Bridging The Gap Between Teachers and Curriculum Reform: Teachers' Opinions on The Effects of In-Service Training Course[1]

Öğretmenlerle Fen Programı Reformu Arasındaki Köprüyü Kurmak: Öğretmenlerin Hizmet İçi Eğitim Kursunun Etkileriyle İlgili Görüşleri

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Abstract

The aim of this study is to present teachers' opinions on the effects of the course teachers' knowledge related to science learning and teaching methods, and their opinions' on the difficulties related with science teaching methods. The participants included 16 science teachers. The reflective journal was used as a database for the study. Despite the limitations of short-term effect to teachers, the course contributed to positive changes in teachers' opinions about science learning and knowledge of science teaching methods. The improvement observed in teachers' knowledge may trigger them to use the methods they learned in the course when they face with difficulties such as covering the content, insufficient science equipment, crowded classes, and classroom management problems.

Keywords: *In-service Teacher Education, Professional Development, Science Education***.**

Özet

Bu araştırmanın amacı, fen öğretmenleri içi düzenlenen hizmet içi eğitim kursuna katılan öğretmenlerin kursun feni öğrenme ve fen öğretimiyle ilgili bilgilerine etkilerini belirlemek ve fen öğretim yöntemlerinin uygulanması sırasında karşılaşacakları sorunlarla ilgili görüşlerini sergilemektir. Çalışmaya 16 öğretmen katılmıştır. Çalışmada öğretmenlerin günlükleri veri toplama aracı olarak kullanılmıştır. Süre olarak kısa sürdüğü için öğretmenler üzerindeki etkileri sınırlı olmasına rağmen, kurs öğretmenlerin feni öğrenme fen öğretimiyle ilgili görüşlerine olumlu etkiler yapmıştır. Öğretmenlerin karşılaştıkları içeriği yetiştirme, yetersiz malzeme, kalabalık sınıflar ve sınıf yönetimi gibi sorunlar, kursta bu yöntemlerle öğrendikleri

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Anahtar sözcükler: *Hizmet İçi Öğretmen Eğitimi, Mesleki Gelişim, Fen Eğitimi.*

1. Introduction

Over the past decade, movements for science education reform have been quite evident. Hurd (1998) reported that science curricula should be updated in order to be consistent with advancements in science and technology. In Turkey, the revision process started with the elementary level in 2004 and, in the following years both the elementary and secondary curriculum were revised (Öztürk, 2011). From the national perspective, there were various reasons for changing the Turkish science curriculum. According to TIMMS, PISA and PIRLS results, the achievements of Turkish students' science and math were lower than those in other countries (Aksit, 2007). Furthermore, research indicated that the attitudes of students became more negative as their grade level increased (Kozcu-Çakır, Şenler & Göçmen-Taşkın, 2007). Researchers stated that science courses were mostly teacher-centered, textbook-driven and content-focused (Yilmaz, 2007). To find solutions for these problems, the science curriculum required radical changes not only in the philosophy of instruction but also in teaching styles, the roles of teachers and students, and the organization of curricula (Elmas, Öztürk, Irmak & Cobern, 2014). The aim of this reform was summarized by Akşit (2007) as a shift to a more student-centered constructivist model including the integration of information and communication technologies (ICT) into instruction and the use of formative assessment to check the student progress. Jansen (1999) proposed that curriculum development takes a long time, and that a revision of the textbooks - not just a reordering of content was necessary. Accordingly, new science textbooks were published based on the learning cycle method (Ekinci & Öter n.d.). Teachers were also recommended to use constructivist teaching and formative assessment methods in science courses (Karadağ Deniz, Korkmaz & Deniz, 2008).

