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Effect of Cooperative Jigsaw II and Subject Jigsaw Techniques on Learning in Science Class

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(Research Article)

Abstract

The aim of this study is to determine the effects of Subject Jigsaw and Jigsaw II methods on the academic success of students in teaching the Force and Motion unit. Sample of the study was selected from Regional Boarding Secondary School located in Posof district of Ardahan province and Imam Hatip Secondary School located in the same district in the fall semester of 2016-2017 academic year. The Subject Jigsaw Method (SG, n=20) was applied to the 7A branch of the first selected secondary school and the Jigsaw II method was applied to the 7B branch (JG, n=20); The teacher-centered teaching method was applied to the 7A branch of the second selected secondary school as the Control Group (CG, n=17). In the study, Force and Energy Achievement Test (FEAT), Module Tests (Module A, Module B, Module C and Module D) were used as measurement tools. Descriptive statistics, one-way Analysis of Variance (ANOVA) were used for data analysis. According to the data obtained as a result of the application, cooperative learning methods contribute positively to the students' science learning levels in learning the concepts in the "Force and Energy" unit. As a result, it was determined that the effects of Subject Jigsaw and Jigsaw II methods on the students' academic success were similar to each other and these students were more successful than students who received education with the traditional method.

Keywords: Cooperative learning, Force and energy, Jigsaw II, Primary education, Science and technology, Subject jigsaw

INTRODUCTION

Individuals first start receiving science education in educational institutions. The skills and knowledge they acquire during this process will significantly benefit them throughout their lives. Thanks to these gains given to individuals in educational institutions, it is aimed to provide them with the knowledge, skills and attitudes they will use in the future processes of their lives. As a result of these goals, science education is of great importance in the individual's

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behavior and in becoming an individual who first observes, questions, investigates in a problem encountered, thinks critically in the process and produces effective and efficient solutions to the problem encountered (Ayas et al. 2002). The importance of ensuring the development of science education is great in raising students with the qualifications required by our age and the desired characteristics in the student profile and in developing and improving the quality of education. The aim of science education is for the student to know and understand himself and his environment well, to be able to use the information in the existing knowledge pool in the situations he encounters, to be able to access information and to produce new information (Kaptan, 1999). Based on this basic purpose, the general purpose in teaching science education is to present concepts directly to students or to teach them how to learn in addition to memorizing them. Purpose is to take into account the individual learning of students and ensure their development in line with their existing skills and abilities. In this way, it is possible to raise them as individuals who research and question (Lind, 2005).

It also provides significant support in technology for student education. With this contribution to education, individuals' skills such as working, benefiting from existing scientific technologies, and working in collaboration will also increase. The developing and changing technological developments are increasing their importance day by day. The need for societies to understand, use and access the knowledge in the process, analyze and synthesize these developments has also increased. It is important for individuals to organize their own lives and keep up with technological developments with science education. The most important function of science education is its contribution to students' scientific literacy. In this way, they use scientific methods as a solution to the encountered problems. It is expected that they will have skills such as determining the encountered problem, analyzing the factors that will cause the problem, concrete suggestions for solving the problem and using technology effectively and efficiently, accessing information, and producing new information (Kaptan 1999).

In the Science and Technology courses in our schools, the course is taught only according to the methods and techniques that the teacher knows. As in traditional education, it is a teacher-centered education, and students are given ready to receive information. The method used in transferring information is to give concepts, principles, and generalizations related to the subject to students who are passive examiners during the lesson (Bayrakçeken et al., 2012). There is an infinite amount of scientific information in traditional education. The reason for this is that scientific information is discovered through observation and experiment. According to the constructivist approach, observations and experiments that form scientific knowledge depend on the hypothesis that forms itself (Tsai, 1999). In the student-centered approach, it is important for students to use problem-solving skills, demonstrate their creativity, and be motivated about a problem or topic that they work on as a group or individually. (Doğan et al. 2010).

