

Evaluation of Peer Instruction Practices in Accordance with Students' Views

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Abstract

This study was carried out in order to determine the views of the students about the course material prepared with the Peer Instruction Method in accordance with magnetism. Studies conducted for this purpose are defined as case studies in the literature. The sample of the study consisted of a group of 30 students in 10th grade who were studying at Ordu Science High School during the 2015-2016 academic year. The practice lasted four weeks, 2 hours per week. The data of the study was derived from Attitude Survey, semi-structured interviews, open-ended questions for observations and the observations themselves. The quantitative data obtained in the study were analyzed by the qualitative content analysis method with the help of the SPSS program. At the end of the Peer Instruction Method, it was determined that the students' attitude questionnaire post test scores ($X = 130.9$) increased and their increase was statistically significant ($t = -7.22$; $p < .05$) compared to the pre-test scores ($X = 101.46$). When the results of the students' opinions and observations are analyzed in detail, the results of the classes conducted by the Peer Instruction Methodology reveals that the students have increased their confidence, improved their ability to comment, have active participation in the classes and have become fun. According to the results obtained with this study, some suggestions were made to the researcher on behalf of the use of different topics in physics considering the positive effect of the Method of Peer Instruction.

Keywords: magnetism, physics education, peer instruction method, conceptual understanding

1. Introduction

Depending on the developments in science and technology, learning and teaching processes and methods are changing, too. From the middle of the 18th century when education began to be regarded as an area of science, various theories were developed to explain how learning is obtained. In the 1800s, while behavioral theories prevailed in education, cognitive theories were dominant in the 1900s. Today, on the other hand, education policies are built on constructivist theories (Alan, 2000).

In the teaching of science, learning theories which were developed especially by Jean Piaget, Jerome Bruner, Robert Gagné and David Ausubel were outstanding. While Piaget describes learning as an age-related process and explains it according to the theory of mental development, Gagné suggests a gradual method from simplicity to complexity, from concrete to abstract. Bruner, who brings concept teaching to science teaching and method of learning through invention, stated that in the course of concept teaching, the name, definition, characteristics and concept examples of the concept should be followed up sequentially. Ausubel has argued that the most important factor influencing learning with the meaningful learning theory it has developed is the existing knowledge, and that this accumulation must be uncovered and taught accordingly (Demirel, 2004).

Under the title of learning theory and teaching approach in the 2013 Physics Teaching Program, one of the most significant indicators of learning is defined as being able to use the common language of the learned field, and according to some learning theories, the level of learning is defined as the level of participation in the discussions about the learned field. As the knowledge and skill levels of the peers are close to each other, students' interactions with their own peers may sometimes be more effective than their interaction with their teachers, and they can learn more things from each other. Thus, the information which the students have is deepened as they share and discuss them, each other (MEB, 2013)

As stated in the 2013 Physics Teaching Program, selecting the methods which would make the student active would make learning easier. Giving chance to the students for discussing with each other in the course will be effective in comprehending the concepts. Generally, traditional methods are preferred in which the teacher is active and the student is inactive because of the authority problem, the excess of the class presence, the inadequacy of the class hour. Though, for meaningful and permanent learning, the student must be actively involved in the learning process. Active learning is a process in which the individual is given the opportunity to make decisions and self-regulation by taking responsibility and is forced to use his mental skills (Açıkgöz, 2003).

One of the active learning methods is the Peer Instruction Method developed by Mazur (1997). Mazur has developed this teaching method by restructuring traditional teaching. In this method, the topic is briefly told. Then, with the conceptual questions asked, the students are enabled to reinforce and deepen the concept by making small group discussions. Reading assignments are given one day before the class so that students can be prepared to come to class. The Peer Instruction Method which was developed by Mazur (1997) and applied to

university students, was later tested on high school students by various researchers and revealed that they are effective in conceptual understanding of students. Aydede and Matyar (2009), Peer Instruction Method is one of the three methods that active sixth graders use in studying the effect of cognitive level on student achievement in the science class. As a result, they emphasized that active learning methods and techniques are activities that can be applied in every environment and they have found that they increase student achievement. According to Crouch and Mazur (2001), discussion with peers is very significant in the success of the Method of Peer Instruction. This method encourages the active participation of the students in the classroom to develop their comprehension skills.

Şekercioğlu (2011) investigated the effects of the Peer Instruction Method on the conceptual understanding levels of the teacher candidates about electrostatic topic and attitudes towards this method. At the end of the study carried out with 157 prospective teachers, it was determined that the success scores of the teacher candidates in the classrooms where the students are taught according to the Peer Instruction Method are higher than the teacher candidates in the classrooms taught with the traditional method. According to the results of the Peer Instruction Method Attitude Questionnaire, it was determined that the attitudes of the teacher candidates towards the method were positive and that the teacher candidates had a positive attitude and opinion towards this method according to the interview data. Zhang, Ding and Mazur (2017) examined the influence of the Peer Instruction Method on students' attitudes and beliefs toward basic philosophy in their study of 441 students at Beijing Normal University in China. The study's data were collected through an attitude survey (Colorado Learning Attitudes about Science Survey). Analyzing the survey results, they found that there was no change in attitudes and beliefs in traditional teaching classes, but in the peer-taught classrooms, students were found to develop attitudes and beliefs towards physics.