To what extent the curriculum reform effected to the teachers practices can be evaluated by examining teachers' opinions and reactions towards the change. Although teachers supported the constructivist learning approach, they adopted a pedagogy in their instructional practices that uses close-ended questions, lecture and low levels of interaction among students (Marshall & Smart 2013; Wang, 2011). Science teachers in Turkey believe that the new curriculum is student centered, and that it aims to improve students' critical thinking skills (Tekbıyık & Akdeniz, 2008). On the other hand, there is some evidence that indicates the gap between the new curriculum's goals and the teachers' knowledge and instructional practices. For instance, it has been shown that the Turkish science teachers' have limited knowledge about the teaching and assessment methods which are the basis of the new curriculum (Güneş et al., 2010). Moreover, their beliefs about student-centered teaching strategies are low (Isikoglu, Basturk & Karaca, 2009). More importantly, teachers continue to use traditional methods of question-answer, lecturing, and presentation-practice in their courses (Şimşek, Hırça & Coşkun, 2012). In order to overcome these problems, Borko (2004) suggests in-service teacher training opportunities focused on the new teaching methods for teachers' professional development (PD). However, Turkish teachers found in-service courses conducted by the Ministry of National Education (MoNE) ineffective, mainly in terms of the quality of the instructors, the teaching methods employed, the duration of the courses and the support available after training (Cimer, Çakır & Çimer, 2010). The limited PD staff (Şenel-Çoruhlu, Er-Nas & Çepni, 2008) also hindered for teachers adaptation to the changes (Doğan, 2010). To help teachers see programs' the vision for learning, teaching and assessment as a whole, PD programs should be designed to improve teachers' knowledge and to align their teaching practice with the new curriculum (Avalos, 2011).

Professional Development for Science Teacher

Professional development (PD) is a complex process developing effectiveness at teachers' learning, learning how to learn and transforming their knowledge into practice for the benefit of their students' growth (Avalos, 2011). In order to make a teacher take part in reform-oriented practices, PD should be planned to provide more learning opportunities for them (Lee, Hart, Cuevas & Enders, 2004). According to Wilson and Berne (1999), one challenge is rooted in the PD. Although curriculum reform emphasizes a change from a traditional textbook-driven approach to a student centred approach (Crawford, 2000), the "traditional" PD programs which are based on a transfer of theoretical knowledge cannot help teachers to improve themselves (Anderson, 2002). In other words, teachers consider that PD is not appropriate to their teaching and student learning as the PD introduces the teaching materials in a different setting than a classroom environment (Sandholtz, 2002). The traditional PD is not learner centered as the content is identified without considering the needs of the teachers and an appropriate learning environment is not provided for them to understand and practice the new teaching method (Bransford, Brown & Cocking, 2000). As a result, most of the teachers do not learn and use the methods emphasized by the curriculum.

Instead of "traditional" PD programs, innovative PD programs are recommended for teachers (Posnanski, 2002). The advantages of innovative programs are centred on using pedagogical strategies, materials and assessment techniques related to specific curricula (Penuel Fishman, Yamaguchi & Gallagher, 2007). When PD provides a rich content and opportunity to internalize the learning that the teachers are expected to create in their classroom, they are able to apply the curriculum pedagogy in practice (Jeanpierre, Oberhauser & Freeman, 2005). Teachers are given opportunities to monitor and assess their thinking, learning, and teaching students' learning processes (Desimone et al., 2002). Teachers have a chance to experience how science is learned by students and how the students are affected by the science teaching methods and strategies in the classroom when a learner-centered approach is utilized during PD (Posnanski, 2002). Therefore, experiencing a learner centered approach enables them to revise their thoughts about science teaching, learning and assessment (Luft, 2001). A stimulating and supportive learning environment is reinforced by teachers' collaboration with their colleagues and teachers instructors from other schools (Banilower et al., 2013). Research has shown that when teachers attended innovative PD programs, they have improved their knowledge and skills about assessment methods (Şenel-Çoruhlu et al., 2008), science-technology-society approaches (Cho, 2002), creativity skills (Park, Lee, Oliver & Cramond, 2006) and efficacy beliefs about science teaching (Roberts, 2010). For example, Tosa and Martin (2010) organized a PD program which covers guided inquiry activities, and teachers' own exploration within a range of given tasks and discussions of the ways to bring their inquiry experiences in their classrooms. Results have indicated that at the end of the course, science and technology teachers' attitudes towards inquiry have improved positively.

