The Effect of Different Cooperative Learning Methods on Laboratory Activities of Science Teacher Candidates

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ABSTRACT
The study aimed to determine the effects of students teams achievement divisions (STAD) and reading-writing-application (RWA) methods on teacher candidates' academic achievements, laboratory attitudes, cooperative work, laboratory safety and scientific process skills in science teaching laboratory practice-I courses. In the research, a quasi-experimental design with pretest-posttest comparison groups was used. The research was conducted with 36 third grade teacher candidates who are studying as science teachers in the fall semester of the 2018-2019 academic year. The data were collected with the academic achievement test and science laboratory attitude scale and observation. In the analysis of the data, descriptive statistics, independent groups t-test, dependent groups t-test were used. Besides, it was determined that there was no statistically significant difference between the academic achievements and laboratory attitudes of the teacher candidates who applied the RWA and the STAD methods. According to the observation results, it was determined that there was no statistically significant difference between the cooperative work of the teacher candidates who applied the RWA and the STAD methods. Also, the results indicated that there was a statistically significant difference between laboratory safety and basic and causal skills of teacher candidates in terms of the RWA method.
Keywords: Science Laboratory Applications, Academic Success, Attitude, Scientific Process Skills, Students Teams Achievement Divisions, Reading-Writing - Application

INTRODUCTION
Science helps us understand and evaluate the Earth and Universe in which we live (Şimşek, Doymuş & Şimşek, 2008). Thus, science and science education is important (Gürses, Doğan, Yalçın & Canpolat, 2002) and it is thought that the existence of science and technology would not be possible without science education. According to this point of view, nature is an untouched laboratory for science that operates with a very wide scope and in a great system. It is necessary to show students that they are a part of the events that take place in this unlimited natural laboratory, to teach the basic science concepts that they can use to explain these events, and to make them love science in order to make them individuals who can think and understand science (Güneş, Şener, Termi & Can, 2013). However, it is not possible to always work in a laboratory of nature, that's why it is of great importance to establish artificial laboratories in school environments to teach science education students (Kırbaşlar, Güneş & Deringöl, 2008). It includes various levels of activities performed in laboratories by using certain materials which range from simple demonstration experiments to complex science experiments (Demir, Böyük & Koç, 2011). The purpose of these experiments is to serve that students learn in a meaningful way by researching, analyzing, and passing the information through mental filters, rather than directly conveying information. Suitable laboratory activities are effective in the development of research, solving a problem and reasoning skills (Uluçınar, 2004). Cooperative learning models including many different methods and techniques will improve the skills of teacher candidates and are useful for both educators and researchers. For example, students improve scientific process skills including observing, inferring, measuring, predicting, interpreting data, formulating hypotheses, creating definitions operationally, determining variables (Bilgin & Toksoy, 2007; Bozdoğan, Taşdemir & Demirbaş, 2006). Cooperative learning model has important features such as positive commitment, individual responsibility, rewards (Slavin, 1983), the formation of groups and group spirit, the role of the teacher, the use of social skills, face-to-face interaction, and group rewards (Bayrakçeken, Doymuş & Doğan, 2013; Johnson & Johnson, 1994). Reading-Writing-Application (RWA) is a kind of cooperative learning model. Before applying the RWA, teams are created that consist of four to six students who are in harmony according to their academic performance, gender, and ethnicity.