Although learning seems like a personal process, it is a social phenomenon (Brufee, 1993). In order for it to be a social process, in addition to students communicating with each other, feelings and thoughts such as acceptance and belonging are also necessary. Communication skills and group work skills also occur thanks to this interaction. Although it is forbidden to

talk to each other outside of group work in our schools, this communication is provided within the scope of group work and course activities (Topsakal, 2010). In order for students to exhibit an attitude in accordance with the constructivist approach, it is essential to use the methods and techniques in contemporary education. The methods, techniques and approaches used in education reveal the importance of both individual and group work models. While individual development is targeted in individual studies, in studies conducted with group work, the individual's awareness that he is a part of the environment he is in enables him to be aware of both the weak and strong aspects of the society and himself and contributes to his development as a social being (Yılmaz, 2007).

Within the scope of the Science and Technology course given in primary education, students encounter the basic skills in the courses they will encounter in physics, chemistry and biology, both in their daily lives and in the future high school process. Therefore, it is important to choose the methods and techniques used in this course appropriately and to apply them by taking into account the readiness of the students. The current crowdedness of the classes in our schools, the implementation of experiments within the scope of the course and the lack of tools and equipment within the scope of the course, and the lack of laboratory environment in schools generally push teachers to give students plain explanations through presentation, do questions and answers, do problem solving exercises and repeat while moving from constructivist education to traditional education. In our education system; the failure to fully realize the previously determined learning and teaching activities, the use of traditional methods and their failure to fully meet the objectives of education have led to the questioning of the methods and techniques used. Therefore, new approaches and methods are needed. In this case, "active learning" methods, in which students actively participate in the course, have begun to be used. This has started to be used not only in our country but also in other countries around the world and large-scale projects have also been carried out. One of the leading methods is the Cooperative Learning method. Cooperative learning is a learning method in which individuals form small mixed groups in the classroom and in other environments outside the classroom and support each other to teach an academic subject in line with a common purpose, individuals' self-confidence increases, their sense of communication develops, and the student participates in the learning activity in the most active way (Doymuş et al., 2005; Stahl, 1994).

The cooperative learning theory is based on behaviorist, cognitive and constructivist theories from learning psychology. Skinner, the founder of behaviorist theory, believed that if the reinforcements given in accordance with the behavior are responded to, it will be more effective if implemented more frequently. Piaget, the founder of cognitive theory, believed that students learn by recognizing and being aware of the social and physical environment they are in. Vygotsky, the founder of constructivist theory, believed that the learner learns by interacting with the subject to be taught by an instructor who knows it better than him (Hines, 2008). Vygotsky attaches importance not only to social tools such as language in the interaction of the individual with his environment, but also to communication and interaction between individuals. It contributes to the development of social behaviors with social learning. It contributes to learning as well as gaining social skills through interaction. It does this through language, which is the key to socialization. It has been stated that this social tool is effective in

the formation of knowledge, support of interaction and cooperation in work (Doolittle 1997; Jars et al. 2004; Johnson et al. 2007; Lin, 2006; Maloof & White, 2005; Özden 2005; Prichard et al., 2006; Saribas & Koseoglu, 2006; Shaaban, 2006; Slavin, 1980; Stockdale & Williams 2004; Wilson-Jones & Caston, 2004).

In cooperative learning, the teacher and student are in constant interaction which both facilitates the process and enables individuals to socialize. It also increases their courage to socialize. All personnel, including individuals, teachers, families and administrators, are involved in this process. Thus, it contributes to the individual's emotional, familial and social relationships (Carpenter & McMillan, 2003; Koçak, 2008; Santos Rego & Lorenzo Moledo, 2005). With this understanding, they have a positive understanding of the problems they encounter with social support and social interaction (Doymuş et al. 2005; Hanze & Berger, 2007). Thus, with this method, students feel responsible for each other and contribute to the development of these responsibilities every day (Aronson, 2002). Cooperative learning offers alternative measurement and many different assessment opportunities (Gupta, 2004). One of these techniques is the observation of groups (Morgan, 2004). Evaluations are made both individually and in groups, both in writing and verbally. In addition, groups evaluate each other (Johnson & Johnson, 1987; Koçak, 2008; Santos Rego & Lorenzo Moledo, 2005). Measurement and evaluation techniques applied to students and the group provide feedback to both the teacher and the students (Lin, 2006). In classes where cooperative learning methods are used, it has been observed that students' communication skills increase, their interactions become more frequent, they look at discussions from many perspectives rather than just one, and they help their group mates within the group. These behaviors provide many opportunities for the teacher to observe the learners and provide serious information about the learners' abilities and performance (Prichard et al. 2006).