In the light of all this, in order to adapt to the curriculum, science teachers should attend PD programs in which topics are identified according to the needs of teachers, while they are active in learning, they can share their ideas with their colleagues, including both theoretical and practical courses. Accordingly, the starting point of this study is to enable teachers to attend an In-Service Training Course (ISTC) where teachers can improve their knowledge about the curriculum, science teaching and assessment methods. It is suggested that the key features of PD includes an increase in teachers' skills and change in their attitudes and beliefs (Desimone, 2009). Therefore to understand how much the course affected teachers' knowledge and skills, their perceptions will be compared before and after the course. In this way, it is possible that both teachers and researchers can evaluate themselves. Consequently, the aim of this study is to investigate the effects of ISTC on science teachers' perceptions of science learning, and teaching methods, and difficulties related to science teaching methods.

2. Method

This study is a part of a general project. The aim of the project was to examine the effectiveness of PD program on science teachers' knowledge and skills about science learning, teaching. One-group pre-test post-test design was used to measure the effectiveness of the ISTC. In the one (single)-group pretest-posttest design, one group of subject is given a pretest, then the treatment, and then the posttest. The pretest and posttest are the same, just given at different times. The result that is examined is a change from pretest to post test (McMillan & Schumacher, 2006:264). Because there is no control group, researcher cannot be sure that order events occurring between the pretest and posttest did not cause the change in students. Extraneous variables which are outside the experimenters' control in one-group pretest-posttest designs threaten to invalidate their research efforts (Cohen, Manion & Morrisson, 2000:212). This paper presents teachers' perceptions of science learning and teaching methods, and difficulties related with science teaching methods during the course as a part of the PD program.

Participants/Subjects

The study was conducted in the eastern region of Turkey. The participants of ISTC included 16 science teachers who volunteered for this study. Eight of the teachers (50%) were male and eight of them (50%) were female. Among them, there was a considerable range of teaching experience: teachers with less than five years' experience (16.7%), teachers with five to ten years' experience (33.3%), teachers with ten to fifteen years' experience (27.7%), and teachers with fifteen to twenty years' experience (22.3%).

Procedure

Needs analysis for ISTC

Researchers started to do a needs-analysis by interviewing five voluntary teachers so they could express their opinions directly. The interviews were transcribed, researchers identified the needs of the teachers, and each need was turned into an item. With the help of these items, researchers composed a nineteen-item needs-analysis survey to identify in which topics teachers felt they lacked knowledge and skills about science learning, teaching and assessment methods. The needs-analysis survey was delivered to a hundred science teachers through a website. Teachers were asked to choose one or more topics which they wanted to learn. They were given two options: theoretical or practical learning for the topics. The topics that teachers chosen are; science and technology curricula, constructivist learning theory, laboratory work, science process skills, conceptual change model, refutation text, predict-observe-explain, analogy, concept maps, and alternative assessment methods.

Planning of ISTC

Researchers constructed the content and instructional materials of the ISTC according to the results of the needs-analysis survey. Hands-on materials, lesson plans, worksheets and assessment tools were prepared for the teachers. Researchers planned to offer both theoretical and practical lessons based on the responses to need analysis survey. In this way, ISTC can be supportive for teachers in addressing, sharing and finding solutions for problems while teachers implement the new curriculum in their class. The course was six hours a day for five days, a total of thirty hours. Each lesson was associated with the learning units for grades 6 to 8 located in the science curricula (Living Organisms and Life, Matter and Change, Physical Events, and Earth and Universe). Science teachers were informed about the date, content, and location of the course.

Training of ISTC

ISTC consisted of two sessions: four hours in the morning and two hours in the afternoon. In the morning sessions, teachers examined the teaching materials that were prepared for them and researchers shared information about the course content. Firstly, the researchers' began the lesson by delivering content through a presentation. While this theoretical session was ongoing, researchers asked teachers to reflect their knowledge, experiences and opinions in a group discussion about the content. Then, teachers worked in groups to construct a lesson plan appropriate for the content and to discuss how they can use this lesson plan in the classroom. In this way teachers had a chance to use the plans that they had completed in their own classes. When this step was completed, teachers were asked to list possible problems they may face while using these plans in their classes. The lesson was finished by providing solutions based on the literature and their colleagues' solutions for these problems to the teachers. In the afternoon sessions, teachers were encouraged to integrate their theoretical knowledge by participating group work with the researchers' guidance. During this session, teachers carried out the same activities. By using simple and cheap materials that can be found in the classroom or in a nearby environment, teachers aimed to have an experience like students in the classroom. In this way, just like students, teachers both revised their prior knowledge about the content and built new knowledge by associating new knowledge with prior knowledge. Then, they were enabled to learn from their colleagues and the interchange of experiences by obtaining feedback from colleagues and researchers. Finally, teachers were asked to keep reflective journals about what they had learned about learning and teaching science at the end of the each course lesson. They explained their ideas concerning with the contribution of the science methods and their implementation in the class to their PD.