The RWA also improves reading, writing, and practicing skills by working individually and in groups. Teams created read different sources, discuss and report what they read with their group without using sources, and then present their work to others teams. This situation improves their skills (Aksoy, 2011; Şahin, 2013). The RWA helps to improve their achievement, as well (Akçay, 2012; Akçay & Doymuş, 2014; Akçay, Doymuş, Şimşek & Okumuş, 2012; Aksoy, 2013; Koç, 2014; Koç, Şimşek & Fırat, 2013; Okumuş, 2014; Şahin, 2013; Şimşek, 2012, 2013; Şimşek, Yılar & Küçük, 2013). Another method is Student Teams-Achievement Divisions (STAD) including six main steps. In the same way, the RWA method, heterogeneous groups of students are formed. Certain topics are given to the groups to learn. Then, the teacher determines which group or groups will present. After completing their work, worksheets are given to each student. Students are ranked according to their average scores. Group success is found by gathering individual achievements and the most successful group deserves rewards (Bayrakçeken, Doymuş, Doğan, 2013). Additionally, itwas concluded that the STAD method helps to improve students' achievements and ensures the integrity of the concepts (Gelici & Bilgin, 2011; Bilgin, 2004; Küçükilhan, 2014; Ocak, Küçükilhan,2015; Ural, Umay & Argün, 2008). Therefore, effective learning environments can be created for teacher candidates who will receive teacher education and these environments will help them achieve these gains. As a result of a comparison of the RWA and the STAD methods, it was determined that the STAD method was much more effective in student success (Alyar & Doymuş, 2015; Doymuş, 2017; Koç, 2014; Koç & Şimşek, 2016; Öztürk & Doymuş, 2018). Generally, studies which compare these two methods examined the effects of these methods on students' academic achievement. When the literature was examined, these methods were found to be effective for academic development of students, but it was determined that there were a limited number of studies to compare the effects of the two methods. This study aimed to determine the effects of these methods on teacher candidates and their academic achievements, laboratory attitudes, cooperative work, laboratory safety and scientific process skills. The main problem of this study: Which one of the methods of the STAD and the RWA are more effective for academic achievement, positive laboratory attitudes, collaborative work, laboratory safety, and scientific process skills of science teacher candidates? The sub research questions of this study:

1. Is there a significant mean difference between the effects of the STAD and the RWA methods on teacher candidates' academic achievements?
2. Which one of the methods of the STAD and the RWA are more effective on the science teacher candidates' academic achievements?
3. Is there a significant mean difference between the effects of the STAD and the RWA methods on teacher candidates' attitudes?
4. Is there a significant mean difference between the effects of the STAD and the RWA methods on collaborative work, laboratory safety, and scientific process skills of science teacher candidates?

METHOD

In the research, a quasi-experimental design with pretest-posttest comparison groups was used. Quasi-experimental designs are those in which individuals in the research group are not assigned to groups randomly or in which all variables cannot be fully controlled (Mcmillan & Schumacher, 2006). Since the effect of the RWA and the STAD methods on academic achievement, laboratory attitude, cooperative work, laboratory safety, and scientific process skills was investigated, the method of pretest-posttest comparison groups was preferred. The experimental plan of the research is given in Figure 1.

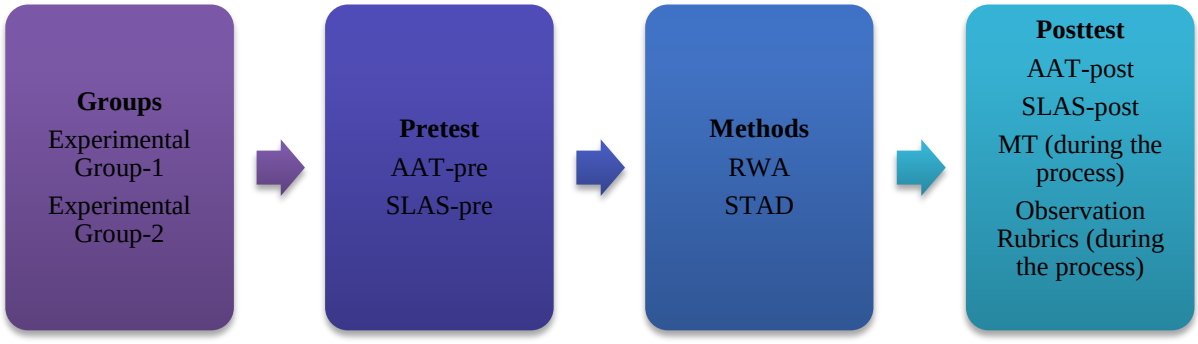

Figure 1: Experimental plan of the research

As seen in Figure 1, at the beginning of the application, the academic achievement test (AAT-pre) and the science laboratory attitude scale (SLAS-pre) were applied as pretests. During the process, the RWA methods were applied to the group which is Experimental Group-1 and the STAD methods in the group which is Experimental Group-2. After application, the academic achievement test (AAT-post) and the science laboratory attitude scale (SLAS-

post) was applied as a posttest. A module test (MT) was applied, and observation data were collected all groups every week during the whole process from the first experiment to the last experiment.

