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Effect of Jigsaw II, reading-writing-presentation, and computer animations on the teaching of "Light" Unit

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The aim of this study is to determine the effect of Jigsaw II technique, reading-writing-presentation method, and computer animation on students' academic achievements, epistemological beliefs, attitudes towards science lesson, and the retention of knowledge in the "Light" unit covered in the 7th grade. The sample of the study consists of 71 seventh-grade students from two different middle schools located in Erzurum City (Turkey) in the 2013-2014 academic year. One of these schools was randomly determined as the Jigsaw II Group (JIIG) (n = 24). In this group, the Jigsaw II technique was used during the cooperative learning. Another school was taken as the Reading-Writing-Presentation Group (RWPG) (n=22). In this group, the reading-writing-presentation method was employed. The other school was appointed as the Animation Group (AG) (25). In this group, computer animations were used. Academic Achievement Test (AAT), Science Lesson Attitude Scale (SLAS), and Epistemological Belief Questionnaire (EBQ) were used for data collection. The data were evaluated by using descriptive statistics, ANOVA, and ANCOVA. According to the analyses results, the Jigsaw II technique and the reading-writing-presentation method are more effective than animations in terms of academic success and retention of knowledge, but the difference between the effectiveness of the reading-writing-presentation method and that of animations is not significant. The results also indicate that Jigsaw II and animations have more positive influences on epistemological beliefs when compared to the reading-writing-presentation method. Finally, they show that all the three methods and techniques used in the study are effective in creating positive attitudes towards the lesson among students, and the use of animations has more positive influences than others.

Key words: Cooperative learning model, Jigsaw II technique, reading-writing-presentation, computer animations, light unit, science and technology attitudes, epistemological belief.

INTRODUCTION

In this age, education is the only means of equipping people with competences that are compatible with the drastic changes and developments in the field of technology. Education is a phenomenon accompanying

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people throughout their lives and leads them to be productive and responsible. It is a factor directing the lives of societies (Gürdal et al., 1995). Science education plays an important role in education due to its contribution to the development of societies. Currently, science education aims at not only offering knowledge to students but also providing the society with individuals who interpret this knowledge, produce, explore, construct, think, criticize, create, are open to innovations, and constantly change themselves as social beings (Şimşek, 2005).

In this sense, we should not aim at making students memorize the scientific concepts in the science lesson. Instead, the abstract concepts covered in the lesson should be concretized via technological developments; students should be encouraged to conduct studies in basic research; attitudes towards science lessons should be improved positively; thinking skills should be developed by teaching how to learn; and active participation of students in the educational environment should be supported (Gök et al., 2012). Such an educational process is possible only after educators determine the teaching method that will raise the learning process at the highest level and undertake the responsibility to employ this method (Şimşek, 2005).

At the present study, the science lessons are taught through the methods and techniques that are familiar to teachers in most educational institutions. The methods and techniques employed by teachers are rather teacher-centered as it is the case with the traditional learning model. This learning model is a delicately-planned and ordered transfer process of the knowledge from the teacher to the students in a ready-to-take way. This model is widely used in schools for transferring knowledge, concepts, and principles and explaining generalizations. It requires teachers to be active while students are passive listeners (Bayrakçeken et al., 2012). In order to eliminate this problem and conduct an effective teaching process, it is necessary to select appropriate methods and techniques that fit the purpose of the lesson (Turgut and Gürbüz, 2011). These methods and techniques, putting a distance between educators and traditional sense of education, have an important role in providing students with permanent knowledge. Releasing the students from being passive and attributing active roles to them in the learning process will ensure this permanency. In other words, it requires preferring the practices which prioritize learning by doing and experience (Yiğit and Akdeniz, 2003). In addition, multiple learning environments should be created to benefit from the information technology, which can be quite useful for educational activities (Yılmaz, 2005).

Student-centered teaching methods allow students to make sense of new situations by using their experiences. Individuals actively participating in the learning process construct knowledge themselves (Çalışkan, 2005). In the active learning approach, students access the sources themselves while doing research, learn how to access information through different sources, organize and present pieces of information they collect, take and share responsibility individually and in group project works, and cooperate with each other through interaction to produce knowledge (Akar, 2012). In this learning approach, the methods and techniques that are in use are project-based learning, problem-based learning, inquiry-based learning, computer animation techniques, and cooperative learning model (Colburn, 2004; Doymuş, 2008).