Data Collection and Analysis

Teachers kept the journals to reflect on what they know before and what they learned about science learning, teaching and assessment methods. They were expected to answer following the prompt questions: "Before the course what did you know about … method?", "What did you learn about this method in the course?" and "Do you think what you learnt today contributed to your professional development?". They were also expected to write their opinions about implementation of the teaching methods recommended by the ISTC in their classes and contribution of the ISTC to their PD.

The reflective journal was used as a database for the study. Teachers' statements were grouped under three main headings: teachers' opinions on their (a) knowledge about science learning, (b) knowledge about science teaching methods, and (c) opinions on the obstacles associated with implementing science teaching methods. Teachers' statements were analyzed according to qualitative data analysis. As suggested by Willig (2013) the first researcher read and re-read the text several times. Codes were generated according to an inductive approach by capturing the meaning contained within the segments (teachers' written statements). Then, all of the researchers came together, examined the codes, and exchanged their ideas about the codes. After there was a consensus among the researchers; the list of codes was completed. Then, the number of teachers in each code was calculated. In the findings section, some quotations from teachers were presented to enable the reader to better understand the codes. During analysis, it was seen that some teachers did not answer some questions or they wrote statements that could be included under more than one code. That is why there were differences in the number of answers for each code.

3. Findings

Teachers' Opinions on Their Knowledge about Science Learning

On the first day of the course, teachers were given information about the constructivist learning theory. The role of teacher, and students in learning/teaching processes were explained. The reasons for students' misconceptions and their effects on the learning/teaching process were discussed. Moreover, the results of studies that identified the students' misconceptions about scientific concepts were shared. The teachers wrote the elements that form the base of the constructivist learning theory. According to seven teachers, students learn the new knowledge best when it is linked to relevant prior knowledge. Four teachers thought that students' misconceptions about scientific concepts were the determinant factor of which that effected their learning. One of the teacher's statements which exemplify this situation is given below:

> *"Previously I thought that students learned with knowledge given by teachers and textbooks etc. Now, I realized that students' prior knowledge should be identified and that student them self should reach the new knowledge, learning can be achieved by blending new (knowledge) and previous (knowledge) and organizing them (NG)".*

Furthermore, after the course, five teachers stated that they had inadequate knowledge about learning until that day. Those teachers said that before the course they understood learning as a "permanent behavior change"; after the course they stated that they realized the importance of learners' prior knowledge. One of the teacher's comparisons of his knowledge before and after the course is given below:

> *"I knew learning was permanent behavior change. I learned that I must take into account their prior knowledge and that the process between using their prior knowledge and reaching new information was learning (DŞ)."*

Teachers' Opinions on Their Knowledge about Science Teaching

All of the teachers said that teaching methods they learned in ISTC improved their knowledge about science teaching. However, according to the teachers' opinions, this progress was divided into three categories. In the first group (G1), there were teachers who had a misunderstanding about teaching science before the course, after the course their misunderstandings changed. In the second group (G2), there were teachers who did not have any knowledge or lack of knowledge about teaching science before the course, yet they gained new knowledge about teaching science after the course. Finally in the third group (G3), there were teachers who held correct prior knowledge about teaching science which was strengthened subsequent to the course. In the following sections, teachers' knowledge about science teaching methods before and after the course was analyzed.

Concept maps

According to the improvements in their knowledge in the course, teachers were placed in G2 and G3 with regard to this method. The teachers' prior knowledge about concept maps was identified. Teachers were given a concept list and using the list, they were asked to draw a concept map. Examples from the concept maps teachers drew are given in Figure 1 a, b, c, d. When the drawings were examined, it was seen that four of the teachers could not place the concepts in the boxes (Fig. 1.1.a). Four of teachers could not create the hierarchy of the map (Fig. 1.1.b), three of teachers drew the arrows that connect the concepts to one another in the wrong direction (Fig. 1.1.d), three of teachers put the examples into boxes (Fig. 1.1.c), and two of teachers did not write the linking words between the concepts (Fig. 1b). All of the teachers said that teaching methods they learned in ISTC improved their knowledge about science teaching. However, according to the teachers' opinions, this progress was divided into three categories. In the first group (G1), there were teachers who had a misunderstanding about teaching science before the course, after the course their misunderstandings changed. In the second group (G2), there were teachers who did not have any knowledge or lack of knowledge about teaching science before the course, yet they gained new knowledge about teaching science after the course.

