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# Comparing with Problem and Cooperative Based Learning Method Applied in Primary Schools on The Success of The Students

**Emine Nedime Korucu** [*]
**Renan Şeker** [**]

## Abstract

This study is made in order to compare the success of the students, their interest to the Science Lectures and their ability of remembering the things on the effects of their levels due to the Techniques of teaching Sience Lectures with Problem-based Learning (PBL) and Cooperative-Learning (CL). The central place of the research is the primary schools in Konya. For example, in Vali Çetinkaya Primary school, a study which has been operated by 7th grade students is conducted through the implementation of pretest-final test and reminder test. The unit titled 'Journey to the Inner Structure of Item' has been taught in 7th grade students for 5 weeks time and in order to carry out our research, this unit is taught with the help of CL in one of the classes while teaching the same unit with PBL to the other class. A test is used to determine the students' level of success. This test's reliability exponent is *Cronbach*α =0.823 and it consists of 30 questions. In addition to this, a behavior scale (α=0.786) which consists of 30 sections is used to determine the students' perspectives to science. In research; the students' scores from pre-experiment and final test and the reminder test which has been implemented ten weeks later after the lesson and their perspectives to science are evaluated as dependent variable, the implemented teaching methods are evaluated as independent variable.At the end of the research, the datas which deal with the level of success and attitudues to science are compared by using SPSS and t-test. In final research, it is concluded both methods which have been implemented have similar effects on students' success but PBL creates a positive result compared to the CL method in terms of attitude. Moreover, the scores of the reminder test which has been implemented 10 weeks after the lesson suggests that There is a significant difference between the posttest and recall test achievement scores of the students in the group with CL method ($p<0.05$). This result shows that students who teach lessons with the CL and PBL method have forgotten some of what they have learned for 10 weeks. In conclusion, it is agreed that there is no appreciable difference between PBL and CL in terms of level of success. But both methods are affected positively in science education.



***Keywords:***

Science Teaching,
Problem Based Learning,
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The Success of the Student,
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***Author correspondence:***
First Author,
Necmettin Erbakan Universitesi Science Faculty, Department of Molecular Biology and Genetics. Meram-KONYA-TURKEY
Email: nedimekorucu@hotmail.com

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[*]Necmettin Erbakan UniversitesiFen Fakültesi, Moleküler Biyoloji ve Genetik Bölümü. Meram-Konya-Türkiye
[**]Necmettin Erbakan Universitesi Ahmet Keleşoğlu Eğitim Fakültesi Fen Bilgisi Eğitimi Anabilim Dalı. Meram- Konya-Türkiye

## 1. Introduction

The basis of today's educational approach is that the student can participate effectively and gain the ability to solve problems by himself. In order to achieve this, different methods and strategies are developed to enable the student to gain knowledge and to gain different perspectives through inter-group discussions. Therefore, students should be taught the source of the information and how to obtain it, how to evaluate it and how to use it to solve the problem [25].

Problem based learning is the way of learning and the way of learning in which the student is at the center and actively participates by creating a problem by the teacher [6].In order to provide effective learning in science education, it is recommended to be supported with student-centered collaborative and problem-based learning. The effectiveness of Problem Based Learning (PBL) approach in teaching students active learning skills in science lessonhas been revealed[2], [15], [17], [26].

Cooperative learning, on the other hand, is an instructor-supported teaching strategy in which student-centered, small groups are formed and responsible for the learning of both the student himself and his group friends. In the same group, students discuss topics with each other to solve a problem, complete a task or achieve a goal [21]. Coperative learning has been proven to have more positive effects on cognitive and affective learning products than other methods, and it has been proven through research in a wide range of student groups. Cooperative learning method; Positive effects on cognitive and affective learning products have been proven, using speech, listening, writing and reflection, which form the basis of active learning methods. It has been reported that this method is a teaching method that is based on the importance of collaboration skills, which enables social interaction, responds to students' needs, enables them to use their mental abilities, and allows them to make decisions about their own learning[1], [9], [12], [16].

## 2. Research Method

In this section, the research model, data collection tools, teaching material used in the CL and PBL group, Data collection process, Working Group Data analysis sections are included.