One commonly used model of active learning approach to cooperative learning model is known as “Cooperative Learning, Work Group, Collaborative Learning, Peer Learning, Peer Teaching, Team Learning, Team Work, Collective Learning, Learning Communities, Reciprocal Learning, Study Circles and Study Group” (Kardaş, 2015). Cooperative learning is not just a group of students sitting together and studying separately or a student’s doing the whole work unaided. It is clear that splitting students into groups and expecting them to study together will not improve learning or collaboration. It is necessary for the sake of effective implication of the technique that students are motivated to study together (Gelici and Bilgin, 2011).

Being one of the methods and techniques of cooperative learning model, the Jigsaw method is used frequently. Employment of this method initially started with a study in which many educators from various branches participated (Aronson, 1978). Afterwards, the forms of practice of the Jigsaw method gained variety following the studies conducted by researchers. Literature contains techniques such as Jigsaw II, III, IV, reverse Jigsaw, and subject Jigsaw (Doymuş, 2008; Slavin, 1986; Hedeen, 2003; Doymuş, 2007). The fundamentals of Jigsaw techniques are the same, but it is possible to come across certain varieties in terms of practice.

The Jigsaw method has four main phases in practice. The introduction phase involves making heterogeneous groups in the class by the researcher. Afterwards, the researcher introduces the material or unit that is going to be studied by the students. She helps them understand what they are going to engage in. Later, the researcher assigns a piece of the material or unit to each of the students in the original groups. Expert group formation process involves bringing the students taking the same part of the material or unit into a single group. These are called expert Jigsaw groups. These expert groups prepare for their subjects with their peers that study the same subject as a group. In the reformation and report phase, the students from the expert groups return to their original groups and try to teach the part of the unit they have studied to their peers. The completion and evaluation phase may involve designing an activity to combine the learning process conducted by the students either individually or in groups. The evaluation phase involves employing assessments that are used for

cooperative learning model, which is followed by the completion of the process (Doymuş, 2008; Artut, Tarim, 2007; Eilks, 2005; Lai, Wu, 2006; Tamah, 2007; Shaaban, 2006). The difference in the implementation process of the Jigsaw II technique, which is one of the Jigsaw methods and employed in this study, is that expert groups take a proficiency exam before returning to their original groups in relation to the subject they have studied. As mentioned before, the Jigsaw II technique was employed to teach many units and yielded positive results (Şimşek, 2012; Doymuş, 2007). However, though there are studies on how this technique influences the epistemological beliefs of students in the field of social studies, there are only few studies dwelling on the practice of this technique in the science lessons in Turkey.

Another method employed in this study is the reading-writing-presentation method, which has been frequently employed in recent years and is one of the methods of cooperative learning model. This method aims at making students read individually and in group from various sources, have positive dependence, construct new knowledge over their existing knowledge, and improve their social and psychological skills. The method consists of three main phases. The reading phase is for students to increase their skills of constructing new knowledge through reading. The task assigned to the students in the reading phase (that is, reading the given texts) is for prolonging the duration students spend in thinking (White and Gustone, 1989; Yıldız, 2008; Cited in: Aksoy, 2011). The writing phase is a very important phase for students to understand, organize, and express what they have learnt. The main purpose of the writing phase is to make group members create a common group product by writing what they have learnt altogether, reach a consensus, and learn to listen to each other. The implementation process should involve creation of appropriate environments for students to conduct activities in all the classes and allow group members to carry out their own works. During the classes, teachers should systematically observe all the elements from small group skills and inter-personal communication to academic progress and inter-group communication. Students' behaviors such as contributions to each other's ideas, encouraging their friends, checking their learning, and contributions to group management should be monitored, and group performances should be determined (Goltz et al., 2008).