Study Group

The research was conducted with 36 third grade teacher candidates who are studying to become science teachers in the fall semester of the 2018-2019 academic year. The random assignment method was used to include teacher candidates in the study group. The names of the teacher candidates were written on papers of the same color and size, folded and put in an invisible bag. Two groups were randomly formed as a Group-1 and Group-2. There was randomly chosen a name from the bag for each group in turn. Then, there was put in the bag again each name chosen and the probability of teacher candidates being selected for the groups was equalized. Before if the name selected appeared, it was folded back into the bag and continued until a new name was released. When all the names were completed, the names of the groups were written on the papers and put in a bag, and a lottery was chosen to determine which one would be Experiment Group-1 and Experiment Group-2. After the experimental groups were formed, the teacher candidates were informed about the process and a volunteer form was signed by each teacher to participate in the study. 6 pre-service teachers who did not want to participate in the research in both groups were excluded from the study groups. As a result, 18 teacher candidates took part in the study group in both experimental groups.

Data Collection Tools

Academic Achievement Test

The achievement test used in this study was developed by the researchers. The test is a two-step test consisting of multiple-choice and open-ended questions. Since there are no certain objectives at the university level, firstly, the subject scope of the experiments and the experiments were determined for groups. Two or three questions related to each topic were written using the indicator table. The test includes questions about the theoretical knowledge, construction, results, and security measures of the experiments. The questions prepared were presented to a group of six people who are experts in physics, chemistry, and biology, and assessment-evaluation. These experts examined the test from many angles, especially the features that it measured, the topic scope, the understandability of the questions, the roots of question, and options, the answer key, the scoring, and formal features. As a result, according to these expert opinions, it was determined that the test exactly provided the topic scope and all the questions were aimed at measuring the same features.Three questions required other knowledge and skills could not be corrected, so they were removed from the test, and two questions were edited. Similarly, according to these expert opinions, the scoring of the answer key was adjusted, as well. After the questions and arrangements were completed, the test was made ready for a pilot application. The pilot application was conducted with 96 senior science teacher candidates who had taken the Science Laboratory Applications course in the previous year. As a result of the analysis of the data obtained from the pilot applications, the KR-20 reliability coefficient for the multiple-choice questions of the test was calculated as 0.86. The average item difficulty index of the test was found to be 0.48 and item difficulty indices ranged from 0.23 to 0.86. The discrimination index of the questions ranged from 0.35 to 0.77. Open-ended questions were carried out by two researchers independently and the Kappa coefficient was found to be 0.82. As a result, the test consisted of two stages: 27 multiple-choice and 8 open-ended questions. Multiple choice questions are scored with 1 point for a correct answer and 0 points for an incorrect or blank answer. The detailed scoring key was used in the evaluation of open-ended questions. The minimum score that could be taken from the test was 0 and the maximum score was 100.

Module Tests

Module tests (MT) which relate to the topic of the experiment were applied every week. These tests were applied at the end of the writing phase of the RWA method. Also, that tests about theoretical knowledge, and the construction and security measures of the experiments were applied after that completed experiment in the STAD method. The questions and answer key of the MTs were prepared at the beginning of the application and presented to the opinions of experts who have a field of physics, chemistry, and biology. Each MT consisted of 3 open-ended questions. All tests were evaluated independently by two different researchers based on the answer keys. The agreement between the researchers' scores was calculated with the Kappa coefficient. Kappa coefficients vary between 0.76 and 0.84. The minimum score that could be obtained from the tests was 0 and the maximum score was 30. After all tests were evaluated, the averages of 11 tests were taken, and the scores were analyzed by converting them into a hundred points system due to the application of a hundred-point grading system.