In environments where the cooperative learning method is used, the teacher pays attention to the individual learning of the students and thus the course becomes easier to process. This process also contributes to the scientific development of the learners (Bozdoğan, et al. 2006). It is expected that the students who are together to achieve a common goal, interact with each other positively, share their thoughts easily and participate in the discussions (Gömleksiz, 1993). Students learn through interactions with each other by explaining the subject to each other, asking questions to each other, and giving similar or different examples. Students support each other in this process, listen to their colleagues, speak when their turn comes, and share their knowledge (Ünlüsoy, 2006). As in all methods used in the education process, difficulties may be experienced in cooperative learning. In this process, some of the students in the group who are together for a common goal may not do their assigned tasks, and the students who do their assigned tasks may think that they are being exploited. The most important feature that distinguishes cooperative learning from cluster group works is that, as in cluster works, one person is not the group leader but everyone is the group leader. Since there will be a distribution of tasks among the students in the process, students who work and want to improve themselves better, while students who do the opposite may fall behind. In this case, individuals with high communication and socialization skills may not respect other students (Bratt, 2008; Felder & Brent, 2001). It should be noted again that not all group work is cooperative learning. In

environments where cooperative learning is used, there are sub-techniques to ensure active participation and increase success. Here, the structuring of cooperative learning activities and the order of the classroom in the environments where they will be applied are important (Hedeen, 2003; Sucuoğlu, 2003). The most commonly used method among these techniques is the jigsaw method, which is also widely used in science education. This method was first initiated by Eliot Aronson, who brought many teachers together (Hedeen, 2003). Later, it was developed by other researchers and contributed to the production of many new techniques. Jigsaw II was developed by Slavin (1986), Jigsaw III by Stahl (1994), Jigsaw IV by Holliday (2000), Reverse jigsaw by Hedeen (2003) and Subject jigsaw by Doymuş (2007).

Although various student-centered teaching methods exist, peer education has emerged as one of the most effective approaches for promoting interdisciplinary learning in the 21st century. Among these, the most successful methods are those aligned with the collaborative learning model, which emphasizes shared responsibility and active participation. Within this model, the Subject Jigsaw technique stands out as particularly effective. This technique not only fosters deeper understanding across disciplines but also significantly enhances students' academic achievement. Its structured and systematic approach sets it apart from other collaborative techniques, ensuring a more disciplined and focused learning environment.

METHOD

In this section, the research model, the universe and sample of the research, data collection tools, details of the implementation process and how the data were analyzed are given.

Research Model

A quasi-experimental design with a pretest-posttest control group, one of the quantitative research designs, was used in the study. If the purpose of scientific research is to measure variables and determine the cause-effect relationships between these measured variables, it is appropriate to use an experimental design (Karasar, 2009). In an experimental design, the application group is an experimental or control group selected with equal probability. A quasi-experimental design was used in the study (Büyüköztürk et al., 2012). Quasi-experimental designs are frequently used in educational research. Because the groups to be studied are determined in advance and experimental group and control group might be randomly selected. If a quasi-experimental design with one experimental and one control group is used, two branches of the school can be used as the experimental and control groups. The factor whose effect is to be measured was applied to the experimental group, and no application was made to the control group. The successes of both groups were measured before and after the application.

