Volume-3, Issue-8, August-2014 • ISSN No 2277 - 8160

Research Paper Education

Influence of The Subject Jigsaw Technique on Elementary School Seventh Grade Students' Academic Achievement and on Their Problem Solving Skills

Dr. Oğuzhan Sevim

Atatürk University, Kazım Karabekir Education Faculty, Department of Turkish Education, Turkey

ABSTRACT

The purpose of this study was to examine the influence of the subject jigsaw technique on elementary school seventh grade students' academic achievements and on their problem solving skills. The study was carried out on the basis of a quasi-experimental design with a pretest-posttest control group. The study group made up of control and experimental groups of 16 students in each included a total of 32 students. The research data were collected with the Narration Types Achievement Test, Problem Solving Inventory for Children and Student Interview Form for Process. Predictive statistics for the analysis of the quantitative data and the descriptive analysis technique for the qualitative data were applied. The results revealed a significant difference both in the experimental and control groups in terms of achievement before the application. On the other hand, with respect to problem solving skills, only in the experimental group was a significant difference found.

KEYWORDS : Subject jigsaw technique, elementary school seventh grade students, academic achievement, problem solving skills

Introduction

In today's learning environments in which different instructional strategies and methods are used, a learning method which has been common and popular since its first appearance in related literature is the cooperative learning method. Today, it is a well-known fact that the reason for such frequent use of the cooperative learning method applicable in all school levels from elementary school to university level is that students decide to solve a problem in the light of problem solving methods by defining that problem during group works, that they help one another during this process and that they thus become aware of various ways of learning (Osgood, Mitchell & Anderson, 2005; Watanabe et.al., 2007). Development and application of effective ways of problem solving play an important role in achievement.

The cooperative learning method, which paves the way for an experimental learning environment by making it compulsory for students to take active part in activities in the learning environment, allows students to transfer their knowledge easily into different applications (Sönmez, 2005). In this process, while trying to carry out activities both individually and as a group for common purposes, students use their communication skills as they are responsible for each other's learning. This contributes to the development of their oral communication skills (Bershon, 1992).

It would not be right to regard the cooperative learning method as a learning method determined with clear norms of application. There are different ways of application of this method. Some of these techniques involving various experiences for different events include Academic Controversy (Johnson & Johnson, 1987), Student Teams-Achievement Sections (Slavin, 1990), Team-Game-Tournament (Slavin, 1978), Group Search (Sharan & Hertz-Lazarowitz, 1980), Learning Together (Johnson & Johnson, 1991) and Jigsaw (Aranson et.al., 1978. These techniques have common features in terms of the application of the cooperative learning principles, yet they differ only with respect to their ways of application regarding the establishment of cooperation.

Differences in application between cooperative learning techniques are apparent even in the ways of application of the Jigsaw technique developed by Aranson and colleagues (1978). This makes it easier for researchers to apply this technique in different learning situations thanks to its flexible structure. These techniques known as Jigsaw, Jigsaw II, Jigsaw III and Jigsaw IV and Subject Jigsaw are generally made up of such steps as forming the groups, dividing the learning material between the group members, forming the expertise groups, preparing and forming reports, completion and evaluation. Jigsaw techniques, in which group members are in need of one another and which thus involve high levels of positive engagement, not only allow frequent use of the cooperative learning method in class but also increase the importance of this method among others.

Another important factor making the cooperative learning method important is that it creates a learning environment in which students can actively use the problem solving skill, one of the basic skills that individuals are expected to acquire in the contemporary understanding of education. Studies conducted revealed that the learning environment plays an important role in the development of problem solving skills (Mayer, 1992). In cooperative learning, the fact that the learning problems identified in the class environment concern all the group members and that this requires interpersonal relationships demonstrates that problem solving is also a social activity (Ellis & Siegler, 1994). While developing academic relationships with each other in mixed groups, students make use of and apply different problem solving strategies of other students in their own problem cases.

The basis of the current understanding of education requires training individuals who are not afraid of problems, who seek for ways to solve the problems and who can develop strategies in cases of failure. One of the main characteristics of problem solver individuals is that they can view problems from different perspectives. People who can view problems from different perspectives are able to interrogate the efficacies of their own and of other people in the problem solving phase (Ünver, 2003), to establish relationships between their views about their past and present experiences as well as their possible future experiences (Wilson & Jan, 1993) and to monitor their own thinking processes while comparing these processes with others' (Cüceloğlu, 2007). All these skills of individuals allow them to develop a plan for solution by using the data collected regarding the problem, to control their own thinking processes during the application of this plan, to revise the deficiencies in the process and to evaluate the process following the application of the plan. The overall purpose in this process is to understand the problem solving phase rather than solving that problem.

In order for students to be successful in their classes and to develop their problem solving skills, they need to encounter problem solving cases in which they can use their skills. Cooperative studies allow students to support each other's learning and to think about the process they work on together (Ünver, 2003). Based on this, it is thought that cooperative learning will have positive influence on students' academic achievements as well as on their problem solving skills. The present study aimed at examining the influence of the subject jigsaw technique, a cooperative learning technique, on students' academic achievements and on their problem solving skills. The research problems were as follows:

1. What is the influence of the subject jigsaw technique on students' academic achievements?

2. What is the influence of the subject jigsaw technique on students' problem solving skills?
3. What are the experimental group students' views about the subject jigsaw study process?