The third instruction technique employed in this study is the computer animations technique. This technique undertakes various roles in instruction. Certain studies point to three characteristics of animations. These are pictures, demonstration of certain movements, and simulation (similarity-animation). According to another definition, it refers to the demonstration of a series of images and pictures rapidly on the screen; demonstration of motionless and different pictures that are drawn either manually or with computer assistance in a certain order through a mechanical device; and animation of the reality and imaginary with motion (Kurt, 2006; Pekdağ, 2005). Computer animation refers to the creation of visual effects by means of graphical tools, the demonstration of a series of images and pictures rapidly on the screen, and the creation of motion graphics, pictures, or images through various computer software (Arıcı and Dalkılıç, 2006; Emrahoğlu and Bülbül; 2010; Tezcan and Yılmaz, 2003). Thanks to these characteristics, animation use has many benefits such as embellishment, getting attention, ensuring motivation, classification of complex information and events, increasing permanency, offering an effective learning by addressing to both the eye and the ear, and so on (Tezcan and Yılmaz, 2003; Arıcı and Dalkılıç, 2006). In addition, the use of computer animations is an effective method to eliminate the misconceptions of students (Yakışan et al., 2009). Worksheets that are prepared in computers are important because they reduce the cost, save time, and prevent potential accidents by offering a reliable environment of experimentation (Saka and Yılmaz, 2005). Animations help students develop creative ideas, pay attention to possibilities, and make attempts regarding various issues. Thus, they both provide interactive learning environment and offer individual instruction (Arıcı et al., 2006; Powell et al., 2003). Animations can be useful tools for science-technology education because some of the events covered in the science lessons are impossible to observe and hard to imagine (Burke et al., 1998; Sanger and Greenbowe, 1999). It is stated that the methods and techniques that are used to equip students with terminal behaviors in learning-teaching environments are extensively influential on epistemological beliefs, which are considered an area of individual differences, as well as learning and teaching processes (Cevizci, 2005; Öngen, 2003; Deryakulu and Büyüköztürk, 2005; Deryakulu, 2006; Muis, 2004). Based on the assumption that attitudes can be changed, making students more effective "learners" may give birth to more qualified learning processes. In this way, students' academic achievements may be influenced positively, and more importantly, students may become more competent in life-long learning, which may bring success in various phases of their lives (Karhan, 2007). In this sense, this study focuses on how the epistemological beliefs of middle school students, the adults of the future, are influenced and changed by the active learning methods and techniques that are employed in the education-teaching process.

The purpose of this study is to reveal the influence of the Jigsaw II technique, reading-writing-presentation method, and computer animations technique, which are among active learning methods and techniques, on students' academic achievements, epistemological beliefs, attitudes towards the science lessons, and the permanence of their academic achievements within the

Table 1. The research design.

Groups	Pretests	Experiments	Posttests
JIIG	AAT, SLAS, EBQ	Jigsaw II techniques	AAT, SLAS, EBQ, AAT -permanence
RWPG	AAT, SLAS, EBQ	Reading-Writing-Presentation method	AAT, SLAS, EBQ, AAT - permanence
AG	AAT, SLAS, EBQ	Computer Animations	AAT, SLAS, EBQ, AAT - permanence

framework of the "Light" unit covered in the seventh grade. To this end, the sub-problems below were tried to be answered in this study.

1. Is there a statistically significant difference between the academic achievements of the students who were instructed via the Jigsaw II technique, the reading-writing-presentation method, and the computer animations technique?
2. Is there a statistically significant difference between the epistemological beliefs of the students who were instructed via the Jigsaw II technique, the reading-writing-presentation method, and the computer animations technique?
3. Is there a statistically significant difference between the attitudes towards the science lesson of the students who were instructed via the Jigsaw II technique, the reading-writing-presentation method, and the computer animations technique?
4. Is there a statistically significant difference between the permanence of knowledge of the students who were instructed via the Jigsaw II technique, the reading-writing-presentation method, and the computer animations technique?

METHODS

This section deals with the research model employed, research sample, the data collection tools used, and the instructional processes implemented.

Research model

This study employed the reading-writing-presentation method, Jigsaw II technique, and computer animations, which are among the methods of cooperative learning model, to reveal their influences on the students' academic achievements, permanence of knowledge, epistemological beliefs, and attitudes towards the science lesson. Quasi-experimental design with randomly selected pretest posttest comparison groups was employed. In this design, the classes are included in the research as they are for an educational purpose. This design is used when the sample cannot be selected equally (Karasar 2005; McMillan and Schumacher, 2010). The research design is given in Table 1.