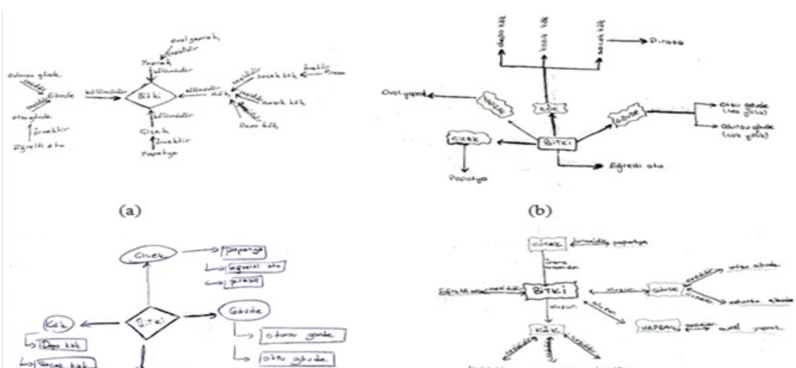

Figure 1. These Examples are from The Concept Maps: (A) A Concept Map In Which The Concepts is not Written in Boxes (B) A Concept Map In Which Connection Words are not Written (C) A Concept Map In Which Connection Wordsare not Written and Concept Examples are Written In Boxes (D) A Concept Map In Which The Arrows are Drawn In The Wrong Direction

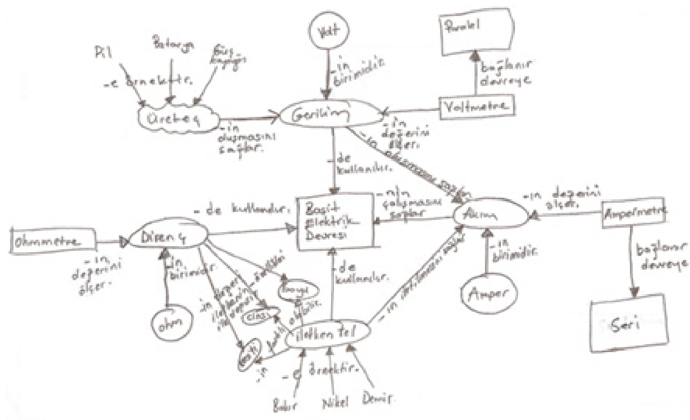

Figure 2. The Last Concept Map Which Teachers Drew about a Basic Electric Circuit

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Refutation Text

About refutation text (*RT)*, the teachers were placed in G1 and G2. Thirteen teachers in G2 said that they had never come across with RT so they had no prior knowledge about it. In the course, the teachers were introduced to RT and its phases were explained. Then, the teachers were asked to prepare an RT to refute a misconception of students: “when the bow is pressurized it stores energy but when it is stretched it doesn’t store any energy”. An example of a RT prepared by one of the teachers is seen in Figure 3.

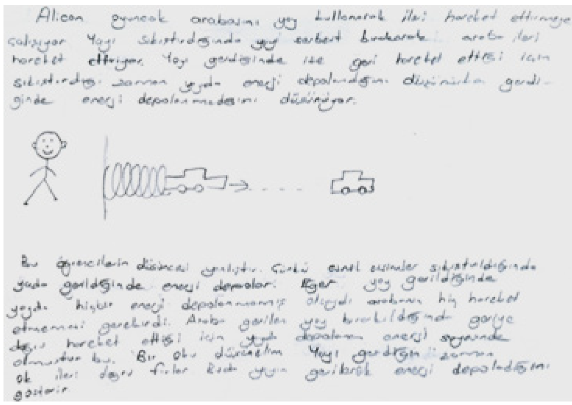

Figure 3. Conceptual Change Text Written By Teacher

Teachers in G2 stated in their reflective journals that they learned RT was a text that reveals a misconception of the student and refutes this misconception. Three teachers in G1 explained that they had inadequate prior knowledge about RT and they changed this knowledge According to these teachers in RT first there must be the students’ misconception then there must be right knowledge about the concept. However, this opinion doesn’t include the second phase of the RT that is eliminating misconception by creating a cognitive conflict. An example statement explaining the change in their knowledge about RT before and after the ISTC is given below:

