

Learning Implementations about Cooperative Learning Method: A Case Study in Turkey

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Abstract

This study aims to evaluate the implementations of cooperative learning method in teaching limit and derivatives and the opinions of prospective teachers and instructors about these implementations. The research is designed as a case study and conducted with 28 prospective teachers (20 female, 8 male) who were attending the course of calculus in the department of science and technology teaching. The data obtained by interviews and observations were analyzed via content analysis. According to results, it was found out that the implementations of cooperative learning method created a positive effect on prospective teachers and made them learn the subjects more easily. On the basis of the results mentioned above, it can be recommended to use the cooperative learning method in teaching the subjects of limit and derivatives in teacher education. This study focused on teaching the subjects of limit and derivative; however similar studies can be carried out with different mathematics topics.

Keywords: Calculus, case study, cooperative learning, student teams-achievement divisions.

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Introduction

Learning mathematical concepts and skills is an active process, not a passive one. Students construct knowledge through their experiences during lessons (Johnson & Johnson, 1991). When the methods and techniques requiring active participation of students to lessons are used, they learn and remember better and faster and they enjoy learning. In Turkey, however, it can be said that a teacher centred education is being conducted in higher education institutions and the students generally follow the lessons as audiences instead of active participants. On the other hand, it is well-known that mathematics topics are the ones which can be learnt meaningfully by the students' participations to the activities, solving the questions and discussing the results.

The significance of students' active participation in the learning and teaching activities has been noticed in Turkey in recent years. Accordingly, the elementary, secondary and high school curriculums have been re-designed in order to provide the students with opportunities to participate in learning and teaching activities. In this context, it is stated in the mathematics curriculum (MoNE, 2018a) that mathematics considers the students as the center and pays attention to the conceptual understanding. Also, students' way of verbal expressing of themselves has an important place in internalizing, understanding and structuring the mathematical concepts. In addition, it is also recommended in the curriculum that the students should exhibit how they structured the concepts in this process and they should be encouraged to communicate personally and inter-personally.

Teacher competencies are another important issue which has been discussed in Turkey in recent years. Teacher competencies are explained as "General Competencies of Teaching Profession" and "Subject Area Competencies" in details in the documents which were published by the Ministry of National Education (MoNE, 2018b). These documents show the importance that the Ministry of National Education, which is the biggest employer and which plays an important role in the planning of education, gives to the teacher competencies. The importance of the teachers' acquiring both subject area competencies and general competencies of teaching profession during their training has become more apparent. In this context, it is thought that the teachers' both being in effective learning environments which will enable them to acquire strong subject knowledge and experiencing the effective learning environments and transferring these experiences into their future teaching careers are important. In this context, cooperative learning method is one of the methods which provides students with active participation to lessons and supports in-class discussions.

Cooperative learning method is used prevalently in many subject areas and class levels. One of the reasons of this is that it has positive effects on academic success (Sharan, 1980; Slavin, Madden and Leavey, 1984; Leikin and Zaslavsky, 1997; Johnson and Johnson, 1981; Johnson and Johnson, 1989; Tarım, 2003; Tarım and Artut, 2004; Artut and Tarım 2007, Artut, 2009; Häsel-Weide and Nührenbörger, 2013). Although the studies about this learning method were focused on elementary and secondary education, it is expressed in discussions about the benefits of this method that it can also be implemented in higher education classes (Artut, 2016, Artut and Tarım, 2007; Emley, 1987; Garfield 1993; Johnson, Johnson and Smith 1998; Johnson, Johnson, and Smith, 2013; Kaptan and Korkmaz, 1995; Van Voorhis 1995).

Cooperative learning method is one in which small groups of students and their peers are used to maximize their learning (Johnson, Johnson and Smith, 1991). In the classrooms in which cooperative learning method is used, the students are expected to discuss, help each other, evaluate other students' knowledge and try to fulfil each other's deficiencies (Slavin, 1995).