Study group

The study group includes 71 seventh grade students attending 3 different middle schools affiliated with the Ministry of National Education of the Republic of Turkey in the 2013-2014 academic year. Randomly, one of the schools was selected for the Jigsaw II technique (JIIG) (n=24); another was selected for the reading-writing-presentation method (RWPG) (n=22); and the last one was selected for computer animations (AG) (n=25).

Data collection tools

Data collection tools are as follows:

1. Academic Achievement Test (AAT)
2. Epistemological Beliefs Questionnaire (EBQ)
3. Science Lesson Attitude Scale (SLAS)

Academic achievement test *(AAT)*

AAT was prepared by the researchers in a way covering all the acquisitions of the "Light" Unit for the seventh graders. The table of specifications was prepared to ensure the validity of the test. This table was submitted to the faculty members of the Department of Primary Education Division of Science Education. Taking into account experts' views, necessary corrections that were made on the questions of AAT. For reliability calculations, the test was administered to 152 eighth grade students who had studied this unit before. Based on the obtained data, the questions decreasing the reliability of the test were excluded. The test containing 40 multiple choice questions was finalized. Reliability coefficient (Cronbach's alpha) of AAT was found to be α=0.78. The test was rated in such a way that each correct answer gets 2.5 points while incorrect or blank answers get 0 point.

Epistemological belief questionnaire (EBQ)

EBQ was developed by Conley et al. (2004). It is a self-reporting questionnaire. Students' answers are taken in a five-point Likert-type scale. The original questionnaire consists of 26 items. After being translated into Turkish language by Özkan (2008), it was administered to a group of primary school students to test the clarity and meaningfulness of the items. Following this implementation process, 2 items having negative correlations were excluded from the questionnaire. In the end, the questionnaire became ready to be used in Turkey. The final EBQ includes 15 positive and 9 negative items (that is, a total of 24 items). The Cronbach's alpha coefficient of the questionnaire was found to be 0.76.The students responded to the items marking the rates "I strongly agree", "I agree", "I am neutral", "I disagree", and "I strongly disagree". The analysis of the questionnaire statements is based on the following scoring: "I strongly agree" corresponds to 5 points and "I agree" corresponds to 4 points for positive statements in a descending order whereas "I strongly agree" corresponds to 1 point and "I agree" corresponds to 2 points for negative statements in an ascending order. The statement "I am neutral" corresponds to 3 points for both positive and negative statements.

Science lesson attitude scale (SLAS)

SLAS was developed by Geban et al. (1994). It is a 5-point Likert

type scale with a Cronbach's alpha reliability coefficient of 0.83. This scale consists of 15 items, 10 of which are positive while 5 are negative. These items are for revealing the attitudes towards the science lesson. The students responded to these items by marking the options I strongly agree, I agree, I am neutral, I disagree, and I strongly disagree. The analysis of the questionnaire statements is based on the following scoring: "I strongly agree" corresponds to 5 points and "I agree" corresponds to 4 points for positive statements in a descending order whereas "I strongly agree" corresponds to 1 point and "I agree" corresponds to 2 points for negative statements in an ascending order. The statement "I am neutral" corresponds to 3 points for both positive and negative statements (Balcı, 2009).

Experiment

The study was conducted with three groups. One of the groups was instructed via the Jigsaw II technique (JIIG). Another group was instructed via the reading-writing-presentation method (RWPG). The last group was instructed via computer animations (AG). Prior to the experiments, AAT, EBQ, and SLAS were administered to these groups as pretest to reveal their prior knowledge of the "Light" unit, epistemological beliefs, and attitudes towards the science lesson. Following the pretests, the instruction was completed in 5 weeks with 4 h per week as planned by the researchers. After the completion of the instruction, the same tests were administered to the groups as posttest. Apart from these, AAT-permanence was administered to the groups two months later following the completion of the instruction in order to reveal the permanence of the knowledge regarding the "Light" unit.