Universe and Sample

Student samples were selected using non-random sampling method. One of the most preferred methods in experimental or quasi-experimental research designs in educational research is non-random sampling methods (Mcmillan & Schumacher, 2006; Yıldırım & Şimşek, 2005). The universe of the study is two Secondary school in Posof district of Ardahan province. The sample of the study was selected from 7^{th} grade students taking science and

technology course in a Regional Boarding School in Posof district and an Imam Hatip Secondary school in Posof district. Before starting the experimental process, meetings were held with the course teachers who would conduct the application in their classes regarding the purpose of the research, the activities to be done and the implementation of the process. As a result of these meetings; two branches in the Regional Boarding School in Posof District were selected as the experimental group where the application would be conducted, and one branch in the Imam Hatip Secondary School in Posof District was selected as the control group. The sample of the study was selected as the first Regional Boarding Secondary School located in Posof district of Ardahan province in the fall semester of 2016-2017 academic year and the second Imam Hatip Secondary School located in the same district. The Subject Jigsaw Method (SG, n=20) was applied to the 7A branch of the first selected secondary school and the Jigsaw II method was applied to the 7B branch (JG, n=20); The teacher-centered teaching method was applied to the 7A branch of the second selected secondary school as the Control Group (KG, n=17).

Procedure

The research was carried out in three stages as "before the applications", "during the applications" and "after the applications". In the first stage, a presentation was made about Subject Jigsaw and Jigsaw II to the teachers of the classes where the applications would be made and the prepared Application Guides were delivered. Then, a presentation was made about Subject Jigsaw and Jigsaw II to the Experimental Groups. Before the applications, Force and Energy Achievement Test (FEAT) was applied to the control and experimental groups.

In the second stage, the in-class and out-of-class activities were carried out during the applications. The processing of the Science course "Force and Energy" unit in the 7th grade was determined as a total of 16 hours for 4 weeks in the curriculum of the Ministry of National Education. In this study, the classroom activities were organized to be completed in 16 hours, adhering to the lesson hours recommended by the Ministry of National Education. In addition, experimental studies were conducted on weekends for a total of 4 hours**.**

Data Collection Tools and Data Collection

In this part of the study, firstly the teacher application guide (guide) developed by the researcher for the activities in the classroom was mentioned, then the data collection tools used in the study, the development steps and how the studies were conducted were explained in detail.

Teacher guides

In the data collection firstly, a teacher guide (guide) was prepared explaining the steps to be taken and what to do in the experimental groups by considering the achievements of the "Force and Energy" unit. This guide includes (1) explanatory information about cooperative learning and Subject Jigsaw and Jigsaw II, (2) guidelines on how to apply cooperative learning techniques to increase academic success. The teachers selected in the school where the application was carried out were informed about the process and the cooperative model. The teacher guide prepared to guide the teachers in the study and the book "Cooperative Learning" prepared by Bayrakçeken et al. (2013) were distributed to teachers. The experimental group

teachers were told that the researcher would provide all kinds of assistance regarding the application during the application process and that any negative situation would be resolved. The control group teacher was also informed about the process.

Force and energy achievement test (FEAT)

FEAT was used as a pre-test before the start of in-class practices and as a post-test at the end of the practices to determine the effectiveness of the methods applied in the study and to compare the academic success of the experimental and control groups depending on this determination. The FEAT used in the study was taken into consideration as the knowledge, skills and attitudes expected to be acquired at the end of the learning process in the "Force and Energy" unit in the 7th grade primary school science curriculum and a table of specifications was prepared including the knowledge, skills and attitudes expected to be acquired by the students at the end of the learning process under the four headings of the unit. The levels of the questions asked in the table of specifications were determined in accordance with the Bloom taxonomy.

Module tests (MT)

Module Tests were prepared in an open-ended, drawing-requiring manner to determine what the students understood at the abstract level at the end of each sub-topic in the "Force and Energy" unit and to determine the misconceptions in the students, taking into consideration the knowledge, skills and attitudes expected to be acquired at the end of the topic. In the "Force and Energy" unit; A total of four Module Tests were created on the sub-topics of Pressure, Energy, Work, and Mass. Three science teachers were consulted for their opinions on the validity of the tests and the deficiencies of the test to be conducted were eliminated in line with their suggestions. In order to increase the reliability of the questions, the module tests were scored independently by two science teachers and the consistency between them was checked. As a result of the feedback received, necessary arrangements were made and the final version of the Module Tests was presented. The teacher of the control group was also informed of the process**.**