Cooperative learning has many different forms, such as Jigsaw, Cooperative Integrated Reading and Composition (CIRC), Teams-Games-Tournament (TGT), Learning Together (LT), Team Assisted Individualization (TAI), Academic Controversy (AC), Group Investigation (GI), Student Teams-Achievement Divisions (STAD), etc. (see Kagan [1992] for more details).

In addition to many other fields, STAD can be used in mathematics. By the help of STAD, students interact mutually, become responsible for each other's learning and they develop their other skills. In the practice of STAD, students start working in their teams and attempt to complete the task given to them on their own after the teacher's presentation of the topic. During this process, they are also responsible for their friends in the same group to contribute to the accomplishment of the task as best as they can. In the last phase, the students are supposed to have a quiz in which they are not allowed to help each other in the group (Slavin, 1990).

In line with the explanations above, it was aimed to implement Student Teams-Achievement Divisions (STAD), which is a technique in cooperative learning method, in the teaching of limits and derivatives topic in the course of calculus of the prospective teachers who were attending the department of science and technology teaching and to evaluate the opinions of the prospective teachers and instructors about this implementation.

Method

This study was designed as a case study. Case study is a method in which one or more than one cases, environments or interactive groups are investigated profoundly. A complex or a special case is investigated in their own conditions in this method (Sönmez & Alacapınar, 2013; Fraenkel & Wallen, 2009). The reason of preferring the case study method in researches is why it enables to investigate a case or a fact profoundly which is based on the questions of "how" and "why" and which cannot be controlled by the researchers (Yıldırım & Şimşek, 2000). This research investigated the implementation process of Student Teams-Achievement Divisions (STAD) technique in the general mathematics class of the first grade students who got certain marks and entitled to get education in the science and technology department of the education faculty in a state university. In this context, the sample of this study consisted of 28 first grade students (20 female, 8 male) who were attending to the general mathematics class in the science and technology department.

Interview form

In this research, an interview form which was developed by the researchers was used so as to determine the opinions of prospective teachers about working in groups based on cooperation while learning mathematics. Here are some of the questions from the interview form:

- Do you prefer working and solving the questions about limits and derivatives in groups or following the questions the teacher solve as in previous implementations? Why?
- Do you think working with your group friend on questions about limits and derivatives as it was implemented in this lesson has an effect on your understanding the topics? How?

Observation

Throughout the research, each session was observed by one of the researchers. A standard observation tool was not used in the study. During the unstructured observation, the relationships and behaviours between the prospective teachers were recorded in written.

Teaching Methods and Implementation

In line with the explanations above, the instruction schedule was developed by following the steps below.

1. Step (Formation of the clusters): The clusters of four prospective teachers were formed by the researchers heterogeneously considering the variables of academic success and gender. After the clusters were formed, cluster working guides were given to every cluster.

2. Step (Instructor presentation): In the first two class hours of the course of calculus I-II which is four class-hour a week, lecturing was done by one of the lecturers. In the rest two class-hour, the clusters worked on the worksheet which was prepared in accordance with the task as explained below.

3. Step (worksheets):

There are two collateral small boxes in which two equivalent questions are asked. Two prospective teachers from each cluster answered the questions in the worksheet together. The first prospective teacher answered the question in the first box and the second prospective teacher answered the question in the other box. While the first prospective teacher was solving the question in the first box, the other prospective teacher was watching him/her. While the first prospective teacher was solving the question step by step, he explained the solution of the problem to his/her friend. If the first prospective teacher was solving the question incorrectly or making a mistake, the other prospective teacher helped him/her. After the first prospective teacher finished solving the question, the second prospective teacher started solving the question in his/her box. This time, the first prospective teachers tried to help the second prospective teacher. By this way, all questions were solved in return. The other two prospective teachers in the same cluster solved all the questions in worksheet in the same way. After both worksheets in the cluster finished, they checked each other's worksheets mutually.