Instruction via the Jigsaw II technique

Before starting the implementation of the Jigsaw II technique, the students were informed by the researcher about the way the technique would be applied. The "Light" unit, which was intended to be taught, was divided into four sub-titles: Absorption of Light, Seeing Objects Colorful, Refraction of Light, and Lenses. Taking pretest scores and gender into account, groups were formed in such a way that they would be heterogeneous within themselves and homogeneity would be ensured between them in general as they had the same structure. The class was divided into 5 original groups (4 groups consisting of 4 members and another group consisting of 5 members). The groups were asked to elect a group leader within themselves. They were also requested to assign a name to themselves.

Each group member was assigned a subject with a sub-title to do research about their original groups. After a week of research and study about their subjects, expert Jigsaw groups, consisting of the students who had been assigned the same subject from all groups, were formed. The students continued their studies in the expert Jigsaw groups for another week and prepared a report to bring back to their original groups. After the completion of the studies in the expert groups, the students took an exam and returned to their original groups. Every student returning to their original groups explained their area of expertise to their peers in their original group for two weeks. Then they prepared a common group report. In the last week, the groups made their presentations. In this way, the instruction of the unit was completed.

Instruction via the reading-writing-presentation method

Before starting the implementation of the reading-writing-presentation method, the students were informed by the researcher about the way the method would be applied. Taking pretest scores and gender into account, groups were formed in such a way that they would be heterogeneous within themselves and homogeneity would be ensured between them in general as they had the same structure. The class was divided into 3 original groups (1group consisting of 4 members and 2 groups consisting of 5 members). The groups were asked to elect a group leader within themselves. They were also requested to assign a name to themselves. For 2 h, the students in the groups read various sources brought by each student regarding the first sub-title of the "Light" unit, which had been divided into four sub-titles. Afterwards, the groups that completed reading phase put away all the sources they read and prepared a report of what they learnt in 2 h. After the reports were evaluated by the researcher, the groups that got low scores were re-directed to the reading phase while those who got high scores passed on to the next phase: presentation. During the presentation, which took 1 h, the presenting group was asked questions by the other groups. As a result, the deficiencies detected by the researcher and peers were eliminated, and the necessary corrections were made. At this point, when there was not enough time to allocate for the presentation of each group, the groups to present was selected by drawing. This was repeated for the other sub-titles of the unit as well. In this way, the implementation process was completed.

Instruction via computer animations

In the class where computer animations were employed, the teacher initially asked the students to do research about the acquisitions of the unit by using relevant sources and their books and be prepared for the lesson. The teacher asked questions to the students regarding these acquisitions and created a discussion environment. Afterwards, the teacher employed 40 animations obtained from http://www.vitaminegitim.com website regarding the activities to be conducted while instructing the unit. In the beginning, the animations were played for 5 min without any students' or teachers' comments. Then these animations were played twice for the students. The students were asked to express their opinions about these animations. After the students expressed their views, the animations were played for a third time with the relevant explanations made by the teacher. After the explanations were made, animations were re-played when necessary and when certain deficiencies were detected among the students. Also, relevant explanations were repeated.

FINDINGS

Table 2 shows descriptive statistics results of the data obtained from AAT administered as a pretest before the instruction in order to reveal the students' prior knowledge.

Table 2 shows that the JIIG students got a higher mean score from pre-AAT compared to the RWPG students while the RWPG students got a higher mean score compared to the AG students. One-way analysis of variance (ANOVA) was carried out to see whether the difference was statistically significant. Analysis results are shown in Table 3.

Table 3 shows that ANOVA results regarding pre-AAT indicate no statistically significant difference between the groups in terms of prior knowledge [$F_{(2, 68)}$ =0,996; p>0, 05]. These values show that all the groups had similar prior knowledge regarding the "Light" unit. Table 4 shows descriptive statistics results of the data obtained from

Table 2. preAAT Descriptive statistics results.

Groups	N	X	SS
JIIG	24	39.0	11.48
RWPG	22	37.0	5.14
AG	25	35.2	10.26

Table 3. ANOVA results regarding pre-AAT.

Groups	Sum of squares	SD	Mean square	F	p
Inter-groups	179.038	2	89.519	0.996	0.375
Intra-groups	6112.737	68	89.893		
Total	6291.775	70			

Table 4. post-AAT descriptive statistics results.

