EXAMINING THE INFLUENCE OF TECHNOLOGY AND PROJECT-SUPPORTED THINKING JOURNEY ON ACHIEVEMENT

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ABSTRACT
The purpose of this study was to investigate the influence of the technology and project-supported Thinking Journey on 11th grade high school students' achievements in the subject of electricity units. The participants were 68 high school 11th grade students from two different science classes. Control and experimental groups were selected at random. The data collection tools were the Electricity Achievement Test consisting of 39 multiple-choice questions and a semi-structured interview form. In the study, the experimental group was taught using the technology and project-supported Thinking Journey while the control group was taught using teacher-centered teaching methods. The Electricity Achievement Test was applied as pre-test and post-test to both experimental and control groups. The data were analyzed with independent group *t*-tests. Findings suggest that a significant difference was found between the experimental and control group students' Electricity Achievement post-test mean scores in favor of the experimental group with respect to sub-dimensions of Bloom's taxonomy. According to the analysis of the interviews, the experimental group students reported their satisfaction with the applications in the study.
Keywords: Technology-Supported Education, Project, Thinking Journey, Electricity Achievement, Students' Views.

INTRODUCTIO*N*

To allow individuals not only to make their knowledge permanent in the learning processes but also to transform their opinions into knowledge, as well as to make learning more attractive, new discussion areas have been formed covering "the systematic and reflective transfer process for the principles related to learning and teaching, instructional materials, instructional activities, information sources and evaluation plans" (Smith and Ragan, 1999). Besides these factors, the relationship between the teacher and the student is among the important factors influencing the learning process. Related to these factors, Yavuz (2006) asks these questions: "Will changes resulting from the rapid development of science and technology influence the teacher-student relationship found in educational institutions today as well as the place and importance of the teacher and of the student in educational environment and their duties and responsibilities in the education system? Will they be able to keep up with the abundant number of technological tools provided by the age of change and development and meet the constantly changing needs? Or will they proceed on their own ways without being influenced in any way by these factors? In addition, are teachers supposed to teach students everything? How much of information should be transferred? Should students receive the information simply from the teacher?"

In order to provide answers to these questions, a number of studies (Montgomery, 2000; Kelly,1980) have been conducted since Dewey (1938), and the student-teacher relationship has been examined. Besides the teacher-student relationship, other factors influence the learning process. For example, the existence of a student in the centre of learning or the creation of technology-supported learning environments is an important factor influencing the learning process (Phillips, 2005). In this respect, computer-supported and constructive-learning approaches have been developed in a way appropriate to the present modern era. Considering the investigations and studies conducted, it is seen that learning approaches placing the individual in the center by both activating the individual's world of thought and benefiting from technological opportunities are quite common (Ölmez and Güzeliş, 2007; Tarım et. al., 2006). **'**Thinking Journey' is one of them. Thinking Journey is a format of teaching, effective in revealing pertinent knowledge of students (Schur and Galili, 2009). It is based on constructive learning approaches. It contains "an intensive dialogue between the teacher and the learner, as well as between the learners presents the tool, which reveals the cognitive needs of the learners required for their construction of valid knowledge" (Schur and Galili, 2009). "These works describe the connections between thinking processes and the ability to observe a phenomenon and its changes" (Yair, Yaron and Mintz, 2003). Besides, Thinking Journey invites students to develop multiple perspectives about scientific concepts. This is important for students in that they can compare situations. After a literature review, it was seen that this approach has rarely been studied. Because of this, this study tested the applicability of a new student-centered learning method.

The present study aimed at investigating the influence of the applications of Thinking Journey supported with the technology and a project that addresses the visual world of students and allows them to think. This study evaluated 11th grade high school students' achievement in the course of physics.

MATERIALS AND METHODS

Participants

The present study was conducted with 68 students from two different 11th grade science classes (each had 34 students) in Diyarbakır in the spring term of the academic year 2009–2010. Of the participants in the experimental group, 58.8% were female and 41.2% were male. In the control group, the number of male and female students was equal.

Data Collection Tools

In this study, the researchers developed the Electricity Achievement Test to determine the students' knowledge regarding electric-related subjects. Two physics education experts, two physics experts, and one measurement and evaluation expert examined content validity and analyzed the test according to Bloom's taxonomy. The test consisted 39 multiple-choice questions – 6 of which were directed to obtain data regarding the students' knowledge; 5 were directed regarding their comprehension; 17 were directed regarding application; and 11 were directed at metacognition level – and was found to have a reliability coefficient of r=.73. Furthermore, a semi-structured interview form was used for determining the students' views about the application process and the applicability of the study. The interviews were done by a recorder.

