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An Investigation of Teacher Response to National Science Curriculum Reforms in Turkey

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Abstract

Major science education curriculum reform is taking place in Turkey involving a substantial break with past science curricula. Such reform has significant implications for teachers but to date there has been little research on teacher response to these reforms. The purpose of this qualitative study was to investigate the impact on the teachers who are charged with implementing reforms. Semi-structured interviews with 18 elementary science teachers were conducted and additional observational data was recorded. The interview schedule comprised 23 questions in 9 themes. According to the data analysis, the main problem for teachers is that curriculum reforms involve overly big innovative ideas within unrealistically short timelines and with limited economic investment in human resources and supporting materials. In addition, there is a lack of organization and coherence between system stakeholders. Another drawback is the very centralized educational system and the idea that change can be driven from the top down.

Keywords: Elementary Science and Technology Curriculum, Curriculum Reform, Elementary School Science Teacher, School Type

Introduction

New trends in science, pedagogy and technology require flexible, modern, and effective elementary science curricula. A reform curriculum which provides better understanding of science, should make connections with daily life, and prepare students for future trends and new developments in society. The Turkish Elementary Science Curriculum was redesigned and disseminated in light of these factors. After almost five years of implementation, although designers are experienced academicians and teachers, it is not yet known whether the reforms have effectively penetrated to the sublevels of the educational system. To evaluate the outcomes of the new elementary science curriculum in real school settings, it is appropriate to take the view points of teachers. Recommendations, ideas, and criticisms are very important for the revision, improvement and development of the new curriculum. The purpose of the study was to determine the public and private elementary science teachers' opinions about, and perceptions of, the new elementary science curriculum, and their reflections on the new reforms. This research focused on the core actors of the new curriculum, i.e., the elementary science teachers.

This study focused on how public and private elementary science teachers' perceptions and opinions about the change. This study sought the answers of the following research questions:

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1) What are the perceptions of public and private elementary science teachers regarding the current science curriculum?

2) What are the opinions of elementary science teachers regarding the implementation of the current science curriculum?

3) What are the differences between the opinions and perceptions of public and private school elementary science teachers regarding the current science curriculum?

Curriculum Reform

Educational reforms have to affect and improve multiple dimensions of science education practices. The curricula emerge as the main source that shapes these dimensions according to the new principles. Curriculum reform must penetrate three layers in the educational system: the macro layer of nation/society/program; the meso layer of school; and the micro layer of classrooms (van den Akker, 2004). Comparing the learning outcomes of students at micro level with program ideals and aims at macro level, without taking notice of the whole, is a very narrow perspective (van den Akker, 2003). Many researchers focus only on the disappointing outcomes at classroom levels, resulting in shallow criticism and one-sided blaming of certain groups. As one of the key actors in this process (Smith & Southerland, 2007), teachers' reactions to the curriculum reform may change according to their perceptions of the curriculum. Thus, how they perceive the curriculum is clearly important. Some teachers openly embrace new curriculum and reform ideas, and implement them successfully (Crawford, 2000; Luft, Roehrig, & Patterson, 2003; Roehrig & Luft, 2004), while other teachers are unwilling or unable to develop their instruction according to the new reforms (Davis, 2002; Laplante, 1997; Yerrick, Parke, & Nugent, 1997). The latter teachers have concerns about their new roles because more hands on activities, wide range of resources, many connections with social contexts, collections of cooperative and collaborative activities, and student-centered teaching styles have great pressure on them. The teachers' acceptance of the constructivist ideas in instruction does not mean that they have learned how to teach accordingly. Therefore, most of them need a comprehensive professional development through both their pre-service and in-service periods on how to apply it in the classroom, how to design the lessons and activities that support this kind of learning (Loucks-Horsley, Hewson, Love, & Stiles, 1998).

Studies show that, in spite of the innovative curriculum reform efforts, teachers generally retain their traditional view of science (Aikenhead, 2006; Davis, 2002; Jenkins, 2002). Aikenhead (2006) explained the reason for this resistance to the challenges caused by 'salient influences' on teacher's values, assumptions, beliefs, ideologies, self-identities, self-images, and loyalties to traditional school science. There are many reported problems that accompany the implementation of curriculum reform such as the difficulty in lesson preparation, insufficient subject matter knowledge (De Jong, Veal, & van Driel, 2002; Guo, 2007), inadequacy of teachers in new pedagogies (Guo, 2007), poor quality of textbooks (Guo, 2007), considerable difficulty in changing roles of teachers and students, teachers' not taking enough support and training (Gray, 1999), and not being patient to see the permanent effects of new pedagogies on students. Bybee and Ben-Zvi (2003) reported that although most of the teachers they studied perceived what is desirable in the new curriculum, implementation was affected by practical constraints and unique aspects of the conditions such as students' level of readiness, time limitations, content overload, and background and content knowledge of the teacher. In addition, when difficulties with the reform curriculum are encountered, some science teachers favor the retention of traditional instruction (Tobin, 2003).