Science Laboratory Attitude Scale

In the study, the Attitude Scale towards Science Laboratory developed by Yamak, Kavak, Canbazoğlu Bilici, Bozkurt and Peder (2012) was used. The scale consists of 23 items that have 15 positive and 8 negative items. For pilot applications of the scale were studied with 236 teacher candidates. Additionally, the validity studies of the scale were also used exploratory and confirmatory factor analysis. As the exploratory factor analysis was

determined that the scale consists of three factors which are the importance of the laboratory, the laboratory lesson and the use of equipment and laboratory documents. It was found that the model emerged as a result of the confirmatory factor analysis was highly compatible with the data. The Cronbach Alpha reliability coefficient of the scale was calculated as 0.88. For this study, confirmatory factor analysis was used in the validity analysis and it was determined that the goodness of fit indexes was within the desired range. In the reliability analysis, the internal consistency coefficient was calculated and the Cronbach Alpha value was found to be 0.91.

Observation Rubrics

Initially, for observation rubrics, the literature on cooperative learning, laboratory safety, and scientific process skills was investigated, and then critical behaviors were determined. While the sections on laboratory safety and scientific process skills consist of the same behaviors for both methods, the section related to cooperative learning has been prepared separately for the behaviors observed in both methods as well. The laboratory safety section consists of behaviors related to the basic safety precautions to be taken before, during and after the experiment. The scientific process skills section consists of basic skills and causal skill behaviors. After the behaviors to be observed were determined, they were presented to the opinions of 3 field experts working on cooperative learning and scientific process skills. The observation form consists of 19 behaviors for cooperative work, 13 for laboratory safety, 5 for basic skills, and 11 for causal skills. Behaviors were observed in five-point Likert type according to their realization degree. The observations were carried out continuously by two researchers independent of each other as a group observation. It was calculated as 0.77 with the coefficient of agreement between the observation data of the two researchers (Miles & Huberman, 1994).

Data Analysis

In the analysis of the data, the compatibility of the parametric tests with the assumptions was primarily examined. The values of the data regarding normality are given in Table 1.

Table 1: Normality values

Test	Group	Kurtosis	Skewness	Min	Max	Med	Mean	St. D	Shapiro-Wilk*
AAT-pre	RWA	0.211	-0.223	18.00	62.00	50.00	49.18	16.32	0.971
	STAD	-0.603	0.051	22.00	68.00	52.00	51.50	12.08	0.481
SLAS-pre	RWA	-0.154	-0.946	58.00	95.00	76.50	78.83	10.94	0.489
	STAD	0.424	-0.241	55.00	102.00	74.00	76.67	12.54	0.817
AAT-post	RWA	0.121	-0.878	58.00	98.00	77.50	76.81	13.54	0.252
	STAD	-0.333	0.087	46.00	96.00	74.38	74.60	12.34	0.237
SLAS-post	RWA	-0.509	-0.093	78.00	103.00	94.00	93.22	73.78	0.571
	STAD	-0.100	-0.810	73.00	108.00	91.00	90.94	69.11	0.661
MT	RWA	0.270	-0.841	59.00	92.00	73.00	73.78	10.95	0.183
	STAD	0.489	-0.626	53.00	93.00	69.00	69.11	11.94	0.291
Cooperative work	RWA	0.052	-0.961	70.00	88.00	77.50	78.50	6.32	.271
	STAD	-0.328	-0.505	61.00	84.00	76.00	77.83	10.84	.920
Laboratory Safety	RWA	-1.626	0.984	28.00	58.00	51.50	49.25	8.27	.061
	STAD	-0.319	-0.942	30.00	50.00	43.00	40.09	7.06	.257
Basic Skills	RWA	-0.028	-0.533	16.00	24.00	21.00	20.00	2.86	.119
	STAD	0.137	-0.517	11.00	22.00	17.00	15.91	3.33	.618

Causal Skills	RWA	0.643	-0.535	31.00	43.00	35.00	35.50	3.80	.288
	STAD	0.074	-0.863	25.00	36.00	31.00	30.45	3.47	.867

*p>.05

The values given in Table 1 show that the data are distributed normally. For this reason, independent groups t-test and dependent groups t-test were used. Effect size values were calculated in terms of eta-squared. The data were analyzed using the SPSS 20 program. In data analysis, the significance value was taken as 0.05.