Data Analysis

Quantitative and qualitative research methods were used in this research in order to analyze the data of the study. In the qualitative part, the pre-test and post-test research design was used for both groups. The difference between the Electricity Achievement pre-test and post-test mean scores was statistically examined. For this purpose, the *t*-test for dependent and independent groups found in SPSS 15.0 was used. In the quantitative part, to obtain views of the 34 students of the experimental group, semi-structured interviews were done by the researchers. The data were obtained from the interviews held was transcript**.** Content analyze method, done by forming theoretical insignificant themes and sub themes.

Application Process

The experimental group was determined on a random basis. The study started with 36 students and completed with 34 fully attending students. The study was conducted with three course-hours in a week and lasted eight weeks. This duration did not include the course-hours during which the students were informed about the Thinking Journey, the "Project", and about the animation-simulation program, or the course-hours during which the Electricity Achievement pre-test and post-test were administered to the experimental and control group students. The study group students were divided into nine groups, each with three or four students. The groups were formed based on the students' choices. The study group students determined the electric-related subjects they wanted to study. Regarding the studies to be carried out by the study group in the course of physics, the course teacher was provided with a work-file covering the fourth and fifth chapters, as well as subjects related to electric circuits presented in the third chapter. In addition, the teacher was informed about the application process.

The researchers prepared the activities to be carried out each week and presented them to the course teacher. The applications were carried out in the three course-hours of the physics course in line with the Thinking Journey, one course-hour being supported with the project and the other supported with simulations and animations in the classroom (Table 1).

On the other hand, the same subjects were taught to the control group students on a teacher-centered basis in the same duration of time.

Table 1: Process steps in technology and project supported thinking journey applications

Process Steps	Duration
Giving information about the applications and forming the team for the project	2 course-hours (in class)
Teacher-student dialogue via simulation-animation presentation	2 course-hours (in class)
Collecting information for the projects	6 days (out of school)
Teacher-student dialogue via simulation-animation presentation	2 course-hours (in class)
Evaluation of the information gathered for the projects	6 course-hours (electricity

	laboratory)
Doing preparations for the reports and presentations	2 days (out of school)
Teacher-student dialogue via simulation-animation presentation	2 course-hours (in class)
Discussion on project subjects with other teams	2 course-hours (in class)
Teacher-student dialogue via simulation-animation presentation	2 course-hours (in class)
Transferring project works into the electronic environment	1 course-hour
Teacher-student dialogue via simulation-animation presentation	2 course-hours (in class)
Presentation	2 course-hours (in class)
Teacher-student dialogue via simulation-animation presentation	4 course-hours (in class)

Experimental Process Steps of the Thinking Journey Based on Teacher and Student Dialogue in Classroom Environment

1. Goals were set: The student's behavioral changes expected to occur at the end of the process were determined.
2. Pictures, videos, simulations, or animations related to the subject were presented via the projector.
3. A question like "What do you see or hear?" was directed. A dialogue was started between the teacher and the student**.**
4. Sequential presentations in relation to the subject were made. The students were then asked to state what they had seen and thought.
5. The teacher directed questions regarding the similarities and differences between the visuals. The questions directed and the visuals presented were organized in a way to have the students make related comparisons.
6. Questions were directed regarding how the students reflected on the visuals in the presentation, taking their own lives into consideration.
7. The students were asked to put themselves into the place of some of the visual objects in the presentation. The question of "How would it be?" was directed.
8. Following this dialogue, the focus was on the object again. The teacher gave examples from real life experiences to help make permanent students' learning.
9. In the last phase, research on the related subject was carried out using simulation and animation programs.