However, the most important obstacle in implementation of the curriculum is teacher perception. Hansen and Olson (1996) stated that most science teachers consider teaching the principles of science as their most important task and hesitate to change their teaching in any reform. Understanding the belief and value structures of teachers is essential to improve their professional careers. Beliefs and perceptions are the most valuable constructs which shapes teachers' instructional design (Coenders, Terlouw, & Dijkstra, 2008; Roehrig, Kruse, & Kern, 2007; Smith & Southerland 2007). These beliefs and perceptions are the driving force that shape who they are as teachers (Haney & McArthur 2002; Laplante, 1997). Without overcoming the belief structures which shapes their perceptions, persuasion of teachers with the current curriculum ideals is not possible (Pajares, 1992). Therefore focusing on perceptions and opinions of the teachers is critically important, and it is a prerequisite for a long term influential change.

Studies examining the effect of school type did not show any difference in student achievement (O'Brien & Pianta, 2010); however, it seems school type affects teachers' job satisfaction (Sonmezer & Eryaman, 2008). According to Sonmezer and Eryaman (2008), in private schools, teachers are more satisfied due to their salary, social ranking, and reputation, and improvement, ability to use skills, administrator employee affairs, and creativity. All these may, in turn, affect the implementation of the current curriculum. In addition, according to Savasci and Berlin (2012), school type may be considered as a potential factor that affects teachers' beliefs regarding constructivism.

Current Situation in Turkey

Curriculum development studies in Turkey began in the 1920s with the recommendations of the American philosopher and educational reformer, John Dewey (Demirbas & Yagbasan, 2005; Gokmenoglu & Eret, 2011; Unal & Unal, 2010). In 1924, with the Law of Common Education, the Turkish Ministry of National Education (MoNE) took over the control of all educational institutions (Gozutok, 2003). Since then, and with the collaboration of teachers and academicians from both Turkey and abroad, there have been many curriculum reform initiatives to meet changing social needs. In the last decade, MoNE initiated science education reform. The main goal was to renovate the science curriculum for the expertise and skills needed in the 21st century (Tutkun & Aksoyalp, 2010; Voogt, Erstad, Dede & Mishra, 2013; Kaufman, 2013; Elmas & Geban, 2012). This attempt began by changing the name of the 'Science' curriculum to 'Science and Technology' curriculum. In 2004, a new science and technology curriculum effort was launched by MoNE and it was disseminated starting from the year of 2005 (MoNE, 2004).

The 2004 curriculum reform brought major changes in philosophy of instruction, teaching styles, teacher and student roles, and curriculum organization basing on a constructivist approach to instruction. The goal is to educate children as scientifically literate citizens regardless of their individual differences (MoNE, 2004). The curriculum emphasizes conceptual learning, multiple intelligences, active learning and reflective thinking. Within the framework of a spiral curriculum, topics are expanded and elaborated throughout the years. A thematic approach is used in the organization of the content (Education Reform Initiative (ERI), 2005) and there are four learning areas: Living Organisms and Life, Matter and Change, Physical Events, and The Earth and the Universe. There are also three learning areas related to skills, attitude and values, which are Science Process Skills, Science-Technology-Society-Environment, and Attitudes and Values (ERI, 2005). Moreover, current curriculum aims to develop skills on critical thinking, creativity, communication, problem solving, and investigation and emphasize decision-making process, and use of information technologies (MoNE, 2006).

The 2004 curriculum incorporates crucial changes about student and teacher roles. First of all, it includes teaching strategies with respect to the constructivist approach (ERI, 2005). Student roles change from passive listeners to active participants who investigate, question, and solve the problems on their own (ERI, 2005). The teacher is the "facilitator" who organizes the teaching environment, guides the learners during the activities, involves students in decision making process, encourages students to share and discuss their ideas and makes connections between daily life examples and scientific concepts. Finally, the 2004 curriculum has different assessment approaches. The aim of the assessment is to assess not the end-product but the entire process with the aid of performance tasks, concept maps, structured grid, projects and poster presentations.