Method

Research Design

The study was carried out based on the quasi-experimental design with the pretest-posttest control group. The students were assigned into the study groups randomly to achieve equality between the groups. In order to assign the students randomly into the groups, the scores obtained by the students via the Narration Types Achievement Test and the Problem Solving Inventory for Children were used. Prior to the experimental process, the students' levels of readiness were determined with the Narration Types Achievement Test and the Problem Solving Inventory for Children. The subject of Narration Types was taught based on the curriculum in the control group, while in the experimental group, it was taught in line with the subject jigsaw technique. The results obtained following the two application processes were analyzed with both intragroup and intergroup comparisons.

Study Group

The study group included 32 seventh grade students attending an elementary school in Yakutiye, a district in the city of Erzurum, in the academic year of 2013-2014. Of all the students in the study group, 16 of them were in the experimental group, and 16 of them constituted the control group.

While determining the experimental and control groups, the scores the students obtained via the Narration Types Achievement Test and the Problem Solving Inventory for Children were taken into account. Of the two groups, which did not lead to any significant difference with respect to the mean scores, one of them was determined as the control group, and the other as the experimental group.

Procedure

In the study, the variable which was examined in terms of its influence was the subject jigsaw technique, one of the cooperative learning techniques. Just like other Jigsaw techniques (Jigsaw I, Jigsaw II, Jigsaw III, Jigsaw IV and Reverse Jigsaw), the subject jigsaw technique developed by Doymuş (2007) appeared based on the differences in the application of the processes of the Jigsaw technique.

The procedure followed for the subject Jigsaw technique applied in the experimental group was as follows:

1st Phase: In this phase, the subject of Narration Types was taken into consideration as the learning material of the course, and the students were randomly divided into four groups each of which was made up of four students. Each of the students in the groups was given a sub-heading of the subject of Narration Types, and a certain amount of time necessary to conduct research was also given to the students.

Table 1. Main Groups in the Research Process

Subject	Main Groups			
	1st Main Group	2nd Main Group	3rd Main Group	4th Main Group
Narrative	A1	B1	C1	D1
Descriptive	A2	B2	C2	D2
Expository	A3	B3	C3	D3
Argumentative	A4	B4	C4	D4

2nd Phase (4 class hours): The students researched the sub-headings given within the allocated time and prepared a report. In order to understand whether the students investigated the subjects given to them, the students (A2, B3, C1 and D4) randomly selected from the groups were asked to present the reports they prepared.

3rd Phase (4 class hours): In this phase, as can be seen in Table 2, the expert groups were formed. Two of the four students who studied on sub-heading and the other two students who studied another sub-heading were selected. In this way, the students in each group expertised on two sub-headings.

Table 2. Expert Groups in the Research Process

Subject	Expert Groups			
	1st Expert Group	2nd Expert Group	3rd Expert Group	4th Expert Group
Narrative	A1 B1	C1 D1		
Descriptive	A2 B2	C2 D2		
Expository			A3 B3	C3 D3
Argumentative			A4 B4	C4 D4

The students A1,B1/C1,D1 taught the narrative type to the students A2,B2/C2,D2, and the students A2,B2/C2,D2 taught the descriptive type to the students A1,B1/C1,D1. Following this, the whole group, deepening their studies, tried to expertise in these two sub-headings (the 1st expert group including the students A1, A2, B1, B2 and the 2nd expert group including the students C1,C2,D1,D2 in the narrative and descriptive types). Similarly, the students A3,B3/C3,D3 taught the expository type to the students A4,B4/C4,D4, and the students A4,B4/C4,D4 taught the argumentative type to the students A3,B3/C3,D3. Afterwards, the whole group, deepening their studies, tried to expertise in these two sub-headings (the 3rd expert group including the students A3,A4, B3, B4 the 4th expert group including the students C3,C4,D3,D4 in the expository and argumentative types).

The expert groups trying to clarify the subject prepared a report telling how to teach this to their peers. As in the second phase, the students A3, B2, C4 and D2 selected randomly from the groups were also asked in this phase to present the reports they prepared.

4th Phase (4 class hours): In this phase, the students completing their studies in the expert groups returned to their main groups. The students returning to their main groups shared their research and their learnings with other group members and tried to teach each other the sub-headings they expertized on.

Table 3. Returning to the Main Groups from the Expert Groups

Student	What to teach (expertise)	What to learn
A1-A2	Narrative-Descriptive	Expository-Argumentative
A3-A4	Expository-Argumentative	Narrative-Descriptive
C1-C2	Narrative-Descriptive	Expository-Argumentative
C3-C4	Expository-Argumentative	Narrative-Descriptive
D1-D2	Narrative-Descriptive	Expository-Argumentative
D3-D4	Expository-Argumentative	Narrative-Descriptive

The students, after studying the whole subject together, prepared summary reports regarding what they had learnt and presented these reports to the class. Following the discussions made regarding the subject, this phase ended.