Application

The experiments determined were completed in 11 weeks (22 lesson hours). However, the implementation duration was completed in total 13 weeks (26 lesson hours) with the application of pre-tests and post-tests. During the application, the researchers took the role of a guide and observer. Group studies were followed carefully, the groups were assisted when necessary, group discussions were initiated by asking questions, experimental setups were checked and additional information about the experiments was given. The experiments given in Figure 2 were carried out in 11 weeks.

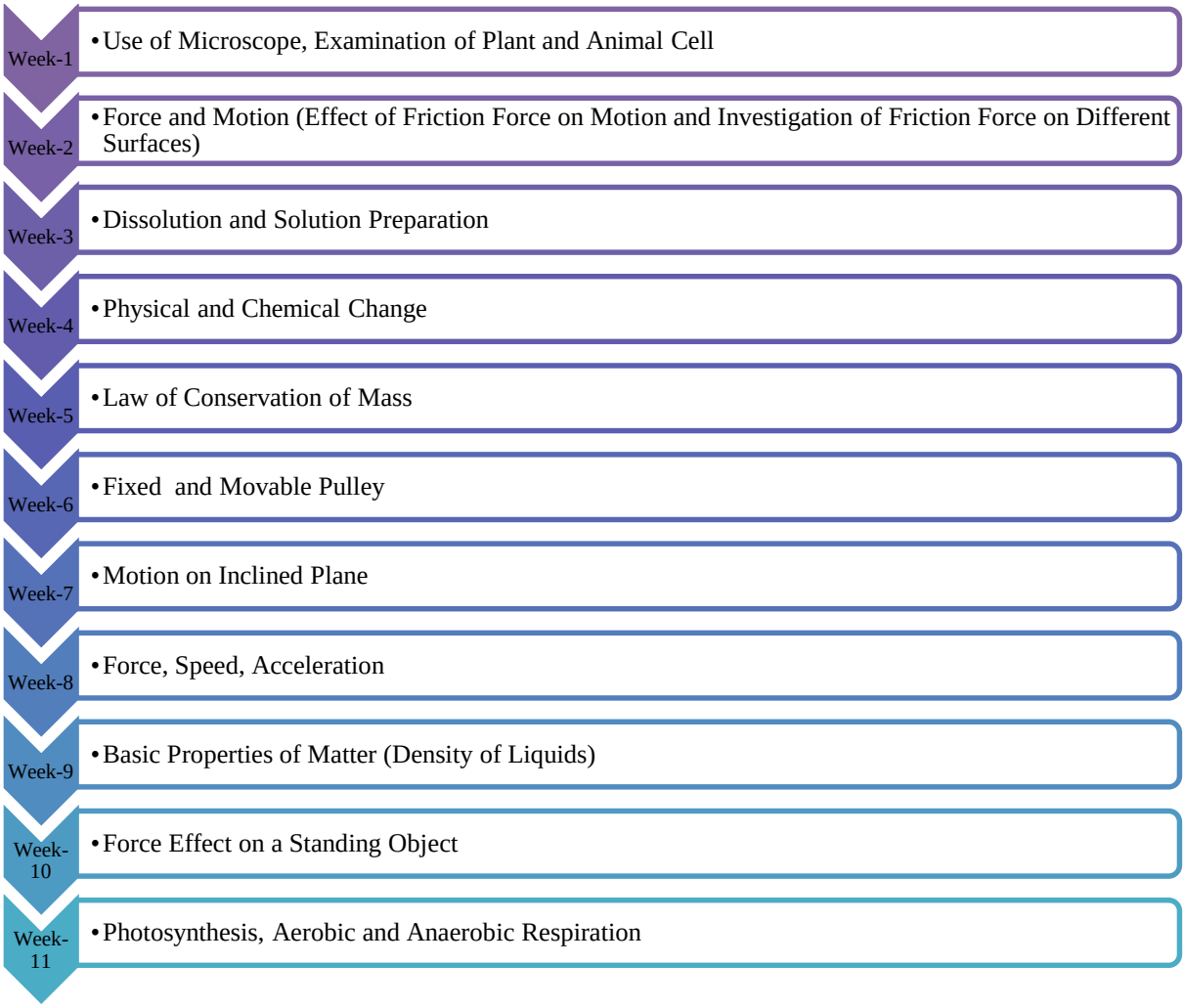

Figure 1: Experiments conducted during research

Application of the RWA Method

The six groups of three of teacher candidates were created taking into account the prior knowledge, gender and attitudes towards the laboratory of them, so that a heterogeneous structure within the group was formed. It was made sure that the structure between groups is homogeneous. After the groups were formed, the teacher candidates took their places on their experiment tables, and determined the group names and logos. It informed teacher candidates about the application and the method of how they apply. Laboratory safety rules are explained to ensure a safe working environment before, during, and after the experiment. Information describing the skills within the scientific method that are necessary to prepare, complete, and present an experiment were presented to students.

The teacher candidates did read sheets provided by the researchers, and additional resources which they brought to the laboratory about the experiment, so they would do each week for 20 minutes. After teacher candidates completed their reading, all sources were removed, the writing stage started, and then they wrote a report from the information they had in their mind. They prepared a report containing the theoretical knowledge, purpose and construction of the experiment with the information remembered from the reading phase nearly for 15 minutes. After the writing phase was completed, 15 minutes were allocated and the MT related to that week was applied. In the next 35 minutes of the lesson, the groups carried out their experiments and in the remaining 15 minutes, they completed their weekly work by making group discussions about the experiment. The reports prepared by the groups during the writing phase were evaluated weekly. Additional points ranging from 5-10 were given to the end-of-term scores as a reward based on their success in writing reports.

Application of the STAD Method