Application of the Subject Jigsaw Method

Since the class size consisted of 20 students, 5 groups of 4 people were formed. Heterogeneous groups were formed by considering the knowledge levels of the students assigned to the groups for academic success. Then, general information was given about what would be done during the study process of the groups. In each group, students who assumed the duties of group leaders, group presenters and group writers were determined. It was said that all students in the groups should actively participate in the learning process**.**

Determination of sub-topics

The sub-topics of the course unit to be studied were divided into sections as many as the number of collaborative groups formed in the class or study (If the number of collaborative groups is high, a sub-topics can be given to two groups. In addition, if the number of sub-topics is high in the number of groups, the sub-topics can be combined and given as a single sub-topics). The sub-topics given to the groups were tried to be learned by the students in the group.

The materials belonging to the sub-topics were presented to the students by the teacher. The course teacher gave general information about how to study the sub-topics.

Combining subtopics

As shown in Figure 1, after the learning process of the first subgroups was completed, the subtopics were combined in 2 or 3 groups. The students in the newly formed groups studied these combined subtopics again. After the study process was completed, the student groups in the combined subtopics changed places. After the changing groups studied the new subtopics, all the subtopics were combined as a unit. In this way, the groups were allowed to study the topics over and over again. After the learning process was completed, the group spokesperson in each group summarized the unit**.**

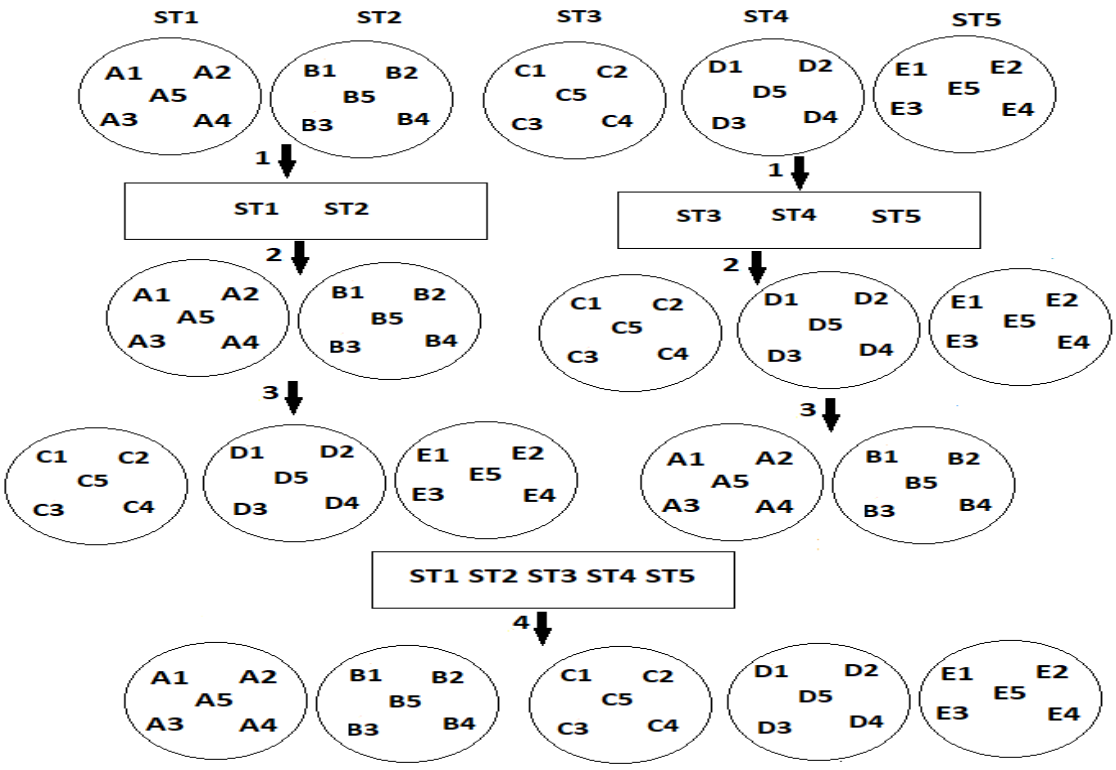

Figure 1. *Subject jigsaw application diagram (ST Sub-topics, Letters represent students) (Doymuş, 2022)*

Exams

Exams are conducted in 3 ways in the Subject Jigsaw method.