5th Phase (4 class hours): In this phase, an exam was prepared which all the students would take and which included separate questions for each of the sub-headings of Narration Types. The students took the exam individually, and the evaluations following the exam were made individually as well. As a result of the evaluations, the students who were found to have deficiencies regarding the Narration Types were sent to their groups to cover their deficiencies. Those who studied again and corrected their deficiencies in their groups were given an exam again together with their peers regarding the sub-headings in which they were weak. Following this, individual evaluations were done again.

The procedure followed for the control group:

The subject of Narration Types was taught by the researcher to the control group based on the activity books prepared in line with the curriculum. The lesson plans regarding the subjects to be taught in line with the curriculum were prepared by the researcher considering the outcomes in the curriculum. The theoretical information about the Narration Types was first presented to the students with the direct teaching method. At the end of each lesson, the instructional activities were carried out. Depending on the feedback received from the students, the subject points that they did not understand well were taught again. For four weeks, the learning deficiencies of the students were determined by the researcher with the question-and-answer technique applied before starting the lessons, and the subjects the students failed to learn or remember were taught again briefly.

The application process was conducted in both groups in four class hours a week in a total of four weeks. The applications both in the experimental and control groups were carried out by the researcher. Following the application, the Narration Types Achievement Test and the Problem Solving Inventory for Children were conducted with the experimental and control groups.

Data Collection Tools

Narration Types Achievement Test (NTAT)

In order to determine the students' achievements in the subject of Narration Types, an item pool of 44 items with four choices was formed in line with the seventh grade Turkish Language course books, supplementary books, related websites on the Internet and the related literature. Regarding the item pool formed by the researcher, two faculty members expert in the field of Turkish Language Teaching, three Turkish Language Teachers from the Ministry of National Education and one expert in the field of measurement and evaluation were asked for their views. The questions were examined by this group of six experts in terms of language, content and outcomes. Based on the experts' views, nine questions were excluded from the item pool, the Narration Types Achievement Test was finalized. The achievement test made up of 35 questions was applied to 150 elementary school seventh grade students who were not among the participants of the study, and the data collected were analyzed statistically. During the analyses, the difficulties of the items, item discriminations and total item correlations were examined. In order to determine the item difficulties and item discriminations of the questions, t test applied to determine the level of significance of the difference between the bottom 27% and top 27% of the groups was used, and it was seen that the t test values for each item in the test were found significant at the significance level of 0,05. Table 4 presents the total item correlations, item difficulties, item discriminations and standard deviations regarding the items found in NTAT:

Table 4: Item analyses for the questions found in NTAT

N.	(v)	(p)	(r)	(s)	N.	(v)	(p)	(r)	(s)
1	.55	.60	.59	.29	21	.53	.68	.48	.26
2	.53	.68	.48	.26	22	.44	.66	.40	.34
3	.51	.66	.48	.29	23	.54	.69	.50	.23
4	.45	.60	.44	.38	24	.60	.65	.57	.23
5	.63	.66	.63	.13	25	.63	.43	.51	.26
6	.43	.51	.46	.43	26	.55	.63	.53	.29
7	.60	.63	.53	.29	27	.61	.54	.63	.34
8	.56	.63	.65	.19	28	.68	.65	.53	.26
9	.76	.52	.78	.26	29	.73	.57	.76	.19
10	.68	.57	.73	.23	30	.71	.58	.71	.23
11	.61	.54	.63	.34	31	.60	.63	.61	.23
12	.73	.47	.71	.38	32	.66	.54	.67	.32
13	.43	.54	.44	.42	33	.53	.46	.50	.45
14	.60	.63	.57	.26	34	.71	.52	.71	.32
15	.75	.55	.73	.26	35	.67	.55	.65	.32
16	.55	.50	.53	.42					
17	.57	.32	.36	.45					
18	.43	.42	.46	.48					
19	.42	.56	.44	.41					
20	.65	.48	.65	.39					

N.: Number; v: Total item correlation; p: Item difficulty; r: Item discrimination; s: Standard deviation

The analyses revealed that the total item correlations and the item discriminations of the test items were 35 and higher. This result is thought to demonstrate that all the test items measured the feature intended to be measured (Büyüköztürk, 2006). When Table 4 is examined, it is seen that the difficulty levels of the items ranged between 0,32 and 0,69; in other words, the test had an average level of difficulty.