Groups	N	X	SS
JIIG	24	78.0	11.34
RWPG	22	71.9	11.25
AG	25	67.4	9.31

Table 5. ANOVA Results of post-AAT.

Groups	Sum of squares	SD	Mean square	F	p	LSD
Inter-groups	1371.871	2	685.936	6.057	0.004	JIIG-AG
Intra-groups	7700.227	68	113.239			
Total	9072.099	70				

AAT administered as a posttest in order to reveal the influences of the methods on academic achievement.

Table 4 shows that the mean scores of the RWPG and AG students were lower than the JIIG students in post-AAT. One-way analysis of variance (ANOVA) was carried out to see whether the difference was statistically significant. Table 5 shows the analysis results.

ANOVA results regarding post-AAT shown in Table 5 indicate statistically significant differences between the academic achievements of the JIIG, RWPG, and AG students in terms of the “Light” unit covered in the science lesson [$F_{(2,68)}$ =6.057; p<0.05]. LSD, which is a multiple comparison test, was employed to reveal the groups such differences were in favor of. The results obtained from this test indicate that the academic achievements of the JIIG students were significantly higher than those of the AG students within the scope of the “Light” unit while the academic achievements of the RWPG students were lower than those of the JIIG students and higher than those of the AG students. However, these differences were not significant.

Table 6 shows the descriptive statistics results of the data obtained from EBQ administered as a pretest to reveal the students’ levels of epistemological beliefs.

Table 6 shows that the JIIG students got lower mean score from pre-EBQ compared to the RWPG and AG students. One-way analysis of variance (ANOVA) was carried out to see whether the difference was statistically significant. The analysis results are given in Table 7.

ANOVA results regarding pre-EBQ shown in Table 7 indicate statistically significant differences between the epistemological beliefs of the JIIG, RWPG, and AG students prior to the instruction [$F_{(2, 68)}$ =5.516; p<0.05]. Games-Howell, which is a multiple comparison test, was employed to reveal to the groups these differences were in favor of. The relevant results indicate that there was no difference between the epistemological beliefs of the RWPG and AG students while the JIIG students clearly had more negative epistemological beliefs compared to these groups.

Posttests were subjected to ANCOVA through covariation of the effect of the pretest on the posttest in

Table 6. Descriptive statistics results of pre-EBQ.

Groups	N	X	SS
JIIG	24	60.4	18.38
RWPG	22	72.4	8.51
AG	25	71.5	12.68

Table 7. ANOVA Results of pre-EBQ.

Groups	Sum of squares	SD	Mean square	F	p	Games-Howell
Inter-groups	2132.760	2	1066.380	5.516	0.006	OYUG-JIIG, AG-JIIG
Intra-groups	13147.183	68	193.341			
Total	15279.944	70				

Table 8. Descriptive statistics results of post-EBQ.

Groups	N	X	SS
JIIG	24	88.2	13.92
RWPG	22	70.5	9.58
AG	25	85.6	13.27

Table 9. The ANCOVA results of post-EBQ.

Source	Sum of squares	SD	Mean square	F	p	LSD
Pre-EBQ	1824.704	1	1824.704	13.916	0.001	
Groups	5427.767	2	2713.884	20.698	0.001	JIIG-OYUG, AG-OYUG
Error	8785.056	67	131.120			
CORRECTED Total	14785.972	70				

order to reveal which one among the RWA method, Jigsaw II technique, and computer animations was more influential on the students' epistemological beliefs. Descriptive statistics regarding the posttest scores were calculated. The results are given in Tables 8 and 9.

Table 8 shows that the mean scores of the JIIG and AG students got from post-EBQ were higher than the mean score got by the RWPG students.