Experimental Process Steps of Project

1. The target behavior that students were expected to have by the end of the applications was determined.
2. The outline of the subjects to be focused on or the work to be handled was determined. Using the list, the students chose the subjects they would study.
3. The students chose friends to work with and were divided into groups of three or four.
4. The students were informed about how the reports to be prepared would be and about which subjects the reports would cover. For presentation, CD and PowerPoint were selected.
5. The students were given the sample work schedule and were asked to plan their work time. In this way, the time planned for the applications was used effectively.
6. The students were regularly controlled. They were asked to list the studies they conducted for the projects they would carry out and to list the materials they would use in these projects.
7. The evaluation phase was devised at the beginning of the application as process and product evaluation. The "Individual Activities Evaluation Form (Student Autonomy)" and the "Group Activities Evaluation Form" were used as process and product evaluation.
8. The students gathered information from various sources. The Internet and the library acted as sources for the project research.
9. All the data gathered were reorganized, and the data considered necessary were put into report form. In this phase, the students discussed the projects together with their friends from the other group.
10. Finally, the projects prepared were transferred into CDs and the students presented to the class.

Groups and Project Subjects

The distribution of the subjects with respect to the groups formed was:
Group 1: Serial and parallel connection of resistors, factors influencing the resistance of a conductor, calculation of the resistance of water, reading the value of a resistor via color codes.
Group 2: Various methods of producing electric currency, forming an electric field.
Group 3: Wheatstone bridge, short circuit.
Group 4: Electrical work and heat.
Group 5: Producing a generator, connection of generators, fields of their use.
Group 6: Producing a fuse, producing an engine, fields of use of fuses and engines.
Group 7: Producing a condenser, serial and parallel connection of condensers, fields of their use.

Group 8: Electric circuits, producing a mini lamp, connection of a voltmeter to the circuit, connection of an ammeter to the circuit, Ohm's law, measurement of resistance, fields of their use.
Group 9: Serial and parallel connection of lamps, duration of their consumption, conductors and non-conductors, fields of their use.

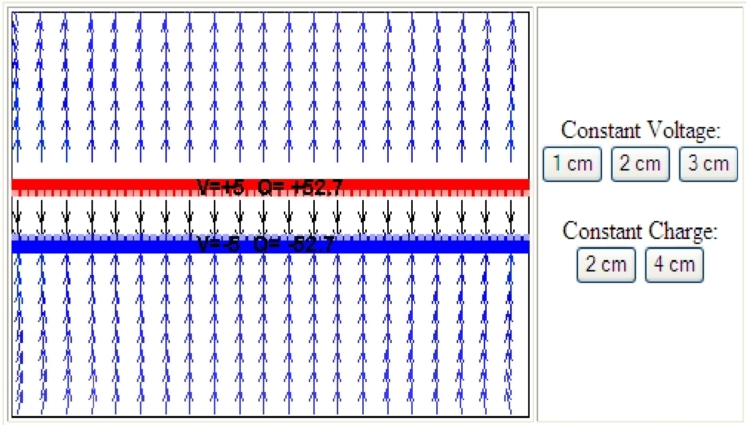

Figure 1: A sample application for condensers

Teacher: "*Let's look at the simulation above. We will make changes under constant voltage in one of them and under constant charge in the other. Now, what do you see?*"
Student 10: "*You change the charge distances between the plates.*"
Student 1: "*As the plates get away from each other, the potential increases, sir.*"
Teacher: "*All right, how will the charge change if we increase the distance between the plates under constant voltage?*"
Student 8: "*The charge on the computer seems to decrease.*"
Teacher: "*Let's look at the formula of C= k(A/d) =Q/V. Accordingly, let's think again looking at the simulation. How would the capacity change if I increase the distance, that is 'd'?*"
Student 3: "*It decreases because there is inverse proportion in-between.*"
Student 5: "*If the capacity decreases, the potential will increase due to inverse proportion.*"
Teacher: "*What would happen if I increase the distance between the plates while keeping the potential constant?*"
Student 5: "*The capacity will decrease again, but since it is in direct proportion to the charge, the charge will decrease as well.*"
Teacher: "*Well, what would happen if we put the plates closer to each other?*"
Student 5: "*Sir, just the opposite result to the previous one will occur.*"
Teacher: "*What do you mean?*"
Student 10: "*We see the capacity increase both in the simulation and in the formula.*"
Teacher: "*All right, can you give examples from our daily lives for the structure of the condenser?*"
No response.
Teacher: "*All right everybody, look out of the window? How is the weather outside at the moment?*"
(Student 11): "*Rainy.*"
Teacher: "*What do you think about whether the weather is conductive or not at the moment?*"
Student 11: "*Yes sir, the weather is conductive at the moment.*"
Teacher: "*Why do you think so?*"
Student 11: "*Well, the lightning flashes. There is flow of charge in lightning as well. In such situations, the air becomes conductive.*"
Teacher: "*Good, considering the fact that now the rainy weather becomes conductive, think what could happen outside at the moment?*"
Student 12: "*If the rainy weather is conductive, then electron flow occurs everywhere. In such a case, there would have to be lightning and thunderbolts everywhere. Now, there are no thunderbolts or lightning; then, the air is not conductive.*"
Teacher: "*All right, what do you think about the weather? Do you think it is conductive now?*"
Student 2: "*No, it is not. If it were, we would all get electric shock. Electric current everywhere would harm everything around.*"