Problem Solving Inventory for Children (PSIC)

In order to determine the students' problem solving skills, the Problem Solving Inventory for Children (PSIC) developed by Serin, Bulut Serin and Saygılı (2010) was used. The inventory was piloted with fourth, fifth, sixth, seventh and eighth grade students. PSIC was a five-point Likert-Type scale made up of three factors: confidence in problem solving skills, self-control and avoidance. The items found in the scale were responded and scored as 1: I never behave in that way, 2: I rarely behave in that way, 3: I sometimes behave in that way, 4: I frequently behave in that way and 5: I always behave in that way. The scale included a total of 24 items: 12 items in the dimension of confidence in problem solving skills, seven items in the dimension of self-control, five items in the dimension of avoidance. The reliability study for the 24-item scale was conducted, and the Cronbach alpha reliability coefficient was calculated as 0,80. This result shows that the scale had a high level of reliability (Klein, 1998). The highest score to be produced by the scale was 120, and the lowest was 24.

Student Interview Form for the Process (SIFP)

In order to determine the students' views about the studies they conducted as appropriate to the subject jigsaw technique, the literature related to cooperative learning was reviewed, and a nine-item item pool of open-ended questions was formed. Regarding this item pool, expert view was taken. Accordingly, four items were excluded as they did not serve the purpose of the study, and two questions were combined as their meanings were close to each other. The four questions remaining in the final form were directed to the experimental group students in semi-structured form.

Data Analysis

For the pretest-posttest normality analyses regarding the experimental and control group students' achievement scores as well as their problem solving scores, Shapiro Wilks test was applied. The results revealed that the data did not have a normal distribution. In addition, due to the fact that the number of the participants in the experimental and control groups was 16 and that this number did not meet the assumption regarding the number of participants in parametric tests, Wilcoxon and Mann Whitney U tests, which are nonparametric tests, were used. For repeated measures, that is for the intragroup comparisons between the groups during the application of Wilcoxon test, Mann Whitney U test was conducted. The data collected via PSIC were analyzed, and the negative items were calculated by scoring them reversely. During the analysis of the data collected via NTAT, each correct answer was assigned 4 points, and the incorrect answers were not given any point.

For the analysis of the data collected via SIFP, the descriptive analysis technique used in qualitative studies was applied. The students' responses to each question in the interview form regarding the activity process in which the subject Jigsaw technique was applied were examined within the context of the related question, and the codes to reflect the responses were created. Following the coding process, the codes found thematically in the same context were gathered under a main theme. These codes classified thematically were presented in frequencies and percentages in tables below.

Findings

The findings obtained in the study were examined under three headings based on the research sub-problems.

Findings regarding the first research problem:

The pretest-posttest achievement scores of the experimental and control group students were compared with Mann Whitney U test, and the results are presented in Table 5:

Table 5. Mann Whitney U Test Results Regarding the Comparison of the Pretest-Posttest Achievement Mean Scores of The Experimental and Control Group Students

		N	X	Mean Rank	Sum of Ranks	U	Sig. (p)
Pretest	Control	16	84,6	17,6	282,5	109,5	,47
	Experimental	16	82,4	15,3	245,5		
Posttest	Control	16	87,3	15,2	244,5	108,5	,45
	Experimental	16	89,0	17,7	283,5		

When Table 5 is examined, it is seen that there was no significant difference between the pretest-posttest achievement mean scores of the experimental and control group students. The findings revealed that the groups were similar in terms of narration skills at the beginning of the research process and that there was no significant difference between the groups despite the increase in the achievement mean scores of the two groups at the end of the application.

Table 6 presents the Wilcoxon test results regarding the intragroup comparisons of the pretest-posttest achievement mean scores of the experimental and control group students.

		N	Mean Rank	Sum of Ranks	Z	Sig. (p)
Control Group Pretest-Posttest	Negative Ranks	1	4,50	4,50	2,484	,013
	Positive Ranks	9	5,61	50,50		
	Ties	6				
Experimental Group Pretest-Posttest	Negative Ranks	0	,00	,00	3,197	,001
	Positive Ranks	13	7,00	91,00		
	Ties	3				

As can be seen in Table 6, the pretest-posttest achievement mean scores of the experimental group in which the subject jigsaw technique was applied and those of the control group in which the activities prepared in line with the current curriculum were compared. The results revealed a significant difference in favor of the posttest for both groups. Depending on this finding, it could be stated that not only the activities prepared in line with the current curriculum but also the subject jigsaw technique applied were influential on students' learning the narration types. When the pretest-posttest achievement mean scores presented in Table 5 regarding the groups were examined, it was seen that there was a higher increase in achievement in the experimental group than in the control group and that though no significant difference was found between the groups, the subject jigsaw technique was more influential on achievement than the activities carried out in line with the current curriculum.

Findings regarding the second research problem:

The pretest-posttest problem solving skill mean scores of the experimental and control group students were compared with Mann Whitney U test, and the results obtained are presented in Table 7.

Table 7. Mann Whitney U Test Results Regarding the Comparison of the Pretest-Posttest Problem Solving Skill Mean Scores of the Experimental and Control Group Students

		N	X	Mean Rank	Sum of Ranks	U	Sig. (p)
Pretest	Control	16	65,63	17,22	275,50	116,500	,664
	Experimental	16	63,56	15,78	252,50		
Posttest	Control	16	65,56	12,66	202,50	66,500	,020
	Experimental	16	74,19	20,34	325,50		

The pretest-posttest problem solving skill mean scores of the experimental and control group students were compared. The results presented in Table 7 revealed that a significant difference was found between the posttest mean scores though there was no significant difference between the pretest mean scores and that this difference was in favor of the experimental group in which the subject jigsaw technique was applied. Depending on this finding, it could be stated that the subject jigsaw technique was significantly more influential on the students' problem solving skills than the activities carried out in line with the current curriculum.