> *“I used to know (RT) was changing misconception (in a text) with the right conceptions. I learned that in a given text finding, searching, observing misconceptions enabled the learner to learn the right (concepts) (EEA).”*

Predict-Observe-Explain

Teachers were placed under G1, G2 and G3. In G1, seven teachers noticed that they had a misunderstanding in their prior knowledge. They stated that in their classes, they first present a problem that students would make a prediction, and then they listened to students’ predictions and gave the right answer just after their predictions. Moreover, they said that they did not provide an experience where students could observe and they did not provide an opportunity to compare their prediction with their observations. Six teachers in G2 said they had not known POE until they attended the course and they had never implemented it. All participant teachers in the course were divided into groups and attended an activity in a laboratory about the value and direction of the electric current in a basic electric circuit. In the activity, teachers were asked to put themselves in their students' shoes and identify possible student misconceptions and the reasons for them. In this way, it was aimed to teach how POE could be used to eliminate students' misconceptions. Figure 4 shows the prediction and observe phase of one group while thinking about possible misconceptions of student.

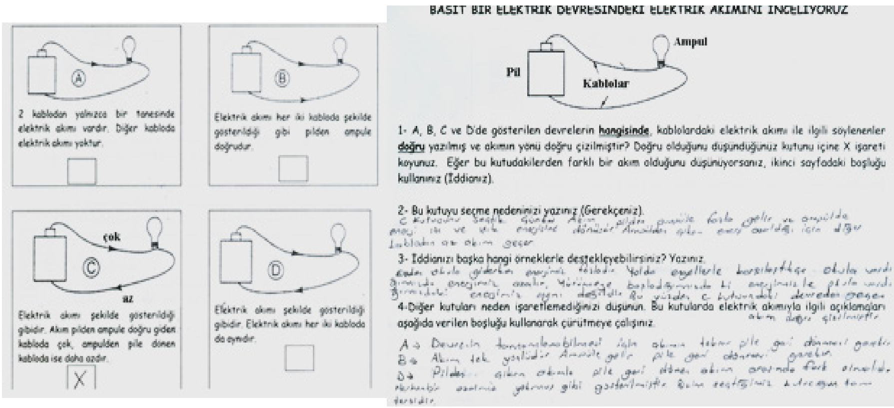

Figure 4. Teachers' Worksheets Completed By Using POE

In explain phase, teachers are asked to form a basic electric circuit and compare their predictions and observations an electric current. After completing their work, the teachers shared their work with other groups. While doing so, teachers exchanged ideas about students' misconceptions and the reasons for them. A teacher's comparison between his previous and new knowledge in his journal in G1 is given below:

> *"My misunderstanding about POE is to implement this method piecemeal without following the order. I make the student only observe or predict. Moreover, without giving students enough opportunity I pass (made) to my explanation (DB)"."*

Laboratory work and science process skills

In this method, all teachers were placed in G2. Ten of the teachers said that they did not have any information about science process skills (SPS) like "hypothesizing" and "identifying variables" before the course. Apart from these two skills, forming tables and inferences were also among the SPS they learnt for the first time". In the course, using both theoretical and practical lessons from the curricula and daily life, the teachers' attention was diverted into the use of SPS and its importance. Teachers were grouped in the laboratory and an open-ended experiment was carried out about "the relationship between the strength of electromagnet's and the amount of electric current. After this lesson, nine of the teachers stated that SPS is effective for students to learn science concepts and that they will try to help students acquire these skills.