### 2.1. Model of the research

Our research is a research in the trial model, which is one of the quantitative research methods. The design of the study is a semi-experimental pattern with pretest-posttest control group. In the experimental design, it is aimed to reach a result by establishing cause and effect relationship between the variables and measuring the variables. In this model, when creating groups, it is requested that the control and experiment groups are randomly distributed and that these groups are as equivalent as possible. However, it may sometimes be impossible to randomly distribute groups, or the researcher does not want it. In this case, it is preferred to use a semi-experimental model [11].

In this study, pretest-posttest was applied to experimental and control groups and problem-based learning (PBL) and cooperative learning (CL) methods were compared both within themselves and by applying t-test with each other. In our study, while the cooperative teaching method was applied to the Control group, the problem-based teaching method was applied to the experimental group. In the research, “Student Teams Success Sections” technique of problem-based learning method and cooperative learning method were applied and compared. In the light of this independent variable, students' attitudes towards science lesson and their attitudes towards the lesson were also examined as dependent variables.

### 2.2. Data collection tools

In the research, the Achievement Test on the "Journey to the Internal Structure of Matter", which was prepared to collect the data, was used. The 3 goals determined in the section related to the “Journey to the Internal Structure of Matter” unit prepared by the Ministry of National Education's Board of Education, for the science lesson and taught in 7th grades, and 12 student acquisitions in line with these goals were based on. Using the primary school textbooks and test books, a 30-question achievement test was prepared taking these goals into consideration. In the preparation of the questions, it was made by taking advantage of the opinions of 4 experts, 2 of whom were faculty members and 2 of them were science teachers.

These prepared questions were applied to 103 students studying in the 8th grade of the school where the research was conducted. According to the students' answers, the reliability of the test was determined with the statistical package program SPSS-12, and the reliability coefficient of the questions (croncbah alpha) was found as $\alpha = 0.823$. This prepared 30-question achievement test was applied to 7th grade (6 branches) of Governor Necati Çetinkaya Primary School as a pre-test. According to the findings of the students' pre-test scores, the two classes with the closest success averages were selected for the research. Later, some of the

students in these classes who scored at the most extreme points in the achievement test were excluded from the experiment and their number of students (28 students) and their achievement score averages were equalized (18.14). In which class the PBL method and in which class the course will be taught with the Lecture method was determined by drawing lots. The research was carried out with a total of 56 students, 28 from each class.

2.3. Teaching material used in the CL and PBL group

Preparation of the teaching material used took approximately 1 month. The outline of the subject in which the material is prepared;

- Classification of Substances as Solid, Liquid and Gas
- Physical and Chemical Changes
- Physical Separation of Mixtures
- Chemical Separation of Compounds
- Creating Compounds from Elements

It was determined as. Scenarios were prepared for the students in PBL method with the help of experts on these issues. The students in both groups were assisted in obtaining resources, and some addresses were given to the students who will obtain information from the computer.

2.4. Data collection process

In the study; 30-question achievement test with a reliability coefficient of $\alpha = 0.823$ was used to establish groups, determine the success at the end of the trial and the level of recall after the end of the trial. According to the answers given by the students to these questions, the effects of PBL and cooperative learning methods on students' success were determined. The course duration with different methods took 5 weeks. During the application process, the courses were taught to the students in the experimental group with a problem-based learning approach prepared in accordance with the science education program, and to the students in the control group with a cooperative method. The same success test was applied to the experimental and control groups again 10 weeks after the end of the trial and the permanence status of the learned was determined. On the other hand, the 30-item science attitude scale ($\alpha = 0.786$), which was used by Yurdanur Altunay (2006) in the master thesis, was used at the beginning and at the end of the experiment to determine students' attitudes towards science lesson [3].

2.5. Working group

The study group of the research consisted of 7th grade students of Governor Necati Çetinkaya Primary School, one of the Primary Schools in Konya. Two of the 7th grades in this school were divided into selected classes as a control and experimental group. A total of 56 students, 28 students in both classes, participated in the study.

2.6. Analysis of the data

The students' scores from the pretest, posttest, recall and attitude scale were analyzed using the statistical package program SPSS 12.0. In the achievement and recall test, the correct answers were coded by giving the correct answers 1, and each question they answered incorrectly was coded by giving the value of 0. The attitudes towards the science lesson were evaluated with a triple scale, which is expressed as "I agree" 3, "I agree moderately" 2, "I disagree" 1. It was coded by giving the values of the positive items 3 to 1 respectively, and the options of the negative items by 1 to 3 values. The highest total score (90) for positive attitudes is the lowest total score (30) for negative attitudes. In the evaluation of the data, independent groups t-test analysis was used for inter-group comparisons, and dependent groups t-test analysis was used for intra-group comparisons.