Table 8 presents the Wilcoxon test results regarding the intragroup comparison of the pretest-posttest problem solving skill mean scores of the experimental and control group students:

Table 8. Wilcoxon Test Results Regarding the Intragroup Comparisons of the Pretest-Posttest Problem Solving Skill Mean Scores of the Experimental and Control Group Students

		N	Mean Rank	Sum of Ranks	Z	Sig. (p)
Control Group Pretest-Posttest	Negative Ranks	7	5,50	38,50	-,492	,623
	Positive Ranks	4	6,88	27,50		
	Ties	5				
Experimental Group Pretest-Posttest	Negative Ranks	0	,00	,00	-3,530	,00
	Positive Ranks	16	8,50	136,00		
	Ties	0				

As can be seen in Table 8, the pretest-posttest problem solving skill mean scores of the study groups were compared, and it was found out that that there was no significant difference between the pretest-posttest problem solving skill mean scores of the control group students and that there was a significant difference between the pretest-posttest problem solving skill mean scores of the experimental group students in favor of the posttest. Based on these findings, it could be stated that the activities carried out in line with the current curriculum were not significantly influential on the development of the students' problem solving skills and that the jigsaw technique applied was fairly influential on the development of these skills.

Findings regarding the third research problem:

In this part of the study, the data collected via SIFP were represented with frequencies and percentages in tables. Table 9 presents the students' views regarding the question of "What are the features that make the courses in this study different from other courses?"

Table 9. Students' Views Regarding the First Question in SIFP

	Views	f	%
Effective communication	Sharing	7	11,48
	Discussion	5	8,20
	Confidence	3	4,92
	Free expression	2	3,28
Problem solving	Research skill	8	13,11
	Planned study	6	9,84
	Different solutions	5	8,20
	Searching for sources	3	4,92
	Awareness of the process	2	3,28
	Tolerance	2	3,28
Positive engagement	Information sharing	6	9,84
	Expertize	6	9,84
	Worth doing	4	6,56
	Need	2	3,28
	Total	61	100

When Table 9 is examined, it is seen that the experimental group students' views about the features that differentiated the courses taught with the subject jigsaw technique from other courses were gathered under three themes such as effective communication, problem solving and positive engagement and that these main themes were divided into sub-themes. When the frequency values for the sub-themes were taken into account, it was seen that the students focused especially on the main theme of problem solving skills. Some of the students' related views were as follows:

In the past, we couldn't come together with friends to study. When we met to study, I had the chance to establish closer relationships with some of my friends (Participant 4).

We don't do so much research in other courses. In this course, I learnt how to do research (Participant 9).

To me, what's best about this process is that we shared our knowledge with all our friends (Participant 6).

Table 10 presents the students' views regarding the question of "How did you feel during these activities":

Table 10. Students' Views Regarding the Second Question in SIFP

Views	f	%
Doing constant research made me happy.	9	34,62
I got excited during the presentation of the reports.	6	23,08
Helping my friends made me happy.	5	19,23
Being divided into expert groups excited me.	3	11,54
I felt myself valuable.	2	7,69
I was afraid of failing the exam.	1	3,85
Total	26	100

When Table 10 was examined, it was seen that the students enjoyed doing research during the activities and that they got excited while they were presenting their studies in class. Some of the students' related views are as follows:

While studying for my expertise, I understood how entertaining it was to do research (Participant 9).

It was easy to study our expertise subjects, but the thought that we were expected to report and present our studies in class made me anxious (Participant 15).

The fact that the students helped their friends in the expertise groups during the activities carried out as appropriate to the subject jigsaw technique made the students happy and caused them to feel themselves valuable. However, evaluation of achievement individually, not as a group, caused them to experience exam-related anxiety and even fear. Regarding this point, some of the students' views were as follows:

Helping my friends in the expertise group regarding the subjects they didn't understand made me happy (Participant 3).

I was an ordinary student in other courses, yet I was an expert in the courses in which the subject jigsaw technique was applied (Participant 7).

To me, if the evaluation had been made as a group, we wouldn't have been so much afraid of exams (Participant 10).

Table 11 presents the students' views regarding the question of "Did you ever experience any difficulty during these activities? If yes, then what were these difficulties?"

Table 11. Students' Views Regarding the Third Question in SIFP

Views	f	%
Coming together	4	33,33
Time management	4	33,33
Resentment	2	16,67
Responsibility	1	8,33
Selfishness	1	8,33
Total	12	100

When Table 11 was examined, it was seen that both the failure to come together during the activities and the difficulties regarding time management were among the most important difficulties experienced by the students. Some of the students' related views were as follows:

After the expert groups were formed, we determined the meeting times as a group, but some of our friends did not attend these meetings for various reasons (Participant 5).