Teacher: "*Good! The rainy weather is non-conductive if there is no electron flow, so is it dielectric? I said previously that in rainy weather, clouds are charged. The ground is also charged in opposite to the charge on clouds.*"

There were such ongoing dialogues between the teacher and the students.

Figure 2: A sample laboratory work related to the production of a condenser

Figure 2 shows an image showing an experimental group student's attempt to produce a condenser in the electric laboratory.

RESULTS

Table 2 presents the results of the analysis regarding the comparisons of the Electricity Achievement pre-test mean scores of the experimental and control groups in the study.

Table 2: Independent groups t-test results regarding the Electricity Achievement pre-test mean scores of the experimental and control groups prior to the experimental process (N=34)

Experimental	Group	$\overline{X}$	df	t	P
Knowledge	Control	1.94	1.179	-1.541	.128
	Experimental	2.38	1.181		
Comprehension	Control	1.03	.758	-1.724	.089
	Experimental	1.38	.922		
Application	Control	3.68	1.996	.563	.575
	Experimental	3.41	1.877		
Metacognition	Control	2.26	1.214	-1.234	.139
	Experimental	2.85	8.289		
Total	Control	8.85	2.630	-1.541	.128
	Experimental	10.12	3.998		

When Table 2 was examined, it was seen that there was no significant difference between the experimental and control groups' Electricity Achievement pre-test mean scores prior to the experimental process with respect to such sub-dimensions of Bloom's taxonomy as knowledge, application, and metacognition and with respect to the total scores (P>0.05).

Following the experimental process, the experimental and control groups' Electricity Achievement post-test mean scores were compared, Table 3 presents the results.

Table 3: Independent groups t-test results regarding the Electricity Achievement post-test mean scores of the experimental and control group after the experimental process (N=34)

Source of Variance	Groups	$\overline{X}$	df	T	P
Knowledge	Control	2.38	1.349	-4.338	.000
	Experimental	4.00	1.701		
Comprehension	Control	1.12	.946	-5.194	.000
	Experimental	2.65	1.433		
Application	Control	4.88	1.871	-5.515	.000

	Experimental	8.97	3.896		
Metacognition	Control	3.21	1.572	-4.424	.000
	Experimental	5.38	2.400		
Total	Control	11.59	3.526	-6.168	.000
	Experimental	21.12	8.289		

When Table 3 was examined, it was seen that following the applications, the experimental group was more successful than the control group with respect to all the steps of Bloom's taxonomy (P<0.05).
Before the applications were started, the experimental group was asked directed questions about their knowledge of physics and about whether they wanted to work in a field related to physics, yet no positive response was received from any of the students. The students stated that physics teachers could not easily find a job and reported that they generally preferred to be a doctor (faculty of medicine) or other professions with a higher possibility of finding a job. Moreover, to determine how the active learning applications in experimental group affected students' learnings and ideas about the process and applicability of the "Thinking Journey Supported with the Technology and Project" in detail, semi-structured interviews were conducted. The researchers analyzed the interviews held with the experimental group students following the applications content of the data. According to the results, the experimental group's views were gathered under ten headings: usefulness of the applications; the sections that the students most enjoyed during the applications; difficulties experienced during the applications; views about the application of the method in other courses; preference of the method; laboratory experience and effectiveness; reflections of what had been learnt via the method into real life; contribution of the method applied; attitudes towards the course and the subject; and the contribution of the method applied to social relationships. Following the examination of these headings, themes were determined, which were the main points of the students' views. Below are these themes, as well as the students' views about these themes:

Permanency: The experimental group students stated that the "Thinking Journey Supported with Technology and Project" applied was beneficial because it was more permanent than the teacher-centered method. One of the students reported his views about whether the "Thinking Journey Supported with the Technology and Project" was beneficial or not, as follows:

> *"Of course, I believe it is useful because this is my 11th year as a student and for the first time, we conducted an experiment related to physics in a laboratory environment; we saw the animations, and we talked about them. It was more permanent for me. At least, I did by seeing. I did it by myself, not worrying about my job. It was easier for me, and it was better to understand"* (Student A).