The aforementioned changes in the new elementary science curriculum have also some implications for the secondary science education in Turkey. In 2011, secondary science education curriculum namely biology curriculum (MoNE, 2011a), physics curriculum (MoNE, 2011b), and chemistry curriculum (MoNE, 2011c) changed considerably. Reforms in the elementary science curriculum shed light on the reforms in secondary science education programs. For instance, as stated in the new physics curriculum (MoNE, 2011b), since students' prior knowledge namely what they learned in the elementary science courses is very crucial for the secondary physics education; therefore while the new physics curriculum was prepared, points such as constructivist teaching approach, key concepts, spiral curriculum, and science process skills in the elementary curriculum were examined and taken into consideration. As a consequence, changes in the elementary science curriculum have influenced the reform in secondary science courses.

Besides all these, it is important to note that, in the writing process of the present paper, MoNE made some minor changes in the elementary science curriculum in Turkey (MoNE, 2013). The first prominent change was that the starting year of science education will be the third year of formal education. In addition, some of the sub dimensions of the learning areas were changed. For instance, in the Science-Technology-Society-Environment learning area, socio scientific issues and sustainable development concepts were added. There is also a decrease in the total number of objectives throughout the curriculum. However, the major approach to science teaching, the topic structure, the general aims of the curriculum, suggested teaching methods and spiral structure of the elementary science curriculum stayed the same.

To sum up, the 2004 science and technology curriculum reform was comprehensive taking into account students, teachers, instructional materials, teaching approaches and philosophies. Effectiveness of the 2004 curriculum with respect to teachers, however, has not yet been thoroughly investigated. The study reported in this paper emphasizes this point.

Methodology

Research Design

In accordance with the nature of qualitative research, the data were used to construct a framework about the research problems being investigated. As a phenomenological research, the present study mainly focused on the shared meanings of experiences related to a phenomenon for several individuals. Phenomenology is the study of lived experiences and the way we understand those experiences to develop a world view (Marshall & Rossman, 2006). For this purpose, interviews and observations were conducted. It was planned to capture the meaning of lived experiences of elementary science teachers about the implementation of the current curriculum.

Setting

After a gradual implementation beginning from 2004, in 2008, all the elementary schools in Turkey started to implement the new science curriculum. MoNE initiated the curriculum implementation as a year by year process starting from the 6th grade to 8th grade. Because of the centralized educational system in Turkey, all elementary schools are required to implement the same science curriculum. For this reason, the sample of the study consisted of any available public and private school science teachers in Ankara. The characteristics (years of experience, discipline, etc.) of the teachers who participated in this study were presented in detail considering ethics and confidentiality. In addition, the characteristics of schools, (environment, physical conditions, etc.) from which the teachers were selected, were presented.

Sampling

In phenomenology, data sources are the individuals or groups who experience the phenomenon that is at the center of the research and who could reflect these experiences in depth (Yıldırım & Simsek, 2008). Correspondingly, the participants of this study were elementary science teachers who have been implementing the 2004 curriculum. In this research, a two-step sampling process was used. While putting a curriculum on the stage, one or more typical cases should be used (Patton, 2002). The aim of using two-step process is to describe the typical experiences of science teachers, and not to infer generalized statements. Therefore, in the first step, typical case sampling was used. Nine public and four private elementary schools were selected. Schools which were chosen for the study were not the extreme ones (not the best or the worst schools with respect to their academic achievement, physical conditions, and socioeconomic status of parents). In the second step, 18 science teachers were selected from these 13 schools. Table 1 and Table 2 display the demographic information about the public and private school teachers participated in the study. Meanwhile, maximum variation sampling was used. Any common experiences of science teachers that emerge from great variation depending on the years of experience were of special interest and valuable in capturing the core patterns, shared experiences and different points of views related to the current science curriculum (Patton, 2002).

As can be seen from the Table 1, public school teachers graduated from different disciplines but they mostly have a B.Sc. degree from faculty of education, and their teaching experience ranges from 5 to 32 years.