1. Step (Quiz): All prospective teachers were given a quiz about the topic covered individually every other week.

2. Evaluation: Through the interview form below, the opinions of the prospective teachers were taken about the implementation with worksheets as mentioned above.

Data Analysis

The data obtained by interviews and observations were analyzed via content analysis, a qualitative research data analysis method. The data were evaluated with constant comparative method in order to make content analysis. Through this way, themes and codes were constituted by comparing the data in the interview form. The data obtained from the prospective teachers were coded so as to present and not to create disruption without revealing the identities of the prospective teachers. Therefore, the first student who was interviewed was coded as "PT1", the other prospective teachers were coded as "PT2, PT3" in the same way according to their turn in interviews.

Results

In this study in which the evaluation of the implementation of Student Teams-Achievement Divisions technique in the instruction of limits and derivatives, the data obtained were presented under two titles as interview and observation findings.

Interview findings

The codes and themes which were formed through the analysis of the data obtained from the interviews were given in Table 1.

Table 1. The codes and themes about the interview form

Theme	Code
Learning process	It fertilizes learning
	It facilitates learning
	It makes learning permanent
	It provides active participation in the process
Cooperating and sharing	Offering help to his/her friends
	-bilgi alışverişini kolaylaştırıyor
	-Arkadaşımı izlerken öğrendiği fark ettim
	We discuss our results together
Participating of each student	Participating in the work,
	Willing to complete the task
	Completing his/her task

When Table 1 was considered, it was seen that the interviews with the students were collected under three themes as learning process, cooperating and sharing and participating of each prospective teacher. Four codes were used in the theme about learning process. In this context, 21 of the prospective teachers who participated in the research stated that the method which was implemented fertilized learning, 19 of them expressed that it facilitated learning, 14 of them told that it made learning permanent and 8 of them remarked that it provided active participation in the process. For example, some of the students' opinions are as follows:

-From my point of view, the lessons are much more productive than the ones before. I realized that I can learn more easily this way (PT2).

-In the previous implementations, lecturer of the lesson used to solve the questions about the topic by himself/herself; we used to watch and I used to think I learnt the topic. Later, I had a lot of difficulty when I tried to solve a question about the topic. By the help of this method, I try to solve the question with my friend since I am active in the process instead of just watching (PT 10).

-As students have feelings for other students, I think I can understand better this way (PT 21).

When Table 1 was taken into account, the theme of cooperating and sharing consisted of two codes. In this context, it was seen that 22 of the students declared that they offered help to their friends and 7 of them stated that this method provided them with discussion about the topic together with their friends. For example, some of the students' opinions are as follows:

-When I had difficulty while solving the question in my box in the worksheet, my friend offered help to me. I also offered help to my friend when s/he had difficulty (PT11).

-After completing the task given to us, we shared our results with each other and discussed on them. That was really useful (PT 7).

When Table 1 is considered, three codes are seen in the theme of participating of each student. In this context, it is seen that all of the students expressed that they participated in the tasks given to them, 24 of them told that they completed the tasks ambitiously and 28 of them remarked that they completed the tasks given to them. For example, some of the students' opinions are as follows:

-I participated in all the tasks ambitiously and I could complete (PT 15).

-I really enjoyed every task given to me during these studies (PT 5).

Observation findings

The results of content analysis based on the data obtained from the observations throughout the research process were collected under two titles as learning process and cooperating and sharing.

i. Learning process: The observations showed that all of the students participated in the tasks, worked on the tasks carefully and they tried to complete the tasks by checking the notes that they took in the lessons and their course books when they could not solve the questions. Another situation that was observed was the students' more careful behaviours about attendance.

ii. Cooperating and sharing: The observations revealed that while the students were working on the tasks given to them in groups of two, one of them tried to help the other while watching his/her friend trying to solve question and they worked on the tasks given cooperatively. It was also observed that the groups of two tried to cooperate with the other groups after asking for help from the other group of two in their group when they could not solve a question. It was often observed that they tried to compare their results with the other groups to check its correctness. The following dialogue was observed between two students in the same group during the studies based on cooperation.