Concretizing: The students reported that supporting the electric subjects visually with the new method was beneficial because it was based upon the Thinking Journey. Regarding this subject, one of the students reported:

> *"Well, it is beautiful and sounds better and more reasonable. We believe it is beneficial. We reinforce the subjects by conducting experiments. For example, we see the sources. We learnt how to use a voltmeter and ammeter by seeing and touching"* (Student C).

Usefulness: The students stated that they were satisfied with the new method because they were provided with the opportunity to conduct experiments themselves in the laboratory environment and because they had the chance to talk during the in-class applications. In addition, the students reported that in the previous method (teacher-centered), they learnt something via the teacher's instruction, but with the new technique, they did something on their own, which was more effective. Regarding this subject, one of the students reported:

> *"Yes, sir, it was certainly beneficial. It was good to speak in class and discuss with friends. We also developed our computer use. Also, we are studying in a laboratory environment for the first time. This contributed to us as well"* (Student D).

Visuality: A majority of the students stated that the visual presentations influenced them and that they found this new method beneficial. They also pointed out that seeing certain activities and presentation types both in the computer environment and in the laboratory environment was more effective on them. Regarding this subject, one of the students reported:

> *"Well, it was useful for me. I liked it because if it is based more on formulas, we get bored more easily of that course. Now, because the subject is taught visually, we were entertained more. I can remember more things about the subject but because we are generally accustomed to formulas, well, actually, we can only deal with questions"* (Student G).

Simulations-animations: The students stated that they met simulations and animations for the first time and enjoyed them. Regarding this subject, one of the students reported:

> *"I liked the simulations and the animations that you demonstrated in the computer, they are very enjoyable"* (Student C).

Dialogue: Some of the students pointed out that they had the chance to speak in class and enjoyed stating their views in the class. Regarding this subject, one of the students reported:

> *"Sir, speaking in class and discussing with friends was very beautiful"* (Student J).

Interest in the course of physics: The students stated that following the experimental process, their interest in the course of physics had increased. Regarding this subject, one of the students reported:

> *"In the past, to tell the truth, I was never interested in physics. Yes, only the formulas. Well, we used to answer the same questions with a single formula. It was quite difficult. When we use only one single formula, well, it really becomes difficult. Thus, we at least saw in this way"* (Student E).

Cognitive contribution: The students stated that they were more successful in electric-related subjects. The students reported their views about the question of whether the new method applied contributed to them cognitively:

> *"Well, I, as a 7th grade student, never listened to the teacher in the course of physics. I don't remember listening to the lesson. I even don't remember the subjects we learnt during the lessons. Well, I don't remember exactly but the subjects were, I think, buoyancy of water, something like that. I didn't have much knowledge about electric. But now I have, and I liked it. It was pleasant. Now, for example, we know all the concepts, especially the lamps"* (Student H).

DISCUSSION

In the study, no significant difference between the experimental and control group students' Electricity Achievement pre-test mean scores prior to the experimental process was found at the significance level of 0.05 with respect to such sub-dimensions of Bloom's taxonomy as knowledge, application, and metacognition and with respect to the total scores. Based on these findings, it could be stated that the experimental and control group students had similar levels of achievement prior to the experimental process. This is considered important for an experimental study to provide healthy results. Other studies showed that experimental and control groups' similar levels of achievement prior to experimental processes are considered important (Güven and Gürdal, 2002; Güler and Sağlam, 2002; Aladağ, 2008).