**3. Results and Analysis**

3.1. Findings Regarding the Scores Taken from the Science Achievement Test

In this section, the findings obtained from the achievement test performed before and after the application and the recall test applied after 10 weeks are included in order to examine the effects of the CL and PBL methods in terms of the success, attitude and the permanence of the learned lessons. In addition, the findings of the attitude scale applied at the beginning and end of the research are also included in this section.

Table 1. Independent groups t-test analysis results based on pre-test achievement scores related to the journey to the internal structure of the item of the groups applied in the CL and PBL methods(over 30 points)

| | Group | N | Mean | Standart Error | Sd | t | P |
|---|---|---|---|---|---|---|---|
| Pre-test | CL | 28 | 18.14 | ± 0.56 | 54 | 0.000 | 1.000 |
| | PBL | 28 | 18.14 | ± 0.40 | | | |

As seen in Table 1, the pre-test average scores and standard deviations of the students in the group who applied the PBL method were 18.14 ± 0.40, whereas the pre-test average scores and standard deviations of the students in the group with the CL method were 18.14 ± 0.56. Here, the achievement point averages of both groups at the beginning of the experiment were adjusted to match. Therefore, there is no significant difference between the two. (t = 0.000; P = 1.000, p> 0.05).

Table 2. Independent groups t-test analysis results (based on 30 points) organized according to the posttest achievement scores related to the journey of the substance to the internal structure of the groups applied to the CL and PBL methods.

| | Group | N | Mean | Standart Error | Sd | T | P |
|---|---|---|---|---|---|---|---|
| Post test | CL | 28 | 25.36 | ± 0.70 | 54 | 0.817 | 0.417 |
| | PBL | 28 | 24.54 | ± 0.72 | | | |

In Table 2, the results of the analysis made by independent groups t-test of the post-test scores of the science achievement test of the students in the groups applied to the CL and PBL methods are shown. While the post-test mean score of the group with the CL method was 25.36 ± 0.70, the post-test mean score of the group with the PBL method was 24.54 ± 0.72. No significant difference was found between the average scores of the students in the groups in which the PBL method and the CL methods were applied, regarding the journey to the internal structure of the item. (t = 0.817; P = 0.417, p> 0.05).

Table 3. Dependent groups t-test analysis results based on the pre-test and post-test achievement scores of the students in the group applied to the CL method regarding the journey to the internal structure of the substance (over 30 points)

| Group | Application | N | Mean | Standart Error | Sd | T | P |
|---|---|---|---|---|---|---|---|
| CL method | Pre test | 28 | 18.14 | ± 0.56 | 27 | -10.387 | 0.000 |
| | Post test | 28 | 25.36 | ± 0.70 | | | |

Table 3 shows the results of the dependent groups t-test analysis arranged according to the pre-test and post-test achievement scores of the students in the group in which the CL method was applied. While the pre-test average scores of the students in the group who applied the CL method were 18.14 ± 0.56, the post-test average scores were 25.36 ± 0.70. There is a significant difference between the pre-application and post-application success scores of the students in the group in which the CL method was applied (t = -10.387; P = 0.000, p <0.05). After five weeks of practice, the success of students who taught in a collaborative way has increased significantly.

Table 4. Dependent groups t-test analysis results based on the pre-test and post-test achievement scores of the students in the group where the PBL method was applied, regarding the journey to the internal structure of the substance (over 30 points)

| Group | Application | N | Mean | Standart Error | Sd | t | P |
|---|---|---|---|---|---|---|---|
| PBL method | Pre test | 28 | 18.14 | ± 0.40 | 27 | -6.818 | 0.000 |
| | Post test | 28 | 24.54 | ± 0.72 | | | |

Table 4 shows the results of the dependent groups t-test analysis of the pre-test and post-test achievement scores related to the journey of the substance to the internal structure of the students in the group in which the PBL method was applied. While the pre-test average scores of the students in the group with PBL method were 18.14 ± 0.40, the post-test average scores were 24.54 ± 0.72. As a result of the application, the achievements of the students in the group who applied PBL method increased significantly (t = -6.818; P = 0.000, p <0.05).