The teacher candidates were divided into groups of three in a way to create a heterogeneous structure within the group, taking into account their prior knowledge level, gender, and attitudes towards the laboratory. It was made sure that the structure between groups is homogeneous. After the groups were formed, the teacher candidates took their places on their experiment tables, and determined the group names and logos. It was explained about the application and method to groups. Additionally, it has been provided about information on basic laboratory safety. Teacher candidates were informed about scientific process skills how they can use and develop in experiments. The researchers shortly presented nearly for a 5-minute about the experiment each week. After the presentations, the groups worked together on the experiment for 15 minutes on how they will do. After the group work, they carried out their experiments together for 35 minutes and made group discussions in the next 15 minutes. The groups prepared their reports on the experiment in the remaining 15 minutes. In the last 15 minutes of the lesson, MT for that week was applied. Individual progress scores were recorded by comparing the scores of the teacher candidates from the weekly tests with the target scores formed by considering the pre-test scores applied at the beginning. Additional points were given to the teacher candidates as a reward in terms of their individual progress scores.

FINDINGS

Findings of the First Research Question

The dependent groups t-test analysis results, which were made to determine the effect of the RWA and the STAD methods on the academic achievements of teacher candidates, are given in Table 2.

Table 2: Dependent groups t-test results regarding the effects of the RWA and the STAD applications on academic achievement

Method	Measurement	N	M	Std. D.	df	t	p*
RWA	Pretest	18	49.18	16.32	17	-9.457	.000
	Posttest	18	76.81	13.54			
STAD	Pretest	18	51.50	12.08	17	-5.627	.000
	Posttest	18	74.60	12.34			

*p<.05

As can be seen from the analysis results given in Table 2, the academic achievements of the teacher candidates who were applied the RWA method ($t_{(17)}$=-9.457, p<.05, η^2=.84) and the STAD method ($t_{(17)}$=-5.627, p<.05, η^2=.65) increased statistically significantly. Eta-squared effect sizes were calculated as .84 for the RWA method and .65 for the STAD method, and these values were classified as very large effects by Cohen (1988). Accordingly, it can be said that the increase observed in the academic achievements of teacher candidates is 84% due to the RWA method and 65% from the STAD method.

Findings of the Second Research Question

The independent groups t-test analysis results, which were made to compare the effects of the methods on the academic achievement of teacher candidates, are given in Table 3.