The purpose of this study is to determine the students' approaches and views about the practice of Peer Instruction Method in physics teaching, which is based on constructivist theory of learning and which would make the students more active in the classes.

2. Method

This study was carried out in order to determine the opinions of the students about the course material prepared with the Peer Instruction Method for magnetism. Studies conducted for this purpose are defined as case studies in the literature. The case study, enables the very small details, causes and effects and the variables to be explained in terms of their relation with each other by enabling to focus on a specific situation (Çepni, 2007). The sample of the study consisted of a group of 30 students in 10th grade who were studying at Ordu Science High School during the 2015-2016 academic year. The practice lasted four weeks, 2 hours per week.

Data Collection Tool

The data of this study was derived from, Attitude Survey, open-ended interview questions, observations and semi-structured interviews.

In this study, the Attitude Survey which was developed by Tekbıyık (2010) was used in order to determine the attitudes of the students towards physics. The opinions and recommendations of physics instructors and educational science specialists and physics teachers are taken into account to ensure the content validity of the scale. The scale was applied to 166 students and item discrimination, factor analysis and determination of internal consistency were carried out. The Physique Attitude Questionnaire consisted of four sub-dimensions called importance ($\alpha = 0,838$), grip ($\alpha = 0,795$), need ($\alpha = 0,749$) and interest ($\alpha = 0,717$) and the internal consistency coefficient for the 30-item scale was calculated as $\alpha = 0.873$ (Tekbıyık, 2010).

Semi-structured interviews were made with five students in order to determine the students' views about the prepared materials and the activities conducted during the classes. The students were selected with purposive sampling. Taking the consent of the students, the interviews were recorded. Then, they were written. Thinking of the possibility that the students could not be frank and realist; the views of all the students in the study were taken and evaluated. Besides, the researcher reflected his observations about the conducted class and the behaviors of the students at the end of the each class.

The Process

The following sequence was followed while teaching with the Peer Instruction Method:

- ✓ Reading assignments were given to prepare students for classes beforehand.
- ✓ Whether the students did their reading exercise or not was controlled by applying easy reading tests.
- ✓ The subject (concept) was briefly told by the researcher for 10-15 minutes. The course materials were reflected in the classroom environment with the help of interactive board.
- ✓ The conceptual questions about the concept were reflected on the board.
- ✓ Students were given 1-2 minutes depending on the degree of difficulty of the problem and they were asked to discuss correct answers. They were enabled to answer by raising the cards in their hands.

- ✓ If the correct answer is around 90%, it was passed to the new question; (2-4 minutes) in case of a lesser degree, students were provided with the opportunity to discuss and think with each other. If deemed necessary, the course teacher made explanations. When the time was over, the students were asked to show their joint answer by raising again the cards in their hands.

Data Analysis

The Physics Attitude Questionnaire which was used in the research was designed as a five-point Likert type. In the analysis of the data obtained from the scale, firstly the arithmetic mean of the scale items was examined. The SPSS program was used for the necessary statistical analysis of the obtained data.

Content analysis method was used in order to evaluate the interviews, the open-ended questions and observations in the study. In content analysis, similar data was organized and interpreted with the help of specific concepts and themes brought together and presented to the reader. When this is done, the collected data are organized under the specified subtitles. Then the data is processed according to the specified subtitles (theme). Finally, this data is defined and interpreted (Yıldırım and Şimşek, 2006).

3. Findings

3.1. Findings Derived From the Attitudes Towards Physics

In order to investigate the effect of Peer Instruction Method on students' attitudes towards the physics lesson, the pre-test and post test attitude scores of the experimental group, which is the group which was taught by the peer instruction method, were compared with the dependent sample t test. The results of the analysis are given in Table 1.

Table 1: Experiment Group Physics Attitude Test Dependent Samples t Test

Student Group	N	Art. Mean	SS	t	p
Pre-test	30	101,46	21,04	-7,22	,000
Pro-test	30	130,9	9,23		

When Table 1 was examined, it was found that at the end of the peer instruction method, the final test scores ($X = 130.9$) of the students of the experimental group increased significantly ($t = -7.22$, $p < .05$) when compared to their pre-test scores ($X = 101.46$). This finding can be interpreted as a way of improving the positive attitude of the students towards the physics lesson.