Table 5. Independent groups t-test analysis results (based on 30 points) organized according to the recall test achievement scores related to the journey of the substance to the internal structure of the students in the groups where the PBL and CL methods were applied.

| | Group | N | Mean | Standart Error | Sd | t | P |
|---|---|---|---|---|---|---|---|
| Recall test | CL | 28 | 23.29 | ± 0.92 | 54 | 0.649 | 0.519 |
| | PBL | 28 | 22.46 | ± 0.87 | | | |

Table 5 shows the results of independent groups t-test analysis of the recall test achievement scores regarding the journey to the internal structure of the substance in the groups in which the CL and PBL methods were applied. The mean scores of the recall test of the students in the group who applied the CL method were 23.29 ± 0.92, and the mean scores of the recall test of the students in the group that applied the PBL method was 22.46 ± 0.87. As a result of the recall test performed 10 weeks after the application: There was no significant difference in the scores of the students in the group who applied the CL method compared to the students in the group who applied the PBL method (t = 0649; P = 0.519, p> 0.05).

Table 6. Dependent groups t-test analysis results based on the pre-test and recall test achievement scores of the students in the group applied to the CL method regarding the journey to the internal structure of the item (over 30 points)

| Group | Application | N | Mean | Standart Error | Sd | t | P |
|---|---|---|---|---|---|---|---|
| CL method | Pre test | 28 | 18.14 | ± 0.56 | 27 | -6.033 | 0.000 |
| | Recall test | 28 | 23.29 | ± 0.92 | | | |

Table 6 shows the results of the dependent groups t-test analysis of the pre-test and recall test achievement scores related to the journey of the substance to the internal structure of the students in the group in which the CL method was applied. While the pre-test average scores of the students in the group who applied the CL method were 18.14 ± 0.56, the mean scores of the recall test were 23.29 ± 0.92. It is seen that the scores of the students in the group applied to the CL method from the recall test have a significant difference compared to the pre-test (t = -6.033; P = 0.000, p <0.05). This result shows that the control group students did not fall down to their first knowledge even after 10 weeks.

Table 7. Dependent groups t-test analysis results based on the pre-test and recall test achievement scores of the students in the group where the PBL method was applied, regarding the journey to the internal structure of the substance (over 30 points)

| Group | Application | N | Mean | Standart Error | Sd | T | P |
|---|---|---|---|---|---|---|---|
| PBL method | Pre test | 28 | 18.14 | ± 0.40 | 27 | -4.733 | 0.000 |
| | Recall test | 28 | 22.46 | ± 0.87 | | | |

Table 7 shows the results of the t-test analysis of the dependent groups between the pre-test regarding the science knowledge and the recall test achievement scores of the students in the PBL method. While the pre-test average scores of the students in the group with PBL method were 18.14 ± 0.40, the mean scores of the recall test were 22.46 ± 0.87. It is seen that there is a significant difference between the pre-test and recall test scores of the students in the group in which the PBL method was applied (t = -4.733; P = 0.000, p <0.05). This result shows that the experimental group students do not fall down to their first knowledge even after 10 weeks.

Table 8. Dependent groups t-test analysis results based on the post-test and recall test achievement scores of the students in the group applied to the CL method on the journey to the internal structure of the substance (over 30 points)

| Group | Application | N | Mean | Standart Error | Sd | t | P |
|---|---|---|---|---|---|---|---|
| CL method | Post test | 28 | 25.36 | ± 0.70 | 27 | 3.108 | 0.004 |
| | Recall test | 28 | 23.29 | ± 0.92 | | | |

Table 8 gives the results of the t-test analysis of the dependent groups regarding the post-test and recall test achievement scores of students in the group in which the CL method was applied. While the posttest mean scores of the students in the group with CL method were 25.36 ± 0.70, the mean scores of the recall test were 23.29 ± 0.92. There is a significant difference between the posttest and recall test achievement scores of the students in the group with CL method ($t = 3.108$; $P = 0.004$, $p < 0.05$). This result shows that students who teach lessons with the CL method have forgotten some of what they have learned for 10 weeks.