1) Module test; members of each group take this test individually. The questions in the test are generally open-ended. Module tests are designed in such a way that 4 questions are created in each sub-topic. The aim is to determine which sub-topic the students are inadequate in.

2) Force and Energy Achievement Test (FEAT); the questions in this test are multiple choice. The questions in the test are prepared to cover the entire unit. The aim of this test is to determine to what extent the students have mastered the unit in terms of knowledge.

Application of Jigsaw II Method

In the first stage, the course teacher carefully divides the class into main groups so that the groups are heterogeneous. Then, the subject, the unit title that the group members will work on, is introduced to the group members. Group members were informed on how the material they will work on will be used, what they need to do and how they will continue the process. Then, the course teacher explains to the members how the group members will learn and how they will be evaluated at this stage and gives all the students in the main groups a part of the material to be prepared or allows the student to choose a part of the material.

The course teacher gathers the members who work on a similar part of the study material or the relevant study topic in their main groups into a group and creates new study groups, which we call expert teams. The students in these new groups prepare the study topics together with their expert group friends in order to teach them to their teammates when they go back to their original teams. At this stage, the course teacher channels the group members into positive behaviors such as expressing their ideas, discussing their thoughts and helping each other with other group members and motivates them in this regard. At the end of this stage, individuals in expert teams complete their preparations for learning the topics they are thought to have specialized in or the parts of the material they will use that have been given to them.

In report preparation and reformatting, group members who are experts in their own topics or materials go back to their main teams and make an effort to teach the topics they have specialized in and prepared to the other group members in their expert teams. During this time, they learn and teach the topics better by examining them in depth with their other expert friends in their main groups. In completion and evaluation, the course teacher can organize an organization where individual, mini-group or general class can participate in order to ensure that students internalize their learning. For example, one of the main teams can have a demonstration for the presentation of the learned topic or material. Students who perform the learning task as group members can have their learning reinforced by making presentations individually. In the whole class evaluation stage, the study is concluded by performing the evaluation methods used in the cooperative learning method.

Control Group Application

Lesson was taught in accordance with the Ministry of National Education regulations for the 7^{th} A class of Posof Imam Hatip Secondary School in the Posof district of Ardahan Province. Before the unit started, the FEAT pre-test was applied to the group. Then, the teacher introduced the lesson by talking about the content of the subject and examples that can be encountered in daily life at the beginning of the unit. The attention of the students was tried to be drawn by mentioning that the unit had potential questions in exams. The course was generally carried out with verbal explanation. The questions in the course book were solved with the help of the teacher.

FINDINGS

At this stage, the data obtained from the FEAT, which was administered as a pre-test in order to determine the knowledge of all students in the research groups before starting the study, are given. Descriptive statistics obtained from the FEAT administered to the students in the research groups before the study are given in Table 1, and One-way ANOVA results are given in Table 2.

Table 1. *Descriptive statistics of data obtained in the pre-test of FEAT*

Groups	N	X	SD
SG	20	27.35	8.83
JG	20	29.50	9.73
CG	17	26.59	6.18

When Table 1 is examined, it is seen that the average scores of students in all groups are close to each other.

Table 2. *One-way ANOVA results of data obtained from pre-test of FEAT*

	Sum of Squares	DF	Mean of Squares	F	p
Between Groups	86.473	2	43.236	1.599	.553
Within Groups	3895.668	54	72.142		
Total	3982.140	56			

When Table 2 was examined, it was seen that the data obtained from the FEAT (pre-test) applied to the students before the application was examined, no statistically significant difference was observed between the groups (p>.05).

Findings Obtained from the Post-Test of FEAT, Descriptive statistics of the results obtained from the FEAT (post-test) applied to the students in the study groups at the end of the study are given in Table 3, and One-way ANOVA results are given in Table 4.