I didn't have enough time to share my research results with my friends (Participant 16).

When Table 11 was examined, it was found out that the other difficulties experienced by the students in this process included resentment between group members, their failure to fulfill their responsibilities and selfish behaviors of some of the group members:

Sometimes, we experienced arguments in the group, and it took quite a lot of time to soothe our offended friends (Participant 8).

While I was trying to fulfill my duties, others did not pay much attention to theirs (Participant 1).

Some of my friends did not share their knowledge with us that they got as a result of their research (Participant 13).

Table 12 presents the students' views regarding the question of "What did you do to overcome the difficulties you experienced during the activities?

Table 12. Students' Views Regarding the Fourth Question in SIFP

Views	f	%
Getting help from expert groups	8	29,63
Effective listening	5	18,52
Reading-comprehension	4	14,81
Awareness of one's responsibilities	4	14,81
More research	4	14,81
Asking the teacher	2	7,41
Total	27	100

When Table 12 was taken into account, it was seen that the students mostly asked their friends in expert groups for their help to overcome the problems they experienced. Regarding this, some of the students' views were as follows:

I asked my friends in the expert group for their help to learn the parts I did not understand (Participant 5).

As there were four experts on each subject in our class, we were able to learn an unknown subject by asking the expert on that subject (Participant 7).

When the students' views regarding the fourth question in the interview form were examined, it was seen that the students tried to overcome the problems experienced in the process via effective listening, reading-comprehension, doing more research and asking the teacher:

It was enough for me to listen to my expert friend carefully (Participant 10).

I read a number of texts to understand the difference between the subject I was responsible for and the other subjects (Participant 4).

When we fulfilled our duties regarding the subjects determined, we did not experience any problems (Participant 3).

When we encountered problems, I immediately went to the library to do research (Participant 12).

My teacher was my biggest source of help regarding the problems I experienced (Participant 2).

When the students' views regarding the fourth question in the interview form were examined as a whole, it was seen that they primarily preferred to get help from expert groups. Besides getting help from expert groups, it was also found out that the students were aware of the need to use such skills as effective listening and reading-comprehension and to act by being aware of their responsibilities.

Conclusion and Discussion

The results obtained in the present study which examined the effects of the subject jigsaw technique on elementary school seventh grade students' achievement and on their problem solving skills were as follows:

The pretest-posttest achievement mean scores of the experimental and control group students were compared with Mann Whitney U test, and no significant difference was found both before and after the application. Depending on this finding, it could be stated that the subject jigsaw technique applied in the experimental group was not influential enough on achievement to cause a significant difference between the groups.

When the intergroup comparisons of the pretest-posttest achievement mean scores of the experimental and control groups were taken into account, it was seen that there was a significant difference between the pretest-posttest achievement mean scores of the two groups following the application. After the application, there was an increase of three points in favor of the control group while there was a seven-point increase in favor of the experimental group in which the subject jigsaw technique was applied. Based on this finding, it could be stated that the subject jigsaw technique applied in the experimental group was more influential than the activities carried in the control group in line with the current curriculum although there was no significant difference between the groups.

It is thought that the subject jigsaw technique was influential on the students' achievements due to the fact that they were able to express their thoughts freely; that they trusted one another; that they shared their knowledge with each other; that there was a discussion environment within the group; that they managed to find different ways of solution to the problems; and that the group members encouraged each other (Gillies, 2006; Hennessy & Evans 2006; Şimşek, 2007). In addition, it could also be stated that different from other jigsaw techniques, in the subject jigsaw technique, the students were found successful because they were evaluated individually and because they coped with their deficiencies with the help of the group members before taking the exam again.

Another effect of the subject jigsaw technique on the increase in the students' achievements was that the students expertised on their own subjects and that they shared their subject-related knowledge with the other students in their main groups. When the students' views about the process were examined, it was seen that the student expert on a subject was in need of getting help from other group members regarding a subject he or she was not expert on and that this situation was valid for all other group members. This situation is believed to lead to positive engagement among group members (Barken, 2001; Cohen, 1994). In addition, the fact that the students in the expert groups used individual learning techniques while doing research on their own subjects could be said not only to allow the learning process to appeal to the individual differences of the students (Doymuş & Şimşek, 2007) but also to enable the students to do research by choosing the learning method most appropriate to them.

When the students' views about the difficulties they experienced during the activities were examined, it was seen that these difficulties were similar to the problems encountered in other cooperative learning studies (Koç, 2009; Sancı, 2011; Yıldırım. 2007). Among the problems which were experienced by the students in the present study regarding the subject jigsaw technique and which were also encountered in other cooperative learning techniques was the fact that the group members did not obey the study hours previously determined; that they failed to manage the time effectively; that some of the group members were unable to fulfill their responsibilities; and that resentments were caused by arguments in the group.