Table 1. Demographic information about public school teachers (T = Teacher)

	Gender	Discipline	Educational level	Teaching experience	Experience with new curriculum	Grade level taught
T1	Female	Physics Education	B.Sc.	23 years	6 years	6th, 7th, 8th
T2	Female	Physics	B.Sc.	16 years	6 years	6th, 7th, 8th
T3	Male	Physics Education	B.Sc.	17 years	5 years	6th, 7th
T4	Female	Chemical Engineering	B.Sc.	24 years	6 years	6th, 7th, 8th
T5	Male	Chemistry Education	B.Sc.	32 years	6 years	6th, 7th
T6	Female	Science Education	M.Sc.	5 years	5 years	6th, 7th, 8th
T7	Female	Biology	B.Sc.	17 years	6 years	6th, 8th
T8	Female	Chemistry	B.Sc.	17 years	5 years	6th, 7th
T9	Male	Science Education	Ph.D. Candidate	5 years	5 years	7th, 8th
T10	Female	Chemistry Education	B.Sc.	17 years	5 years	7th
T11	Male	Physics Education	B.Sc.	11 years	6 years	6th, 7th, 8th
T12	Female	Chemical Engineering	B.Sc.	14 years	6 years	6th, 7th, 8th

Table 2. Demographic information about the private school teachers (T = Teacher)

	Gender	Discipline	Educational Level	Teaching Experience	Experience with New Curriculum	Grade Level Taught
T1	Female	Elementary Science Education	B.S.	8 years	6 years	6th, 7th, 8th
T2	Female	Elementary science education	Ph.D. Candidate	7 years	2 years	4th, 5th, 6th, 7th, 8th
T3	Female	Education institute	B.S	33 years	6 years	6th, 8th
T4	Female	Elementary science education	B.S.	6 years	6 years	6th, 7th
T5	Female	Elementary science education	M.Sc.	8 years	6 years	6th, 7th, 8th
T6	Female	Elementary science education	B.S.	4 years	4 years	6th, 7th, 8^{th}

All of the private school teachers have undergraduate degree from elementary science education programs and two of them have graduate education. Their teaching experience ranges from 4 to 33 years.

Data Collection

Interviews

In order to enable elementary science teachers to reveal their own ideas without directing their responses and because of the complexity of teachers' personalities and their beliefs structures, it was decided to conduct interviews with teachers instead of using a questionnaire. Interviews are one of the most popular and useful data collection methods in qualitative research (Bogdan & Biklen, 2007; Marshall & Rossman, 2006; Patton, 2002). Interviewing is an efficient way to get in-depth understanding of data, and to reflect the thoughts and feelings of the interviewee in a short time period. In this study, semi-structured interview was used. Each interview took approximately 25 to 30 minutes and was conducted in a period of 10 weeks. All the interviews were tape-recorded upon the consent of teachers and were transcribed verbatim. The interviews were conducted in the teachers' room, science lab or a free room in the schools.

A semi-structured interview schedule used in this study included the questions and follow-ups ensuring the organization of the interview and played a role to make sure that the same style of query was pursued with each interviewee (Patton, 2002). Based on the literature review, nine themes were decided to be included in the interview schedule. The themes of the interview schedule are; structure of the change, acceptance of the change, opinions about the change, feelings about the change, personal accountability for the change, implementation of the change, teacher competency in the change and effect of the change on teacher. In addition to these themes and follow-up questions, there were introduction and demographic questions parts in the beginning of the interview schedule. The semi-structured interview schedule involved the interviewer asking questions and follow-ups to focus on the teachers' responses

toward the topic of interest. Follow-ups were used to collect in depth information about the reflections of teachers regarding the curriculum reform.

Observations

Physical settings such as the seating arrangement, technological tools, and class size are the important requirements for the implementation of the curriculum. In the present study, the purpose of the observations was to portray the school and the classroom. There were two themes namely the characteristics of the school and the portrayal of the classroom. Within the former theme, there were 11 items related to the school characteristics such as science laboratory, library, multi-media facilities and so on. The latter theme involved five items related to the portrayal of the classroom such as the seating arrangement, technological tools and so on. Observation data regarding these items were used to confirm the interview data (Bogdan & Biklen, 2007; Yıldırım & Simsek, 2008). This was the second source of the triangulation process.

Documents

The third data source of the study were curriculum documents, which they formed one of the main sources of the data to comprehend the curriculum extensively. The data collected from documents provided insight for the researchers about the ideas, paradigms, and perspectives of the current curriculum. They were supplementary sources for the main data collection process to understand the phenomenon in depth. Inspection of the curriculum provided the framework of what was intended and what was expected from teachers for designing the instruction. The analysis of the curriculum was a cross-check of the interviews and observations.