Table 3. *Descriptive statistics of data obtained from the FEAT posttest.*

Groups	N	X	SD
SG	20	46.75	13.537
JG	20	45.30	13.804
CG	17	35.35	12.031

According to Table 3, after completing the application, it is seen that the highest average belongs to the SG (X=46.75), followed by JG (X=45.30) and CG (X=35.35), respectively.

Table 4. *FEAT One-way ANOVA results of data obtained from the post-test*

	Sum of Squares	DF	Mean of Squares	F	p
Between Groups	1379.747	2	689.873	3.956	.025
Within Groups	9417.832	54	254.699		
Total	10797.579	56			

According to the One-way ANOVA statistics given in Table 4, it is seen that there is a statistically significant difference between the groups (F=3.952; p<.05). In order to determine which groups this difference is between, the LSD test was used in the Post Hoc tests. According to the LSD test results, it is seen that the success of the SG and JG groups is close to each other and superior than CG group. The average values given in Table 3 also support this situation (XSG=46.75; XJG= 45.30 and XCG= 35.35).

Findings Obtained from Module Tests (MT)

This section provides the findings obtained from the MTs used to measure the personal success of group members (students in the control and experimental groups) and to observe their development.

Findings obtained from module A

Descriptive statistics of the data obtained from Module A applied to the students in the study groups are given in Table 5 and One-way ANOVA results are given in Table 6.

Table 5. *Descriptive statistics of data obtained from module A test*

Groups	N	X	SD
SG	20	68.75	26.895
JG	20	67.45	29.092
CG	17	46.18	26.606

According to Table 5, the group with the highest average is SG (X=68.75), followed by JG (X=67.45) and CG (X=26.606), respectively.

Table 6. *ANOVA results of data obtained from module A test*

	Sum of Squares	DF	Mean of Squares	F	p
Between Groups	5750.864	2	2875.432	3.773	.029
Within Groups	41151.171	54	762.059		
Total	46902.035	56			

When Table 6 is examined, it is seen that there is a statistically significant difference between the groups according to the data obtained from Module A (p<.05). It is seen that the success of the SG and JG groups is close to each other and superior than CG group.

Findings obtained from module B

Descriptive statistics of the data obtained from Module B applied to individuals in the study groups are given in Table 7, and One-way ANOVA results are given in Table 8**.**

Table 5. *Descriptive statistics of data obtained from module B test*

Groups	N	X	SD
SG	20	46.25	26.895
JG	20	32.75	17.657
CG	17	32.06	15.718

According to Table 7, it is seen that the group with the highest average is the Subject Jigsaw Group (46.25), followed by the Jigsaw Group (X=32.75) and CG (X=32.06).

Table 8. *ANOVA results of data obtained from module B test*

	Sum of Squares	DF	Mean of Squares	F	p
Between Groups	2483.068	2	1241.534	2.838	0.067
Within Groups	23620.441	54	437.416		
Total	26103.509	56			

When Table 8 is examined, it is seen that there is no statistically significant difference among the groups according to the results obtained from Module B (p>.05).

Findings from module C

Descriptive statistics of the data obtained from Module C applied to the students in the study groups are given in Table 9, and One-way ANOVA results are given in Table 10.

Table 9. *descriptive statistics of data obtained from module C test*

Groups	N	X	SD
SG	20	51.00	25.423
JG	20	33.50	17.022
CG	17	40.29	14.521

According to Table 9, the group with the highest average is SG Group (X=51.00), followed by CG (X=40.29) and JG (x=33.50).

Table10. *ANOVA results of data obtained from module C test*

	Sum of Squares	DF	Mean of Squares	F	p
Between Groups	3108.137	2	154.069	3.966	0.025
Within Groups	21158.529	54	391.825		
Total	24266.667	56			

When Table 10 is examined, it is seen that there is a statistically significant difference between the groups in the Module C test. It is seen that the success of the SG superior than JG group (p<.05).