Table 9. Dependent groups t-test analysis results based on the post-test and recall test achievement scores of the students in the group applied to the PBL method on the journey to the internal structure of the substance (over 30 points)

| Group | Application | N | Mean | Standart Error | Sd | t | P |
|---|---|---|---|---|---|---|---|
| PBL method | Post-test | 28 | 24.54 | ± 0.72 | 27 | 2.194 | 0.037 |
| | Recall test | 28 | 22.46 | ± 0.87 | | | |

Table 9 gives the results of the t-test analysis of the dependent groups regarding the post-test and recall test achievement scores of students in the group in which the PBL method was applied. While the posttest mean scores of the students in the group with PBL method were 24.54 ± 0.72, the mean scores of the recall test were 22.46 ± 0.87. There is a significant difference between the posttest and recall test achievement scores of the students in the group with PBL method ($t = 2.194$; $P = 0.037$, $p < 0.05$). This result shows that students who teach lessons with the PBL method have forgotten some of what they have learned for 10 weeks. Students' forgetting what they have learned after a certain period of time can be considered as the usual situation seen in most methods.

3.2. Findings Regarding Students' Attitude Scores Regarding Science Course

This section includes attitudes towards Science Lesson with CL and PBL methods.

Table 10. Independent groups t-test analysis results based on first attitude test scores of students in the applied groups of CL and PBL methods (out of 90 points)

| Group | N | Mean | Standart Error | Sd | T | P |
|---|---|---|---|---|---|---|
| CL first attitude | 28 | 70.86 | ± 2.21 | 54 | -1.882 | 0.070 |
| PBL first attitude | 28 | 77.11 | ± 2.56 | | | |

Table 10 shows the results of the independent groups t-test analysis of the first attitude scores of the students in the groups applied to the CL and PBL methods. While the average attitude scores of the students in the group who applied the CL method was 70.86 ± 2.21, the average attitude scores of the students in the group that applied the PBL method was 77.11 ± 2.56. There is no significant difference between PBL and IR methods in terms of attitude before application ($t = -1.882$, $P = 0.070$, $p > 0.05$).

Table 11. Independent groups t-test analysis results based on the final attitude test scores of the students in the applied groups of CLand PBL methods (out of 90 points)

| Group | N | Mean | Standart Error | Sd | T | P |
|---|---|---|---|---|---|---|
| CL final attitude | 28 | 74.04 | ± 2.22 | 54 | -2.091 | 0.041 |
| PBL final attitude | 28 | 79.89 | ± 1.70 | | | |

Table 11 shows the independent groups t-test analysis results of the students' post-application attitude scores towards post-application science knowledge. While the final attitude average scores of the students in the group applied to the CL method were 74.04 ± 2.22, the final attitude average scores of the students in the group that applied the PBL method was 79.89 ± 1.70. There is a significant difference in favor of PBL between groups, where PBL and CL methods were applied (t = -2.091, P = 0.041, p <0.05). This shows that when both methods are compared, PBL creates a positive result compared to the other in terms of attitude.

Table 12. Dependent groups t-test analysis results arranged according to the scores of first attitude and last attitude test of students in the group applied to the CL method (out of 90 points)

| Group | Application | N | Mean | Standart Error | Sd | t | P |
|---|---|---|---|---|---|---|---|
| CL method | First attitude | 28 | 70.86 | ± 2.21 | 27 | -1.882 | 0.071 |
| | Last attitude | 28 | 74.04 | ± 2.22 | | | |

Table 12 shows the results of the dependent groups t-test analysis arranged according to the scores of the first attitude and final attitude test scores of the students in the group in which the CL method was applied. While the average attitude average scores of the students in the group who applied the CL method was 70.86 ± 2.21, the average attitude average scores were 74.04 ± 2.22. No significant difference was found in terms of the attitudes of the students in the group who applied the CL method before and after the application (t = -1.882, P = 0.071, p> 0.05). If the attitudes are thought to change in a long time, it can be accepted that the research period cannot create a sufficient time for attitude change.

Table 13. Dependent groups t-test analysis results arranged according to the scores of first attitude and last attitude test of students in the group that applied PBL method (over 90 points)

| Group | Application | N | Mean | Standart Error | Sd | T | P |
|---|---|---|---|---|---|---|---|
| PBL method | First attitude | 28 | 77.11 | ± 2.56 | 27 | -1.612 | 0.119 |
| | Last attitude | 28 | 79.89 | ± 1.70 | | | |

Table 13 shows the results of dependent groups t-test analysis arranged according to the scores of first attitude and last attitude test of students in the group that applied PBL method. While the average attitude scores of the students in the group with PBL method were 77.11 ± 2.56, the average attitude scores of the last attitude was 79.89 ± 1.70. There is no significant difference in the pre-post and post-application attitudes of the students in the group who applied the PBL method (t = -1.612, P = 0.119, p> 0.05). Again, we can think that the implementation period is not enough to change the attitude.