PT 3: I cannot solve this question. Do you have an idea?

PT 7: I cannot solve the question, either. Let's ask the other friends in our group.

PT 3: OK.

Another mutual dialogue was observed as below.

PT 12: I wonder if this way of solving this question correct? I am not sure.

PT 21: I am not sure, either. Why don't we compare it with the results of other groups?

Conclusion and Recommendation

According to the students' views, the findings of this study revealed that the lesson implementations based on Student Teams-Achievement Divisions technique resulted in a positive effect on the students' learning the subject of limit and derivatives. This finding is consistent with the literature findings (Sharan, 1980; Slavin, Madden, & Leavey, 1984; Leikin & Zaslavsky, 1997; Johnson & Johnson, 1981, 1989; Tarim, 2003; Artut & Tarim, 2007, Artut, 2016) suggesting that cooperative learning method was effective on mathematics teaching. It is believed that this positive effect might have been produced as the learning environment enables the pre-service teachers' active participation in the classes.

Both the interview and observation findings of this research presented that cooperative learning environment supports the pre-service teachers' active participation in the classes. Similarly, Cavanagh (2011) propounded that the cooperative learning environment encourages the students' active participation in the classes. In addition, according to Gilbert-Macmillan (1983), students were given opportunities in cooperative learning method for thinking aloud and this method presented environments to come across different ideas and concentrated on the problem-solving process more than the answer of the problem. In this study, it was found out that the views of the prospective teachers were also in line with this direction. The prospective teachers expressed that they shared their point of views effortlessly while they were working together, discussed on the questions for long and contributed in effective discussions on particularly defining the strategies to implement while solving the problem and the appropriateness of the results they reached. Moreover, Dimabuyo and Portia (2011) mentioned that in cooperative learning method, students were more actively busy with communicating with each other, so it helped their mathematical communication to develop.

In this research, it was revealed that the prospective teachers were able to understand the subjects which they hadn't understood before by cooperating with their group friends more easily. One of its reasons can be the peer interaction which was expressed by a prospective teacher as "I think I can understand better this way as the students can understand each other better (S21)". It can be said that this study is consistent with the literature findings that show working in cooperative learning environment increases the peer interaction.

The observation findings of this research showed that all of the students worked on the task cooperatively, they completed the task, they helped each other and they shared the results they obtained with the other groups. For example, one of the prospective teachers stated his opinion as "After completing the task, we shared our conclusions with each other and we discussed on the results. This was very beneficial for us (PT2)". Accordingly, it can be said that this process might have resulted in a positive effect on their understanding the subject.

There are many studies which show that cooperative learning method has a positive effect on developing positive attitudes towards mathematics class (Gelici & Bilgin, 2012; Gök, Doğan, Doymuş & Karaçöp 2009; Lazrowitz, Lazarowitz & Baird, 1994; Nichols & Hall 1995; Tlusty 1993; Ural 2007; Yıldırım 2011). In this study, the prospective teachers expressed that they enjoyed studying on the tasks with their opinions as "I was willing to participate in all of the tasks given and I was able to complete them (PT15)" and "I really enjoyed completing every task during these studies (PT5)". This can be considered as an indication of the prospective teachers' developing positive attitudes towards mathematics class.

Consequently, it can be said that studying in groups based on cooperation affected the pre-service teachers' learning the subjects of limit and derivatives positively. On the basis of the results mentioned above, it can be recommended to use the cooperative learning method in teaching the subjects of limit and derivatives in teacher education. This study was conducted on teaching the subjects of limit and derivatives. Similar studies can be carried out on different mathematics topics. In line with the results of this study, it can be recommended to conduct an experimental study which examines the efficacy of this method in teaching the subjects of limit and derivatives.

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