When the general trends of the attitude scale applied before and after the teaching of the magnets and currents magnetic effect to the students of the experiment group were evaluated using the questionnaire general grading system, it was seen that the general trends of students were 2.98 before teaching; while it was 3.42 after teaching. When we examined the items that changed the general tendency after the training, it was seen that after the Peer Instruction Method, the students changed their attitude towards physics positively.

It can be said that from the interviews made with the students and impressions from the observations while the lessons are being conducted, the students showed a positive attitude towards the physics lesson. They even expressed that the lessons learned through the Peer Instruction Method were followed closely by a great deal of interest and curiosity, that the lessons were more enjoyable and that the lessons learned were more permanent, that they began studying on their own, or even read a section on physics in college.

3.2. Findings Derived from the Semi-Structured Interviews

Semi-structured interviews were made with five students in order to determine the students' views about the prepared materials and the activities conducted during the classes. Students' answers in the interviews were reflected using qualitative research techniques without the scoring path. Interview data were recorded electronically and analyzed by the researcher. In the interviews, students were asked to compare the method of peer instruction method with the traditional method, and their advantages and disadvantages were asked. Some of the answers given by the students are as follows:

S₁:...*At first, I was a bit prejudiced. I thought that the discussion was a waste of time. As the classes proceeded, the discussions we made about the concepts, developed my ability to make comments. My faith for the success increase. I could say that I began to love physics. This method makes learning easy and permanent. However, not solving many numerical questions may be troublesome for the exams for higher education.*

S₂: *As we learn something by discussing about the questions, the classes were more enjoyable for me than the older ones. It eased our comprehension of the concepts. The discussions were also enjoyable because we got prepared for the class beforehand. The classes were more interesting and exciting when compared to the older ones. What I learned during these classes developed my ability to comment on the issues around. We could share the information we learnt with our friends by means of the discussions we made. As the visual materials are enabled by the smart-board application, I believe that the information I learnt would be more permanent...I even thought to select a department related to the physics in the university.*

S₃: *When the teacher said that we would use a different method in the class, I thought that he was mocking us until we started the classes. The reading assignment and test were very interesting. Previously, the definitions of*

the concepts were made, then the formula was given immediately and then the question was solved. Now we have attended the classes actively, we have discussed the subject. We understand that the discussion does not create chaos...

S₄: I was too bored during the classes. I memorized the formulas in a foolish way. However, learning with this method was more interesting. Our ability to comment has developed by means of the discussions we made with our friends. Our self-confidence has increased. I believe that the information we learnt would be more permanent. The method enables active learning, emphasizes on conception, different evaluation questions are asked and the participation of the student is also enabled. These features are the important advantages. However, this system could be a disadvantage while studying for the exams for higher education. Moreover, this system could not be applied in the crowded classes.

S₅: I was prejudiced against physics. I overcome this prejudice. I believed that you could not learn physics without a teacher. Now I think, I can learn some things by studying on my own. It was interesting to discuss, to be active continuously, to correct our mistakes. Now, when I face a question, I do not think about the formula which would solve it but I think about my own interpretation...

It can be derived from the interviews and the observations which were made during the practice of the study that the students found Peer Instruction Method positive and advantageous in the classes. When the statements of the students were analyzed, it was seen that the method's being interesting, permanent learning, conceptual learning, student-centred education, active participation in the classes and cooperation are the outstanding advantages. The most important disadvantage which the students stated is whether this system would be according to the system of ÖSYM (Assessment Selection and Placement Center). In the interviews, they frequently expressed this trouble. Besides, they explicitly said that the crowded classes could be a disadvantage for this method. The students' views are summed up in the following table:

Table 2: The Students' Views about the Peer Instruction Method

Codes	Frequency
Self-confidence	4
Ability to Comment	3
Cooperation and sharing	2
Active participation in the classes	5
Permanent learning	3
Interest and Curiosity	4
Enjoyful Information	5
Willingness for discussion	4

In relation to the difficulties about the prepared materials and the conducted classes, the students told that the time was not enough, they had difficulty in solving the numerical questions and sometimes there was chaos while they were discussing.

3.3. Findings Derived from the Open-Ended Questions

In order to determine the students' views about the classes conducted with the Peer Instruction Method, all students were asked open-ended questions and asked to state their opinions in written form. The positive and negative views of the students on the peer instruction method are given in Table 3 in the light of the findings of this study.

Table 3: The Findings Derived From the Open-Ended Questions

Status	Positive	Negative	Viewless
Reading activity before the class	28		2
Reading exams	24	3	3
Teaching the class (Conceptual explanations)	25	4	1
Teaching the class (Conceptual questions)	27	3	
Short-time peer discussion	24	6	
General point of view	24	6	

The third of the open ended questions was about "conceptual explanations during the teaching in the class. The students' views about this issue as follows (The numbers in the parenthesis indicates the number of the students):

As we read the topic beforehand, we could understand the concepts properly (6).

