG ($p<.05$). The examination of the results obtained from the LSD test on the P3 and P4 principles showed that there was a statistically significant difference between EG2 and CG ($p<.05$). It can be stated that for the P2, P3, and P7 principles, the model had a major influence on the SPOS scores of groups, while for P1 and P4, the model had a moderate influence (P1: η^2= .083; P2: η^2= .19; P3: η^2= .16; P4: η^2= .12; P7: η^2= .19).

Discussion, Conclusion and Recommendations

This study investigated the effect of the Peer-Led Team Learning Instructional Model (PLTL) on the students' learning of the simple electrical circuits subject presented in the Science and Technology Laboratory Applications course in accordance with the seven principles for good practice. The results and discussion of the findings obtained from this study are presented below.

There was no statistically significant difference between the experimental and control groups according to the findings obtained from the pre-test. The reason of it may be that students receive their undergraduate courses from the same instructors before this research. According to the findings obtained from the post-test, the experimental groups performed better than the control group, and a statistically significant difference was found between them. The effect size of the method was found to be .154. When the effect size is higher than .14, the application has a high effect size (Cohen, 1988; Pallant, 2003: p 201). Therefore, it can be considered that the PLTL had a high effect size, which means that the method was effective in attaining the objectives of the seven principles for good practice. The PLTL has been used successfully in courses like chemistry, biology, physics, mathematics, computer science, and engineering (Eberlein, Kampmeier, Minderhout, Moog, Platt, Varma-Nelson, & White, 2008).

The post-test found that there was a significant difference in favour of the experimental group in terms of the "Encouraging Student-Faculty Contact" principle. While applying this principle, it is quite important for students to familiarize themselves with their faculties, to express their problems and difficulties that they experience, and to overcome them (Bishoff, 2010; Chickering, 2000; Chickering & Gamson, 1987). In PLTL, the groups have leaders who serve as a bridge for the communication between teachers and students (Quitadamo, Brahler & Crouch, 2009; Lyle & Robinson, 2003; Wamser, 2006; Woodward, Gosser & Weiner, 1993). The student-faculty contact observed in this study was successfully maintained insofar as the prospective primary school teachers

received help from their senior leaders in getting familiar with the lab, and they were successful in their efforts to overcome difficulties experienced while conducting the experiment or learning the subject of simple electric circuits. A significant difference was found in favour of the experimental group in the "Encouraging Cooperation among Students" principle, which shows that the quality of education experience improves if students cooperate while learning (Bishoff, 2010; Chickering, 2000; Chickering & Gamson, 1987). In PLTL, heterogeneous teams are formed according to the demonstrated achievement level of learning subjects, and each team has a leader (Gosser & Roth, 1998; Johnson, Robbins & Loui, 2015; Tien, Roth & Kampmeier, 2004; Wilson & Varma-Nelson, 2016). A set of experimental equipment was given to the teams to carry out the experiment. The study results showed that the positive commitment of the prospective teachers constituting the group had improved. Positive commitment is a characteristic that increases cooperation (Bayrakçeken, Doymuş & Doğan, 2013). It can be argued that due to the additional application carried out in the peer-led team experimental groups, the cooperation principle was satisfied. Significant differences were found in favour of the experimental groups for the "Respect Diverse Talents/Ways of Learning" principle, which suggests that there are differences in the learning styles of students, and that a higher quality education experience can be achieved with the methods carried out by taking these differences into consideration (Bishoff, 2010; Chickering, 2000; Chickering & Gamson, 1987). These differences were considered in the experimental groups because these groups consisted of heterogeneous teams, whose members learned the subject from each other and made a presentation together, and were guided by the leaders and the teacher in the process. The formation of heterogeneous teams is an indication that the prospective teachers' different skills were taken into consideration. In PLTL, students learn the subject through interaction with their peers on the team, while the leaders, who have different characteristics than the students, explain the materials, and in doing so, establish a connection with the students by understanding how they learn (Gosser & Roth, 1998). This role that the leaders play reflects the manner in which different learning styles interact together. From all these features, it can be asserted that the PLTL applied to the experimental group satisfied the "Respect Diverse Talents/Ways of Learning" principle.

Regarding the principles of "Encouraging Active Learning" and "Giving Prompt Feedback", there was a significant difference between EG2 and CG, and the prospective primary school teachers in EG2 were found to be more successful. According to Chickering and Gamson (1987), learners should discuss and write about what they have learned, relate what they have learned with their previous experiences, and adapt what they have learned to daily life in an active learning process. Peer leaders in the PLTL provide a supportive environment that enables the active participation of each student in the science learning process (Eberlein et. all, 2008). One of the aims of the methods employed in this study was to facilitate the prospective primary school teachers' active participation in courses. To achieve this, appropriate conditions were provided to allow the prospective primary school

teachers to conduct the aforementioned experiments together, and they were asked to write down the results of the experiment on the worksheet. In EG2, the teams conducted the experiment by learning from each other under the supervision of their leaders. Leaders participated in the application of the method to maintain the integrity of the team by ensuring that everyone participated. In other words, they served as a role model for their peers. The teacher served as a guide in the process and helped the students when needed.

The examination of the "Emphasizing Time on Task" principle showed that there was no significant difference between the groups in terms of their application of this principle. Time planning is of critical importance in this principle. Effective time planning enables tasks to be carried out appropriately (Bishoff, 2010; Chickering, 2000; Chickering & Gamson, 1987). The method application process to be performed on the experimental and control groups was effectively planned in advance. Thanks to this planning, the prospective primary school teachers in the experimental and control groups were given the means and opportunity to perform their tasks within the process.

Results regarding adherence to the "Communicating High Expectations" principle showed that there was no significant difference between the groups. This principle refers to the need to have high-level (accessible) goals, such as a high-level success or high-level thinking expectations (Bishoff, 2010; Chickering, 2000; Chickering & Gamson, 1987). Many studies showed that the PLTL is effective in helping students to acquire high-level thinking skills (Cracolice, 2005; Deming & Cracolice, 2005). However, the targets of a majority of the undergraduate students were to pass courses and complete their undergraduate education (Page & Mukherjee, 1998). Considering these characteristics of the prospective teachers, the effectiveness of the application carried out according to the PLTL on fulfill high-level accessible expectations could not be determined due to the prospective teachers' low expectations for achieving high-level success. In a study conducted by Graham, Cagiltay, Lim, Craner, and Duffy (2001) interesting homework was used to adapt subjects to real life circumstances in order to create high-level expectations. In modeling-based teaching, which is an active learning method, thought experiments are used for students to perform high-level thinking (Halloun, 2007; Ünal-Çoban, 2009; Zorlu & Sezek, 2019). Additions can be made by reviewing other applications shown by studies in the literature to foster high-level success and thinking expectations in PLTL and to contribute to a good educational process.

For a quality education seven principles for good practice proposed by Chickering and Gamson should be considered as a whole and included in applications. From a student's point of view, it can be challenging to discern the current century; therefore, peers can play an important role in bringing better understanding for students. Peers serving leadership roles can help teachers by taking an active part in the learning processes and facilitating greater social interaction through cooperation. In this regard, selecting the right peer leaders and including them in applications can contribute to the

achievement of principles that are required for a quality education. In the PLTL, prospective teachers who attend courses as team leaders in lower level classes gain teaching experience and improve their personal development. Therefore, teacher-training environments that offer professional development can benefit from the PLTL. It is recommended that further studies on PLTL should be conducted in order to contribute to the relevant literature by investigating the teaching experience that leaders gain in applying the principles necessary for a quality education.

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