Data Analyses

Both deductive and inductive content analyses were applied to analyze the transcriptions of interviews and observations and the program book was examined extensively. Although pre-determined themes were used in the interview schedule, researchers prefer to approach to the data inductively. Inductive content analyses were used to reveal themes, patterns, and categories in the data. Themes, patterns and categories emerged from the data through the analyst's interaction and engagement with the data rather than being imposed by the literature or researcher beforehand. This enhanced analyzing the results of the data in order to catch and find all the patterns and details not just searching for known themes. There were four main steps followed in the process which were coding data, generating themes, describing and organizing the data according to themes, and analyzing and interpreting findings. All the interviews were transcribed verbatim, and then all the texts were coded by hand by the three researchers. Several meetings were arranged to come to a consensus about the codes. In the coding process, all the data were analyzed to emerge any other themes or patterns than the existing ones. After constructing the first level coding, in order to comprehend the themes and patterns, second level coding was initiated. First level codes and sub-codes were organized to infer more meaningful and systematic themes which helped us in the reporting process. Then words and phrases that dealt with the important themes and patterns were coded. These existing themes were examined very carefully in terms of internal homogeneity of the codes under the themes. To be confident about the codes and themes, coding was done by three researchers to ensure the objectivity of the study and the generated codes were used to calculate the inter rater reliability as 0.90. At the end, there was not any different theme emerged than the pre-determined themes.

As a last step, interpretations from the analyses were reported by using the themes. Validity of the study and results was enhanced by using quotes and excerpts in reporting. In

the present study, the issues of validity and reliability were reported according to the social construction and constructivist point of view (Patton, 2002) and the credibility (internal validity), transferability (external validity), dependability (reliability), and confirmability (objectivity) issues were considered (Miles & Huberman 1994; Patton, 2002). In order to help to build trust and relationships and also develop rapport and obtain a wide scope of accurate data (Miles & Huberman, 1994), prolonged engagement was established with school visits. The aim of the former school visits were to explain the aims of this research, to build rapport and trust with the teacher and arrange the interview date and time according to their schedule. Latter visits were for conducting the interviews and for filling out the observation forms. This study assured credibility of the data by using source and analyst triangulation (Patton, 2002). Researchers gathered data from interviews, observations and documents to confirm the source triangulation. Working as a three-person team in the analysis part ensured the analyst triangulation. Peer debriefings were made in various stages with experienced faculty members to search for alternative explanations and check the emerging themes and designs (Miles & Huberman, 1994). In order to establish transferability, descriptions of the characteristics of the settings, the sample, and the processes were provided in detail. Moreover, the sample was purposefully selected aiming to reflect a wide range of experiences of the teachers. An audit trail was done for dependability. The first draft of the present study was sent to an auditor who has no connection with the study to examine whether or not the findings, interpretations and conclusions are supported by the data. Audit trail was also used for confirmability. The external audit examined the process by commenting on interview schedules, documents and observation sheets.

Results

In this section, public and private school teachers' beliefs and opinions about the curriculum reform are presented. The findings obtained from the interviews are elaborated with the observations made from the schools and classrooms.

Public Schools

In the following section, 12 public school teachers' responses to the interview questions are presented according to interview themes.

Structure of change

Teachers were asked what has changed with the new curriculum in terms of teacher role, student role, student activities, textbooks, assessment, supportive materials and teaching style. Answers revealed that teachers generally understand the major principles behind the new approaches and they adapted to the current curriculum. They especially pointed out the importance of the current curriculum being student-centered rather than being teacher-centered.

Teachers pointed out the increase in their responsibilities. For example, according to Teacher 1, teachers should be more creative in the new curriculum. Most of the teachers mentioned that the students' role has changed completely; they are now more creative and independent in the classroom environment and expected to be more active and be prepared before coming to the classroom. Teacher 3 summed up the major changes:

> *"It is obvious in the current curriculum that the content load decreased; the topics are simpler compared to the former curriculum. It is much easier to understand the concepts for the students who actively participate in science courses. No calculations, no more formulas."*

In addition to the changes in student and teacher roles, according to teachers, activities and assessment also changed dramatically. Activities have increased in number, become more connected to daily life and prepared for different types of intelligences. Also, the new curriculum includes different assessment types such as fishbone, fill in the blanks, matching, true-false type questions, performance tasks and projects.

However, the common problem mentioned by the teachers was the project and performance task preparation. Parents mostly do not allow students to encounter and overcome major hurdles while making their project or performance tasks (Petrosino, 2004). Teachers complained that instead of students, parents generally do the project and performance tasks or pay someone to prepare these assignments so that students may get higher scores. According to Teacher 3:

> *"Project and performance tasks are not prepared by the students; they are done by someone else. This is a serious problem and a big obstacle for students in reaching the objectives of the science course."*

In terms of teaching style, all of the teachers mentioned that they changed their teaching style according to the changes in the curriculum. Teachers started to use different kinds of models, more visualization, group work and brain storming techniques. According to Teacher 1, science classes are more 'game-based' now. Instead of direct teaching, student participation increased when compared with the previous curriculum, there is not any calculation-based class hours and formulas in the current curriculum.