Our teacher has already had different methods of teaching. I think that this method has been beneficial for explaining the concepts and relating these concepts with other topics. (2).

There are many different concepts in the physics. Our teacher told them rationally. We could understand them

well(3).

Our teacher had a comprehensive knowledge of this topic. However, it could have been better if he had tell some of the concepts in more details. (5)

Our teacher told the topic in brief but I wish we could have participated and asked questions. (4).

It eased our understanding. We learned the necessary information instead of much information. (5).

Sometimes, it was too fast so we could not understand some parts completely. When we passed on to the questions, the concepts could be understood. (4).

3.4. Findings Derived from the Observations

Observational findings from the investigator's notes during the four weeks of the practice are as follows:

- ✓ When the researcher said that the course will be taught with a different method, a positive motivation in the students was seen.
- ✓ Contrary to the strident and sulky students when we observed during our classical, an atmosphere which was active and based on cooperation comprised.
- ✓ It was understood that the students had fun especially when they were rising the flashcards. The atmosphere was kind of a competition while they were rising the cards.
- ✓ The students were discussing each other not for the purpose of confute the opposite view but for the purpose of benefiting from each other's views.
- ✓ When the class ended, the discussions and the efforts to convince continued in the classrooms and holes.
- ✓ It was observed that in the thirth and fourth weeks, some students became passive.

4. Conclusion, Discussion and Recommendations

In this section, the results derived from the analysis of the study's findings and the and the appropriateness of the studies in the literature with these results was examined. In addition, based on the findings obtained as a result of the research, suggestions were made to the researchers who will work on this field.

In this study, it was observed that the post test scores of the attitudes of the students towards the physics classes in the classes conducted with the Peer Instruction Method increased significantly compared to their pre - test scores. This was also supported by the results of the dependent t-test ($t = -7.22, p < .05$). A similar result was observed when the general trends of attitude scale were evaluated using the questionnaire general rating system; the general trends of students were 2.98 before teaching; And 3.42 after the teaching. Based on these results, it can be said that the Peer Instruction Method contributes to the positive attitudes of the students towards the physics classes.

Independent t test results related to attitudes are generally not statistically significant in studies which compares peer tutoring with traditional teaching. Examples of these studies are those of Eryılmaz (2004), Şekercioğlu (2011) and Yeşiloğlu (2015). The results of Yavuz and Coşkun's (2008) study on the attitudes of the students towards technology use in teaching were found to be significant in the dependent t test. When the students' views about the method and its practice is analyzed, it can be said that at the end of the classes conducted by the Peer Instruction Methodology the students have increased their confidence, improved their ability to comment, have active participation in the classes and have become fun.

The results obtained from the interviews which were made with students in this study are also in accordance with the studies of Nicol and Boyle (2003) and Podolner (2000). Nicol and Boyle taught in the UK using peer instruction methodology with 117 mechanical engineering students and compared group discussions with classroom-wide discussion methods. According to the results of this research, Peer Instruction conducted with group discussions was found to be more effective than the teaching done with the help of class-wide discussions. In Podolner (2000) 's study, it is stated that in the courses conducted by the Peer Instruction Method, as the students try to convince their friends that both the correct answer rate given to the questions and the correctness of the correct answer increase. According to Piepmeier (1998), learning is not only about what the teacher says, but also about the interaction of the students' peers. Every student is given an active role every 15 minutes with the concept test in the Peer Instruction Method, although it is difficult to actively participate in all students in a crowded class.

Fagen, Crouch, and Mazur (2002) found that the method creates a positive atmosphere in the classroom, makes the lesson enjoyable, and maximizes student satisfaction and participation in a study in which they determined the views and ideas of 2750 teachers from 34 countries using the Peer Instruction Method in their classrooms, by conducting questionnaires. Other answers in this questionnaire are generally found the method as enjoyable, as a useful way of improving the participation, making the teaching of the concept well. When the answers given by the students to the open-ended questions are examined, it is seen that the results obtained in this study overlap with the results of Fagen, Crouch and Mazur (2002). Pilzer (2001) stated that peer discussion allows students to think deeply on questions. When the answers to the open-ended questions for the method used

in this study were examined, it was seen that the peer argument contributed to learning. The studies of Yeşiloğlu (2015) and Zhang, Ding and Mazur (2017) are consistent with the results of this study. There are some advices for the ones who would make research about the Peer Instruction Method and Physics Education in the light of the problems faced with and the experiences gained throughout the study, as follows:

Before starting the practice, both the practitioner and the students must be informed about the method and the process. The practitioners (the teachers) must be encouraged and they must be enabled to access the materials (conceptual questions, lesson plans, presentations and etc.) easily. So, the method can be practiced commonly.

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