In the study, in order to examine the influence of the subject jigsaw technique on the students' problem solving skills, the pretest-posttest problem solving skill mean scores of the experimental and control groups were compared. No significant difference was found between the groups before the application, while there was a significant difference in favor of the experimental group following the application. Based on this result, it could be stated that the subject jigsaw technique was more influential on the students' problem solving skills when compared to the activities carried out in line with the current curriculum.

In the study, the intragroup comparison of the pretest-posttest problem solving skill mean scores of the experimental and control group students revealed that there was no significant difference between the pretest-posttest mean scores of the control group students and that there was a significant difference between the pretest-posttest mean scores of the experimental group in favor of the posttest. Depending on this result, it could be stated that the activities carried out in line with the current curriculum were not as effective as the subject jigsaw technique on the development of the problem solving skills of the students.

In the study, the application process of the technique was analyzed to better understand the positive influence of the subject jigsaw technique on the problem solving skills of the students. The subject jigsaw technique not only requires expert students to make good use of a learning environment in which they need experts on other subjects but also makes it necessary for students coming together in this environment to use problem solving skills effectively. Behaviors expected from a student with problem solving skills include both effective use

of communication skills and contribution to the establishment of an environment of trust. In the present study, in which learning activities appropriate to the subject jigsaw technique, the students willing to be successfully individually not just used these skills but gained experience to develop their problem solving skills as well. Thus, it is important to develop the social relations for problem solving skills, to use communication skills effectively and to create an environment of trust. Using these skills, students willing to be successful individually find the opportunity to develop their problem solving skills. When related studies are examined, it is seen that these processes of the subject jigsaw technique play an important role in the development of problem solving skills (Dreu & Weingard; Gillies, 2004; Rutherford, Mathur & Quinn, 1998). In addition, when the students' views about the process were examined, it was seen that the students reported similar views regarding the problem solving processes.

The basic purpose of problem solving is to overcome the difficulty by making use of mental processes and of different ways of solution. When the students' views about the process were taken into account, it was seen that they experienced different difficulties and that they tried different ways of solutions to cope with these difficulties (Sternberg & Grigorenko, 2000). It was seen that while determining different ways of solution, they also demonstrated critical attitudes towards themselves as well as towards other group members. In this study, an example for this critical viewpoint could be the fact that the students were expected to use listening skills effectively to become successful and that all the group members had to be aware of their own responsibilities.

Each student in the study groups was assigned a subject to expertise on. The students started to feel that these subjects were their own problem areas and tried to fulfill their duties successfully by doing planned research. In this process, in order to solve the problems, the students had the opportunity to do research, to organize their knowledge, to determine various ways of solution, to make use of different sources and to decide on the best solution for them. In this process, the students tried to use effective communication skills, to share their knowledge and to become tolerant towards their friends as they studied cooperatively; in brief, they tried to use all their personal abilities to cope with the problems (Gillies & Haynes, 2011; Gillies, Nichols, & Burgh, 2011). It was found out that the students using their abilities successfully started to give value to themselves and to other group members and that they increasingly believed in their achievement due to their confidence in themselves as well as in their friends.

Depending on these findings, it could be stated that the problem solving skills of the experimental group students were developed since they used such processes effectively as reading comprehension, effective listening skills, discussion, understanding new and different parts, analysis, synthesis and summarizing. Studies conducted support the effects of these processes observed in the experimental group (Adeyemi, 2008; Henry, 2013). Although all these processes did not lead to a significant difference between the experimental and control group students in terms of their academic achievements, these processes not only played an important role in increasing the achievement in the experimental group than in the control group but also resulted in a significant difference in favor of the experimental with respect to the problem solving skills of the students.