When the comparisons made between the groups at the end of the applications were taken into consideration, a significant difference was found at the 0.05 level between the experimental and control group students' Electricity Achievement pre-test and post-test mean scores in favor of the experimental group with respect to the sub-dimensions of Bloom's taxonomy as knowledge, comprehension and metacognition, as well as with respect to the total mean scores. Dependent on these findings, it could be stated that the Thinking Journey Supported with Technology and Project was more successful than teacher-centered traditional methods**.** The experimental group students are guided on a thinking journey with carefully constructed, open ended questions. So, it could said that at the end of the study experimental group students improved their cognitive, behavioral, visual skills of their scientific world. Different from other studies in this study we supported Thinking Journey with projects, animation and simulations. This blended method helped the students to improve their thinking skills with touching to the teaching materials via projects and seeing them as a moving net via animations and simulations. The interactions in the Thinking Journey enabled students to observe the concepts from different perspectives. So the students could constructed their scientific concepts with open ended questions, projects and computer. In this way the students were walking in the learning environments with their thinking activities. The teacher only guided them not show them. Being in the center of the learning is very important for the students to transfer their thinking skills to use the knowledge. Schur et al. (2002) stated that this method "may enable the student to extend her/his view of the earth, and to show her/his that her/his initial perspective is just a particular case of the whole picture". In another study, Stein, Schur and Galili (2009) stated that Thinking Journey applications have a strong effect on the students' active learning of physical concepts. Schur and Galili (2009), Schur (1999) and Schur et al. (2002) found out the Thinking Journey they applied in the computer environment positively influenced students' success and motivation. Moreover, Yair, Schur and Mintz (2003) carried out a study named "A Thinking Journey to the Planets Using Scientific Visualization Technologies: Implications to Astronomy Education." In the study, they stated that the use of images, films, computer programs, and other means that make use of visual information is bound to increase in the future educational programs (Barab et al., 2001). In addition to, they stated that with Thinking Journey, students can construct their views of world in scientific situations and this can be enjoyable for them.

In their study on "Examining Teachers' Views about Methods and Techniques Applied in the Field of Education", Aydede et al. (2006) concluded that the majority of teachers believed student-centered and laboratory and technology supported methods and techniques increased students' participation and thus influenced students' success positively. A number of studies conducted revealed a positive influence of student-centered applications on students' success. Aladağ (2008) investigated the "Influence of the Project-Based Approach in Elementary School Mathematics Teaching on 4th Grade Students' Academic Achievement". At the end of the study, it was concluded that the achievement levels of the students receiving instruction via the project-based learning approach were higher than those of the students receiving instruction via traditional methods. Regarding the computer-supported learning, one of the methods increasing students' achievement and motivation, Kıyıcı and Yumuşak (2005) carried out a study called "Influence of Laboratory Experiments in the Course of Science Conducted with the Computer-Supported Learning on Students' Gains." At the end of the study, it was revealed that the students' gains in the computer-supported learning environment were higher than the students' gains in the traditional classroom environment. Especially for the science lessons, assignment of the laboratory experiments as a project subject was an effective method for healthy learning. Laboratory work influences reasoning, critical thinking, and an understanding of science and teaches students how to produce information (Akdeniz et al., 1999). In a study conducted by Güven and Gürdal (2002), the researchers investigated the influence of the method of conducting an experiment in the lesson unit of electricity on students' achievement. At the end of the study, the researchers found that the experimental group was more successful than the control group was.

The data obtained via the interviews held with the experimental group students following the applications of the "Thinking Journey Supported with the Technology and Project" were divided into categories and themes. When the content of these themes was examined, it was seen that the students were satisfied with the process as a whole yet experienced certain difficulties. First, the majority of the students stated that they considered the physics course quite difficult and that their thoughts changed following the applications carried out during the lessons, and they developed more positive attitudes towards physics. The experimental group students also reported that they found "Thinking Journey Supported with the Technology and Project" beneficial; that the method contributed more to them in terms of affective, and cognitive and psychomotor skills; and that the knowledge they acquired was permanent. From these result, it could be said that the students had positive ideas and views about the applications. Similar to this study, Korkmaz (2007), examined students' views towards student-centered learning methods. Korkmaz found that the methods and environment of teaching and learning had a positive effect on most of the students. In Korkmaz's study, the students stated that "student centered methods that were used in the course had positive impact on attendance of course, active learning, meaningful understanding, permanent in learning, and expression of opinions."

CONCLUSIONS

From the results of the study, it could be said that within technology and project supported Thinking Journey method the students were provided to compare, construct, develop multiple perspectives of the scientific concepts and make sense of the learning processes.

The following suggestions were put forward in line with the findings of the present study:

- The teacher should organize the learning environment in the physics course in a way to allow students to direct questions, to have self-confidence, and to express their thoughts comfortably.
- The applicability of this method could be tested in other science courses.
- The Thinking Journey could be applied in other physics-related subjects with the support of various instructional materials.
- Trainings given to science/physics teacher candidates could focus on the effectiveness of creative and critical thinking in education on healthy learning, and related importance could be given in the development of the course contents.
- It would provide a better view with more students.

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