> *"I learned that I can increase the interest of students towards science by using SPS, in this way I could teach the acquirements of the curricula in a more enjoyable and pleasant way (EK)"."*

Another topic emphasized in the course was the characteristics of identifying the problem, the method and results must be done by students, in other words the level of openness in the experiments. Although nine teachers in G2 appreciate the positive effects of the experiments on students, they said that they did not have any information on the level of openness in experiments before the course. The teachers carried out the experiments by defining these characteristics themselves so nine teachers stated that they learned that these experiments were classified according to these characteristics. Six teachers said that when the problem, method and results' characteristics are provided by the teacher or course book, experiments will not contribute to student learning. Furthermore, these teachers considered that, the level of student independence should be increased in the laboratory activities. Figure 5 shows a worksheet completed by a group.

> *"I had some information about the types of experiments. I used to have little information about what SPS are. Now I learned types of experiments and SPS better. I understood that instead of close-ended experiments other type of experiments would be more useful for the students (RB)."*

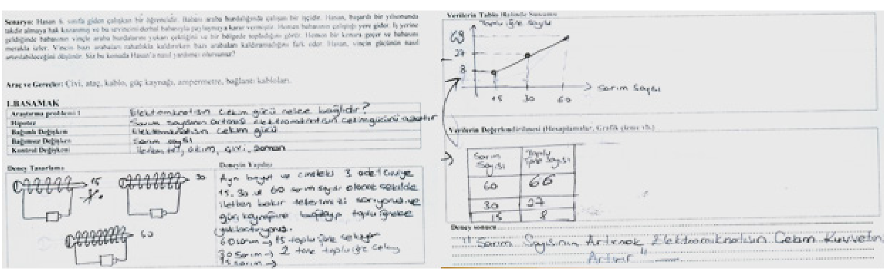

Figure 5. An Experiment Worksheet Completed By Teachers About "What Does Strength Of Electromagnets Depend On?"

Teachers' Opinions on the Obstacles Associated with Implementing Science Teaching Methods

At the end of the ISTC all teachers stated that they believed what they learned in ISTC would have a positive effect on students' learning. But they mentioned the difficulties they would come across while implementing these methods. The themes about the difficulties teachers thought they would come across, numbers of teachers represent these themes and examples for each theme are given in Table 1.

Table 1. The Difficulties Teachers Think They May Face While They Are Implementing Science Teaching Methods in Their Classes and Sample Statements

Difficulties	Sample quotations	N
Time management	I think the methods taught here can be implemented in the class but implementation can be time consuming (IB).	8
Supply of the missing materials	I do not think I will have any difficulty in implementing the activities but I may have difficulties in supplying the materials (FÖ).	7
Students' lack of interest	I will use the methods I learnt (in my classes). I think, I acquired enough professional development to plan the activities. However, when I think of my students who lack interest I think it will be difficult (EK).	7
Classroom population	Crowded classes will cause some difficulties in implementation (EEA).	4
Classroom management	Activities we learnt (teaching methods) can be implemented in the class. However, while achieving classroom management and minimizing the noise I may have some difficulties (EC).	3

Researchers and teachers discussed the ways to overcome these difficulties and exchanged ideas to find out how to solve problems they may come across. For example, five teachers stated that to solve problems stemming from students, a classroom environment where students work in groups can be facilitate an exchange of ideas. Four teachers said that a teacher who is going to use these methods must plan his or her lesson and needs to complete preparations for the planning. Three teachers said that they might come across some difficulties such as crowded classrooms and insufficient materials but as the teacher continues to do the implementation, but these difficulties can be overcome as the teacher continues with the implementation. In sum, it can be claimed that teachers from an enthusiasm to overcome difficulties they will face while they are implementing the teaching methods they learned in the course. The cause of this enthusiasm is that teachers believe that with the help of these methods, students will both learn better and cognitively be more active. The opinion of the teacher given below exemplifies this situation:

> *"From now on I noticed that in any condition and circumstance and whenever I want I can do an activity. We were falling back on excuses because with using simple activities we can get them to acquire the attainments (DŞ)."*

4. Discussion and Results

With the reform movements, in learning, teaching and assessment processes an important change has been observed in curriculum. Teachers' need for in-service training courses has increased in order to keep up with the changes in curriculum. For this purpose, ISTC was held to improve the science teachers' knowledge and skills about the teaching methods. Before the course, some teachers' opinions about science learning as "permanent behavior change" shows that they define learning based on behaviorist learning theory. After the course, in their statements there are terms like "prior knowledge", "misconception", "forming a relationship between prior knowledge and new knowledge", and "schema" which show that they can define learning according to constructivist learning theory. The change observed in teachers' opinions can be associated with the training given in the course and that they were given an opportunity for a period of disequilibrium and cognitive conflict which makes teacher dissatisfied with existing frameworks about science learning (Lee et al., 2004). Through the training about constructivist learning theory, teachers had opportunities to discuss students' misconceptions (Seung, Park & Narayan 2011) and recognize how students' misconceptions cause learning difficulties (Lee et al., 2004).