REFERENCES

Adeyemi, B. A. (2008). Effects of cooperative learning and problem-solving strategies on junior secondary school students' achievement in social studies. Electronic Journal of Research in Educational Psychology, 6 (3), 691-708. | Aronson, E., Stephen, C., Sikes, J., Blaney, N., & Snapp, M. (1978). The jigsaw classroom. Beverly Hills: Sage Publications. | Barken, J. E. (2001).The use cooperative learning techniques in a community college course. Master Thesis. Saint Francis Xavier University, Antigonish, NovaScotia. | Bershon, B. L. (1992). Cooperative problem solving: A link to inner speech, in Hertz-Lazarowitz (eds.) Interaction in Cooperative Learning. 36-48, Ny: Cambridge Press. | Büyüköztürk, Ş. (2006). Sosyal bilimler için veri analizi el kitabı. Ankara: PegemA Yayıncılık. | Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. Review of Educational Research; 64 (1), 1-35. | Cüceloğlu, D. (1997). İyi düşün doğru karar ver. (18. Baskı). İstanbul: Sistem Yayıncılık. | Doymuş, K. (2007). Teaching chemical equilibrium with the jigsaw technique, Research in Science Education, 38, 249-260. | Doymus, K., & Simsek, Ü. (2007). Kimyasal bagların ögretilmesinde jigsaw tekniginin etkisi ve bu teknik hakkında ögrenci görüsleri. Milli Egitim Dergisi, 173(1), 231-243. | Dreu, C. K. W., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: A meta-analysis. Journal of Applied Psychology, 88(4), 741-749. | Ellis, S., & Robert, S. S. (1994). Chapter 11: Development of Problem Solving Thinking and Problem Solving-Handbook of perception and cognition Edited by Robert J Sternberg, Academic Press, USA. pp. 336–363. | Gillies, R. M. (2006). Teachers' and students' verbal behaviors during cooperative and small-group learning. British Journal of Educational Psychology, 76(2), 271- 287. | Gillies, R. M., & Haynes, M. (2011). Increasing explanatory behaviour, problem-solving, and reasoning within classes using cooperative group work. Instructional Science: An International Journal of the Learning Sciences, 39 (3), 349-366. | Gillies, R. M., Nichols, K., & Burgh, G. (2011). Promoting problem-solving and reasoning during cooperative inquiry science. Teaching Education, 22 (4), 427-443. | Gillies, R.M. (2004). The effects of communication training on teachers'and students'verbal behaviours during cooperative learning. International Journal of Educational Research, 41, 257–279. | Hennessy, D., & Evans, R. (2006). Small-group learning in the community college classroom. The Community College Enterprise, 12(1), 93-110. | Henry, T. (2013). Cooperative Problem-Solving and Education. Forum for promoting 3-19 comprehensive education, 55 (2), 185-202. | Johnson, D. W., & Johnson, R. T. (1991). Teaching children to be peacemakers. Edina: Interaction Book Company. | Klein, S. P. (1998). Standards for teacher tests. Journal of Personnel Evaluation in Education. 12 (2), 123-138. | Koç, Y. (2009). Termokimya ve kimyasal kinetik konularının öğretiminde uygulanan jigsaw ve grup araştırması tekniklerinin öğrencilerin akademik başarıları üzerine etkisi. Unpublished MA thesis, Institute of Science, Atatürk University, Erzurum. | Mayer, R. E. (1992). Thinking problem solving cognition, W.H. Freeman and Company Second Edicition, New York, USA. pp.361–454. | Osgood, M. P., Mitchell S. M., & Anderson, W. L. (2005). Teachers as learners in a cooperative learning biochemistry class. Biochemistry And Molecular Biology Education, 33(6), 394–398. | Rutherford, R. B., Mathur, S.R., & Quinn, M.M. (1998). Promoting social communication skills through cooperative learning and direct instruction. Education and Treatment of Children, 21(3), 354-369. | Sancı, M. (2011). İlköğretim 4. sınıf fen ve teknoloji dersi öğretiminde uygulanan jigsaw ve grup araştırması tekniklerinin öğrencilerin akademik balarıları üzerine etkisi. Unpublished MA thesis. Institute of Science, Atatürk University, Erzurum. | Serin, O, Bulut Serin, N., & Saygılı, G. (2010). İlköğretim düzeyindeki çocuklar için problem çözme envanteri'nin (ÇPÇE) geliştirilmesi. Elementary Education Online, 9(2), 446–458. | Sharan, S., & Hertz-Lazarowits, R. (1980). A group investigation method of cooperative learning in the classroom. In Sharan, S., Hare, P.,Webb, C., & Hertz-Lazarowits, R. (Eds.). Cooperative Learning in Education, 14-16.Provo, UT:Birgham Young University Pres. | Şimşek, Ü. (2007). Çözeltiler ve kimyasal denge konularında uygulanan jigsaw ve birlikte öğrenme tekniklerinin öğrencilerin maddenin tanecikli yapıda öğrenmeleri ve akademik başarıları üzerine etkisi. Unpublished Doctorate Thesis. Institute of Science, Atatürk University, Erzurum. | Slavin, R. E. (1978). Using student team learning. Johns Hopkins University, Center for Research on Elemantary and Middle School, Baltimore. | Slavin, R. E. (1990). Cooperative learning: theory, research and practice. New Jersey: Prentice Hall, Englewood Cliffs. | Sönmez, S. (2005). İşbirliğine dayalı öğrenme yöntemi, birleştirme tekniği ile bilgisayar okur-yazarlığı öğretiminin akademik başarıya ve kalıcılığa etkisi. Institute of Social Sciences, Çukurova University. Adana. | Sternberg, R. J., & Grigorenko, E. (2004). Successful intelligence in the classroom. Theory Into Practice.43 (4), 274-280 | Ünver, G. (2003). Yansıtıcı düşünme. PegemA Yay: Ankara. | Watanabe, M., Nunes, N., Mebane, S., Scalise, K., & Claesgens, J. (2007). Chemistry for all, instead of chemistry just for the elite: Lessons learned from detractedchemistry classrooms. Science Education, 91(5), 683-709. | Wilson, J., & Wing J. L. (1993). Thinking for themselves. NSW: Eleanor Curtin Publishing. | Yıldırım, K. (2006). Çoklu zekâ kuramı destekli işbirlikli öğrenme yönteminin ilköğretim 5. sınıf öğrencilerinin matematik dersindeki akademik başarı, benlik saygısı ve kalıcılığına etkisi. MA Thesis, Institute of Social Sciences, Çukurova University, Adana. |