Analysis results in Table 9 show that there are significant differences between the mean scores of the JIIG, RWPG, and AG students obtained from post-EBQ [$F_{(2,67)}$= 20.698; $p<0.05$]. LSD was employed to reveal the groups between which such differences existed. LSD results indicate that there was no difference between the epistemological beliefs of the JIIG and AG students. However, significant differences were detected between these groups of students and the RWPG students in terms of epistemological beliefs. These differences were in favor of the JIIG and AG students. Table 10 shows descriptive statistics results of the data obtained from SLAS administered as a pretest to reveal the students' attitudes towards the science lesson. Table 10 shows that the mean scores of the JIIG and RWPG students got from pre-SLAS were higher than the mean score of the AG students. One-way analysis of variance (ANOVA) was carried out to see whether the difference was statistically significant. The analysis results are given in Table 11. ANOVA results regarding pre-SLAS shown in the Table 11 indicate that there are significant differences between the attitudes of the JIIG, RWPG, and AG students towards the science lesson [$F_{(2, 68)}$ =4.121; $p<0.05$]. Games-Howell, which is a multiple comparison test, was employed to reveal the groups such differences were in favor of. The results indicate that there was a significant difference between the attitudes of the JIIG students and RWPG students towards the science lesson on behalf of the JIIG students while no significant difference was detected with the AG students. In addition, no significant difference was detected between the AG students and the other two groups' students in that matter.

Table 10. Descriptive statistics results of pre-SLAS.

Groups	N	X	SS
JIIG	24	55.6	5.21
RWPG	22	48.5	10.16
AG	25	53.4	9.61

Table 11. ANOVA results of pre-SLAS.

Source	Sum of squares	SD	Mean Square	F	p	Games-Howell
Inter-groups	606.912	2	303.456	4.121	0.020	JIIG-OYUG
Intra-groups	5007.285	68	73.637			
Total	5614.197	70				

Table 12. Descriptive statistics results of post-SLAS.

Groups	N	X	SS
JIIG	24	61.0	7.79
RWPG	22	56.4	6.56
AG	25	67.7	4.64

Table 13. ANCOVA results of post-SLAS.

Source	Sum of squares	SD	Mean square	F	P	LSD
Pre-SLAS	45.610	1	45.610	1.103	0.297	
Groups	1362.417	2	681.209	16.475	0.001	AG-JIIG, AG-OYUG
Error	2770.243	67	41.347			
Corrected total	4320,873	70				

Posttests were subjected to ANCOVA through covariation of the effect of the pretest on the posttest in order to reveal which one among the RWA method, Jigsaw II technique, and computer animations was more influential on the students' attitudes towards the science lesson. Descriptive statistics regarding the posttest scores were calculated. The results are given in Tables 12 and 13.

Table 12 shows that the mean score of the RWPG students got from post-SLAS were lower than those of the JIIG and AG students. The results from Table 13 indicate significant differences between the mean scores of the JIIG, RWPG, and AG students in post-SLAS [$F_{(2, 67)} = 16.475$; $p<0.05$]. LSD was employed to reveal the groups between which such differences existed. The relevant results show that more statistically significant positive developments occurred in the attitudes of the AG students towards the science lesson compared to both the JIIG students and RWPG students.

Table 14 shows that the mean score of the JIIG students got from AAT-permanence of knowledge was higher than the RWPG and AG students' mean scores. One-way analysis of variance (ANOVA) was carried out to see whether the difference was statistically significant. The analysis results are given in Table 15.

ANOVA results shown in the Table 15 indicate that there were statistically significant differences between the achievements of the JIIG, RWPG, and AG students in AAT-permanence [$F_{(2, 68)}=19.093$; $p<0.05$]. LSD, which is a multiple comparison test, was employed to reveal the groups between which such differences were in favor of. The results obtained from this test indicate that the JIIG students were statistically significantly more successful than both the AG students and the RWPG students.

CONCLUSION AND RECOMMENDATIONS

This section presents the results of the study conducted to reveal the influence of the Jigsaw II technique, reading-writing-presentation method, and computer animations on students' academic achievements,

Table 14. Descriptive Statistics Results of AAT-permanence.

Groups	N	X	SS
JIIG	24	76.2	9.32
RWPG	22	65.5	7.44
AG	25	61.7	10.22

Table 15. ANOVA results regarding AAT-permanence.