Findings from module D

Descriptive statistics of the data obtained from the Module D test applied to the students in the study groups are given in Table 11 and One-way ANOVA results are given in Table 12.

Table11. *Descriptive statistics of data obtained from module D test*

Groups	N	X	SD
SG	20	59.25	28.064
JG	20	54.00	25.474
CG	17	42.94	13.700

When Table 11 is examined, it is seen that the group with the highest average after Module D is SG (X=59.25), followed by Group JG (X=54.00) and CG (X=42.94), respectively.

Table 62. *ANOVA results of data obtained from module D test*

	Sum of Squares	DF	Mean of Squares	F	p
Between Groups	2509.449	2	1254.725	2.236	.117
Within Groups	30296.691	54	561.050		
Total	32806.140	56			

When the data obtained from Table 12 is examined, it is seen that there is no statistically significant difference between the groups.

RESULT AND DISCUSSION

When the students' FEAT pre-test results are examined, it is seen that SG, JG and CG are academically close to each other. It is seen that there is no statistically significant difference between SG and JG. When the FEAT post-test results are examined, it is seen that there is a statistically significant difference between SG, JG and CG. There are various reasons for the differences and variations between the control and experimental groups. These reasons include the individuals' desire to learn, cognitive capacities, study routines, the physical condition of the residences they live in, the socioeconomic status of their parents, the educational status of their parents, the physical structure of the school, whether or not there are students with integration in the classroom, and the accessibility of educational equipment. The fact that the schools studied are central schools in the Posof district and offer boarding education has an effect on the student appearance we have.

When the academic successes of the experimental and control group members are compared according to FEAT post-test, it has been determined that the cooperative learning model methods (Subject Jigsaw and Jigsaw II) make positive contributions to the students. According to the results of FEAT applied to the students, it was seen that the academic success levels of the members in the Subject Jigsaw group and Jigsaw II were higher and had a statistically significant difference compared to the students in the Control groups. It was seen that the groups consisting of Subject Jigsaw and Jigsaw II students were more successful than the students in the Control group and this success created a statistically significant difference. The Subject Jigsaw method and Jigsaw II method used in this study had a positive effect on increasing academic success in practice classes compared to the plain narration method. The results obtained by applying cooperative learning methods in our study are consistent with the results of previous studies. (Doymuş, 2008; Ebrahim, 2012; Gelici & Bilgin, 2011; Ünlü & Aydıntan, 2011; Sezek, 2012.

The Subject Jigsaw and Jigsaw II methods are collaborative learning strategies that have been consistently found to increase student engagement, understanding, and overall academic performance compared to traditional learning methods. Some of the reasons why students in these groups did better than the control group is that traditional learning methods often rely on passive information intake, where students listen to lectures and take notes. In contrast, the

Subject Jigsaw and Jigsaw II methods require active participation. Students are responsible for learning specific content and teaching it to their peers, which can encourage deep engagement with the material. Research has shown that students remember information more effectively when they teach what they have learned (Chase, et al., 2009; Fiorella, & Mayer, 2013) The Subject Jigsaw and Jigsaw II approach allows each student to master a section of the lesson and then explain it to their peers. This process of teaching and discussing can enhance understanding and long-term retention. These methods also encourage students to analyze, synthesize, and evaluate information rather than simply memorize facts. Students must understand the subject well enough to be able to explain it to others, which can lead to higher-level thinking skills and a deeper understanding of the subject. Unlike traditional learning, where students often work independently, Subject Jigsaw and Jigsaw II encourage teamwork and collaboration, as students communicate effectively, listen actively, and work together to achieve collaborative understanding, which can be another factor contributing to increased success. Traditional learning methods, especially when lessons are delivered in a lecture format, can sometimes lead to student disinterest. Traditional learning can create a competitive atmosphere where students focus on individual success. Subject Jigsaw and Jigsaw II methods can integrate discussion, visual aids, hands-on activities, and peer instruction, allowing students with different learning styles to interact with the material in ways that best suit them, increasing success (Doymuş, 2022).

Ethics Declaration

Approval was not obtained when the study was conducted from the Department of Science Education

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