Before the course, some teachers said that while implementing RT and POE, they did not consider students prior knowledge and they mostly had the role of transferring the scientific knowledge to the students. After the methods training given in the course, teachers noticed that their prior knowledge was inadequate and they gained more knowledge. Moreover, all teachers stated that they completed their missing knowledge about concept maps, SPS, analogy and drama. Some of the teachers said that they had reinforced their knowledge. Consequently, despite the limitations of short-term effect to teachers, the course contributed to positive changes in teachers' knowledge of science teaching methods. This finding was similar to other studies' findings on the effects of PD on teacher's knowledge and skills with science teaching (Posnanski, 2002; Çınar, 2011). In the course, teachers were provided opportunities to create dissonance between what they know and what they learned about science teaching (Timperley Wilson, Barrar & Fung, 2007). Through discussing and sharing opinions and ideas with the colleagues and the academic coordinators, teachers were able to correct their misconceptions of science teaching (e.g. RT and POE) and got to think from various perspectives, which helped them to improve their science teaching (Bümen, 2009).

Teachers declared that they acquired the knowledge and skills needed to implement the science teaching methods through the course. However, they were identified potential obstacles as covering the content, insufficient science equipment, crowded classes, and classroom management problems. Similarly, many researchers noted that teachers were faced with lack of resources (Alger, 2009), crowded classes (Asilsoy, 2007) and insufficient time (Cheung, 2007). The key point is that, if teachers confront similar obstacles, a change can be achieved by encouraging the sharing of solutions to these problems and it will reinforce the sense that improvement is possible (Garet et al., 2001). However, when these difficulties occur in the class whether the teacher use traditional or constructivist learning theory in his/her teaching activities is a question to be answered. Seung et al. (2011) stated that, although teachers came to the course with traditional views and developed more constructivist views during their PD, they tended to keep their traditional views and add new constructivist perspectives. In this case, the change teachers showed towards constructivist learning theory does not guarantee that their implementations will be congruent with this theory. Nevertheless, the improvement observed in teachers' knowledge about science teaching methods may trigger them to use the methods they learned in the course when they face with difficulties.

5. Implications

According to the results of this study, some suggestions can be made to teacher trainers, program developers, and researchers who plan to organize in-service training courses. Firstly, group works in which teachers are actively participated in the activities designed for the ISTC are recommended. Moreover, trainers that organize the course are suggested to form heterogeneous groups in terms of experience, gender, the level of the class they teach. In this way, while working with teachers with different knowledge and skills, teachers who have inadequate false or missing knowledge about science teaching will have a learning environment to change their knowledge. While implementing teaching methods, course organizers may face complaints from teachers about obstacles like crowded classes, lack of equipment, time, and classroom management. If the trainers aim to hold a grounded course, they should consider these difficulties and they should prepare an environment in which teachers can express problems they may face while implementing science teaching methods in class and a discussion atmosphere to develop strategies with them to solve these problems. Tangible suggestions developed with teachers to solve these problems may help teachers to consider these methods more reasonable and encourage teachers to use them in their classes. If these problems are ignored in the course, teachers may doubt the practicality of these methods and their interest in the course may decrease. It should be clearly expressed that, teachers leave the course with both the materials presented by the trainers and developed during the course these materials as samples that can be used in their classes. In addition to these materials, because of the contextual variables like population of the class, material supply, students' learning status and units, each teacher will need different lesson plans and materials. These situation shows that short term courses are not enough for teacher to translate new knowledge or skills into their classes and they should be supported with longer period follow up activities. Consequently, taking into consideration the parts teachers felt were missing in this study, we are doing a follow up study. In this way, we aim to help teachers while planning teaching, using the knowledge and skills they learned and enriched in the course, and implementing these methods in their classes. We aim to assess after they implement these plans and develop solutions to the difficulties they will face in the class.

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