When our findings are summarized;

1. There is no significant difference between the pre-test achievement scores of the students who are taught with PBL and CL methods.
2. There is no significant difference between the students who learn with the CL method and the students who learn with the PBL method in science lesson (P> 0.05).
3. Science achievement post-test scores of students who have applied PBL method are significantly higher than pre-test scores. This is an expected situation.
4. Science achievement post-test scores of students who are applied to the CL method are significantly higher than pre-test scores. This is an expected situation.
5. There is no significant difference between the recall test scores of the students who are taught with PBL and CL methods.
6. There is a significant difference between the recall test scores and post-test scores of the students who applied the PBL method.

7. There is a significant difference between the recall test scores and post-test scores of the students who applied the CL method.
8. There is a significant difference between the recall test scores and the pre-test scores of the students in the group that applied the PBL method. The information learned by the students did not decrease to the first level after 10 weeks.
9. There is a significant difference between the recall test scores and the pre-test scores of the students in the group in which the CL method was applied. This result shows us that the students' knowledge they have learned does not fall to the first level even after 10 weeks.
10. There is no significant difference between the pre-test scores of the attitude scale of the students who applied PBL and CL methods.
11. There is a significant difference between the post-test scores of the attitude scale of the students who applied PBL and CL methods (P = 0.041). This difference is in favor of the PBL method. In other words, the PBL method has created a better attitude than the other method.
12. The science attitude scale post-test scores of the students in the group in which the CL method was applied are not different from the pre-test scores.
13. Science-attitude scale posttest scores of the students in the group with PBL method are similar to the pre-test scores. There is no significant difference.

**4. Conclusion**

In this study, the students will be taught how to teach the science lesson with PBL method. It is aimed to compare the achievements, attitudes towards this course and their effects on the levels of remembering what has been learned. In many studies conducted so far, the traditional method and the PBL method have been compared. In our study, it was aimed to reveal the superiority of the two effective methods over each other, whether the students' achievements and attitudes also make a difference. The common feature of both methods is to enable students to learn better and more permanently.

The findings we obtained from our research revealed that both the PBL method and the CL method are effective in increasing students' achievements and recalls on the Journey to the Internal Structure of Matter. Our study is compatible with the findings of previous studies in which the effect of PBL method on students' science achievement was investigated[4], [5] , [8], [10],[19], [22], [27]. The results we obtained in the CL methodare similar to the studies performed[7], [14], [18] , [20], [23].

Although there is no difference between these two methods in terms of success, the significant difference between pre-test and post-test reveals that both methods increase success. Being student-centered in the two methods may have caused a reason for their success to be similar.

In this study, there was no difference between the recall test findings in both methods, but there was also a difference between the post-test recall test and the pre-test-recall test findings. These results show us that, in both methods, all information is not completely in mind, but is largely absent. We understand this from the meaningful difference between pre-test and recall test. According to these findings, the information learned after 10 weeks did not fall down to the prior knowledge level.

In our study, a significant difference was found between the post-test scores of the attitude scale of the students who applied PBL and CL methods. However, there was no change in the attitude scores of the students between the pretest and posttests in both methods. When comparing both methods with each other, the positive difference in favor of PBL compared to the other may lead to the conclusion that PBL method has a better attitude towards science lesson than the CL method. When the findings of previous studies investigating the effect of PBL method on students' attitudes towards science lesson are examined, it shows that there are similarities with our study [5],[10],[13],[24].. The reason for the attitude not changing in this research may be that the attitudes may not change in a short time.

As a result; There was no difference between the students who were taught with the PBL method and the students who were taught with the CL method in their attitudes towards success and science.Since the PBL method is difficult to apply to all sections within the units in terms of scenario and time, it should be supported by other methods. The CL method should be supported by other methods for similar reasons.With the scenarios prepared in the PBL method, better and permanent learning can be provided to the students. As long as these scenarios cover the whole subject in detail, it can be thought that it will make it easier for learners to reconcile what they have learned with life.Cooperative and problem-based learning method can be used in other lessons to make it easier for students to adapt to these methods.Presenting these methods, which are applied in many fields, in a combination of different methods in science lessons book, can provide better and permanent learning.

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