Table 3: Independent samples t-test analysis results of AAT-pre and AAT-post data

Measurement	Method	N	M	Std. D.	df	t	p
Pretest	RWA	18	49.18	16.32	34	-.485	.631
	STAD	18	51.50	12.08			
Posttest	RWA	18	76.81	13.54	34	.511	.612
	STAD	18	74.60	12.34			

As can be seen from the analysis results given in Table 3, there is no statistically significant difference between teacher candidates' prior knowledge levels at the beginning of the application ($t_{(34)}$=-.485, p>.05). At the end of the application, it was determined that there is no statistically significant difference between the academic achievements of teacher candidates who were applied the RWA and the STAD methods ($t_{(34)}$=.511, p>.05).
Independent groups t-test analysis results of the data obtained from MTs applied weekly during the application are given in Table 4.

Table 4: Independent samples t-test analysis results of data obtained from MTs

Method	N	M	Std. D.	df	T	p
RWA	18	73.78	10.95	34	1.222	.230
STAD	18	69.11	11.94			

According to the analysis results given in Table 4, there is no statistically significant difference between the achievement of the teacher candidates in the experimental subjects ($t_{(34)}$=1.222, p>.05).

Findings of the Third Research Question
The dependent groups t-test analysis results made in order to determine the effect of the RWA and the STAD methods on the attitudes of teacher candidates towards science laboratories are given in Table 5.

Table 5: Dependent groups t-test results regarding the effect of the RWA and the STAD applications on science laboratory attitudes

Method	Measurement	N	M	Std. D.	Df	t	p
RWA	Pretest	18	78.83	10.94	34	.552	.584
	Posttest	18	76.67	12.54			
STAD	Pretest	18	93.22	73.78	34	.750	.458
	Posttest	18	90.94	69.11			

As can be seen from the analysis results given in Table 5, the laboratory attitudes of the pre-service teachers who were applied the RWA method ($t_{(17)}$=-4.819, p<.05, η^2=.58) and the STAD method ($t_{(17)}$=-5.517, p<.05, η^2=.64) statistically significantly increased. Eta-squared effect sizes were calculated as .58 for the RWA method and as .64 for the STAD method, and these values were classified as very large effects by Cohen (1988). Accordingly, it can be said that the increase observed in teacher candidates' laboratory attitudes is due to 58% the RWA method and 64% the STAD method.

Findings of the Fourth Research Question
Independent groups t-test analysis results made in order to compare the effects of the methods on teacher candidates' laboratory attitudes are given in Table 6.

Table 6: Independent samples t-test analysis results of SLAS-pre and SLAS-post data

Measurement	Method	N	M	Std. D.	Df	t	p
Pretest	RWA	18	78.83	10.94	34	.552	.584
	STAD	18	76.67	12.54			
Posttest	RWA	18	93.22	73.78	34	.750	.458
	STAD	18	90.94	69.11			

As can be seen from the analysis results given in Table 6, there is no statistically significant difference between teacher candidates' attitude levels in the science laboratory at the beginning of the application; ($t_{(34)}$=-.55, p>.05). At the end of the application, it was determined that there was no statistically significant difference between the attitude levels of pre-service teachers who were applied the RWA and the STAD methods ($t_{(34)}$=.750, p>.05).

Findings of the Fifth Research Question

Independent groups t-test analysis results of the data obtained from the observations made during the application are given in Table 7.

Table 7: Independent groups t-test results of observation data

Measurement	Method	N	M	Std. D.	Df	t	p
Cooperative Working	RWA	66	78.50	6.32	64	.184	.856
	STAD	66	77.83	10.84			
Laboratory Safety	RWA	66	49.25	8.27	64	2.843	.010*
	STAD	66	40.09	7.06			
Basic Skills	RWA	66	20.00	2.86	64	3.168	.005*
	STAD	66	15.91	3.33			
Causal Skills	RWA	66	35.50	3.80	64	3.312	.003*
	STAD	66	30.45	3.47			