Groups	Sum of squares	SD	Mean square	F	p	LSD
Inter-groups	3181,239	2	1590,619	19.093	0.001	JIIG-OYUG, JIIG-AG
Intra-groups	5664,958	68	83,308			
Total	8846,197	70				

epistemological beliefs, attitudes towards the science lesson, and permanence of knowledge within the scope of the "Light" unit covered in the 7th grade science lesson and recommendations for future studies. Among the methods and techniques employed in the study, Jigsaw II and reading-writing-presentation were seen to be more influential on academic achievement and permanence of knowledge compared to computer animations. However, the difference between the influences of reading-writing-presentation and computer animations was not significant (Tables 4 and 5). It is possible to say that all the methods and techniques employed in the study ensured the permanence of knowledge. However, Jigsaw II technique was more influential than others (Tables 14 and 15).The reason underlying this result may be students teach the topics they specialize each other, the Jigsaw method direct them to cooperation, they explain their ideas in a relaxed atmosphere while application of Jigsaw method, so learning process are more productive. These results are consistent with the results of the previous studies asserting that cooperative learning model plays an effective role in transforming knowledge into terminal behaviors, improving students' motivations and skills, facilitating the comprehension of subjects that are difficult to understand, and making the knowledge permanent by keeping students active, ensuring personal participation of students in the activities, and making students understand subjects better (Ghaith and El-Malak, 2004; Aladejana and Aderibigbe, 2007; Artut and Tarim, 2007; Doymuş, 2007; McKee et al. ,2007, Maceiras et al., 2009; Aksoy and Doymuş, 2011; Sancı and Kılıç, 2011; Zacharia et al., 2011; Akçay et al., 2012; Demir, 2012; Akkuş, 2013; Aksoy, 2013; Aksoy and Gürbüz, 2013; Evcim and İpek, 2013; Fırat, 2014; Çalıklar, 2015; Kardaş and Cemal, 2015; Şahin, 2011; Kardaş, 2013 b; Kardaş, 2015 a; Kardaş, 2014; Kardaş, 2013a; Kardaş, 2013c; Şahin et al., 2011; Kardaş, 2013 d; Maden et al., 2011). The effectiveness of the Jigsaw technique is supported by other studies as well (Özdilek et al., 2010; Koç, 2013; Kılınç and GüvenYıldırım, 2015; Aydın and Kömürkaraoğlu, 2016; Şahin, 2011 a; Maden, 2011a; Şahin, 2010 a; Maden, 2010; Avşar and Alkış, 2007; Yapıcı et al., 2010).

There were differences between the results of the Epistemological Beliefs Questionnaire administered before and after the instruction in the group instructed via the Jigsaw II technique and the group instructed via computer animations. However, no difference was detected in the group instructed via the reading-writing-presentation method. Hence, it is possible to say that the Jigsaw II technique and the use of animations had a more positive influence than the reading-writing-presentation method (Tables 8 and 9). It is obvious that thanks to the contribution of the Jigsaw II technique and use of animations, the students realized that the only source of knowledge is not the teacher or the book. They became aware of the fact that it is possible to access knowledge through various sources. They also recognized that the correctness of knowledge is testable. All of these made a positive influence on their epistemological beliefs. There are studies in the literature reporting that active learning methods and techniques have significant influences on the epistemological beliefs of students (Conley et al., 2004; Özkan, 2008; Kaynar et al., 2009; Kızılgüneş et al., 2009; Boz et al., 2011; Fırat, 2014; Çalıklar, 2015). It is possible that the reading-writing-presentation method was not influential on the students' epistemological beliefs because they had difficulty in working in group in the reading and writing phases and had a tendency to work individually. There were differences between the results of the Science Lesson Attitude Scale administered before and after the instruction in all the three groups. Hence, it is possible to say that all the methods were effective in creating positive attitudes towards the science lesson among the students. However, the use of animations was seen to be more effective in this matter (Tables 12 and 13). This may be because animations addressed both visual and

auditory senses, created pleasure among the students to follow the instruction, enhanced motivation, and increase the interest in the lesson. Taking the results into account, it is possible to say that active learning methods and techniques can be employed for other subjects and units as well. In this way, learning can become more effective and permanent. In addition, students' epistemological beliefs and attitudes towards lessons can be improved. Moreover, if other active learning methods and techniques are applied for other units and subjects of the science lesson in future studies, beneficial results may be obtained.

Conflict of Interests

The authors have not declared any conflict of interests.

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