*p<.05

According to the analysis results given in Table 7, there is no statistically significant difference between the cooperative working behaviors of the teacher candidates who are applied the RWA and the STAD methods; ($t_{(64)}$=2.843, p>.05). It is seen that there is a significant difference in favor of the pre-service teachers who applied the RWA method between the safety working situations ($t_{(64)}$=-2.843, p<.05, η^2=.11), basic ($t_{(64)}$=-3.168, p<.05, η^2=.14), and causal ($t_{(17)}$=-3.312, p<.05, η^2=.15) scientific process skills of the teacher candidates. Eta-square effect size values; it is classified as a medium effect found to be .11 for laboratory safety, .14 for basic skills and .15 for causal skills and classified as large effect (Cohen, 1988). Accordingly, it can be said that 11% of the variability in laboratory safety behaviors of teacher candidates, 14% of the variability in basic skills and 15% of the variability in causal skills can be attributed to the methods applied.

CONCLUSIONS

The results indicated a significant effect of the STAD and the RWA methods on the academic achievement of science teacher candidates. This result is parallel to the studies of Alyar & Doymuş (2015). However, it can be said that the increase observed in the academic achievement of teacher candidates is 84% due to the RWA method and 65% to the STAD method. This result is similar to the result that the RWA method reached by Koç (2014) is more effective on achievement than the STAD method. In the RWA method, it can be said that the achievement of the teacher candidates increased for some reasons, why they reported what they have read with their group about the experiment (without using sources), benefited from each other's knowledge and experiences throughout the process, and supported each other in their learning (Slavin, 1994, 1995; Stevens, Madden, Slavin & Farnish, 1987).

Also in the STAD method, it can be said that achievement has increased due to teacher candidates working together, discussing on topics, supporting each other in their learning, and achieving the success of the groups they belong to according to their individual progress level. This result obtained from this study is similar to the result that the STAD method is effective on student achievement reached by Küçükilhan (2013), Akar and Doymuş (2015). It was determined that there was no statistically significant difference between the academic achievements of teacher candidates who applied the RWA and the STAD methods. This result is similar to the study reached by Koç and Şimşek, (2016). Although there are some practical differences between cooperative learning methods, all the cooperative learning methods based on fundamental principles, such as, individual responsibility, positive interdependence, individual or group assessment, group work with the guidance of positive structure, and face-to-face interaction among students and these are the methods in which the learner is active in the process and learns through their own life and experiences (Açıkgöz, 1992; Johnson & Johnson, 2014; Slavin, 1983).

The results indicated a significant effect of the STAD and the RWA methods on the science teacher candidates' laboratory attitudes. However, it can be said that the increase observed in the laboratory attitudes of teacher candidates is 58% due to the RWA method and 64% to the STAD method. Also, the results indicated that there was no statistically significant difference between the laboratory attitudes of teacher candidates who applied the RWA and the STAD methods. It can be said that the attitudes of teacher candidates have increased thanks to working together, supporting each other in their learning, positive interdependence between group members, and achieving the success of the groups they belong to according to their individual progress level in both methods (Açıkgöz, 1992; Johnson & Johnson, 2014; Slavin, 1983; Stevens, Madden, Slavin & Farnish, 1987; Slavin, 1994, 1995).

Moreover, it was determined that there was no statistically significant difference between the cooperative work of teacher candidates. Based on this result, it can be said that teacher candidates in two groups acted in accordance with the nature of cooperative learning. The results indicated that there was a statistically significant difference between laboratory safety and basic and causal skills of teacher candidates in terms of the RWA method. This result obtained from this study is similar to the result reached by Aksoy and Doymuş, (2011), and Bilgin and Toksoy, (2007). In general, it can be said that the cooperative learning model has a positive effect on scientific process skills of teacher candidates (Ülük, 2019).

The RWA and the STAD methods can be used to increase academic achievement. Using the RWA and the STAD methods in classrooms with low motivation can be beneficial in increasing the motivation of teacher candidates. Similar applications can be carried out for longer periods and their effects on success and motivation can be examined. The RWA method can be used to increase teacher candidates' safe working behaviors in the laboratory. The RWA method can be used to increase teacher candidates' basic and causal scientific process skills. Teacher candidates should be informed about the essential elements of cooperative learning, such as, positive commitment, acting together in every situation, winning or losing together, and the process should be controlled so that situations that may harm the cooperative learning do not occur during the process.

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