Although some changes have occurred in teaching style with new curriculum, the range is limited because of the high stake exam pressure. Since there is a nation-wide multiple-choice exam, teachers stated that they are obliged to do direct teaching instead of student centered teaching. Related to high stake testing problem, there is also the Cram Schools (Dersane) factor. Cram Schools are private institutions that offer courses to prepare students for the high stake tests. Since students focus on high stake testing, they pay more attention to Cram Schools rather than the formal school. High stake testing is a critical factor determining their enrollment in a high quality secondary school hence; students prefer to practice multiple choice questions rather than being actively involved in student-centered instruction in their schools. Teacher 2 observed that:

> *"Students do not even do their homework given by the school teacher, instead, they do the multiple-choice tests given by Cram Schools (Dersane), and when we ask the reason, they reply that since their families pay a high amount of money to these private institutions, their attention is on Cram Schools".*

Acceptance of change

Public school teachers encountered difficulties while adapting to the current curriculum but they got familiar with it over time. The experienced teachers usually had more adaptation problems compared to inexperienced teachers. Although five years have passed since the dissemination, Teacher 5 and Teacher 10, who are veteran teachers, admitted that they still have some problems in class instruction. Teacher 5 noted that:

> *"I cannot say I implement the new curriculum fully in the expected way. The first time I examined the new curriculum, I thought that it was so superficial and lack of in-depth knowledge. Then I created my own style which combines the traditional and current techniques."*

Similarly, according to Teacher 10:

> *"The new curriculum has very superficial content. When I first examined it I said; no, I cannot teach with this curriculum because it cannot improve students' knowledge and abilities in anyway. Now I am trying to adopt it..."*

Moreover, all the teachers use the program book and most of them find it clear to understand. However, according to Teacher 7 and Teacher 9, there are some problems with the program book in terms of coherence and content load. For instance, according to Teacher 7, there are disconnections within some of the topics. Regarding the same problem, Teacher 9 asserted that the program book is not feasible due to the plenty of objectives. According to her, it is not possible for students to reach all the objectives stated in the program book.

Opinions about the change

Public school teachers were asked about the changes in terms of content load, unit organization and daily life connection in the new curriculum. Also, their opinions about the strengths and weaknesses of the new curriculum were investigated. Regarding the content load, half of the teachers thought that the content load of the new curriculum is heavy while the rest mentioned that it is sufficient. The first impression of experienced science teachers was that there is not sufficient amount of input to teach science in the new curriculum. However, in time, they realized that the content load is more adequate compared to the former curriculum. Besides, almost every teacher admires the unit organization and is aware of the spiral structure of the new curriculum. However, regarding the unit organization, Teacher 6 mentioned that in the 8th grade, there are many physics topics given consecutively. Since physics topics are not generally attractive after one another for most of the students (Krogh & Thomsen, 2005), the consecutive arrangement of these physics topics causes students to feel exhausted. On the other hand, Teacher 7 was not aware of the spiral structure of the new curriculum. She stated that:

> *"We pass over from one topic to another before students understand them respectively. For example, there is a unit about chemical bonds in both 7th grade and in 8th grade. I believe that the separation of the units over years causes some disconnections in students' minds. Hence, each year the elaboration of the topics may not be possible due to the need for the repetition of the initial concepts."*

Finally, all the teachers agreed that students are familiar with the activities and examples in the curriculum since they are connected to their lives. In addition, the activity materials are selected from the daily life rather than the traditional laboratory materials. Teachers appreciated the connections between science topics and everyday life examples since students realized the relevance of their school knowledge to their lives. For instance, Teacher 7 mentioned the example of organ donation, which is one of the current debates discussed in the society, under the topic of digestion system in 7^{th} grade.

Public school teachers were also asked about their opinions related to the strengths and weaknesses of the current curriculum. Table 3 displays public school teachers' opinions about the current curriculum. Notably, public school science teachers mentioned student-centeredness and appropriate content load as the positive points while they stated time restriction and insufficient infrastructure as disadvantages.

Table 3. Mostly emphasized positive and negative points concerning the new curriculum (T = Teacher)

	Strengths	Weaknesses
T1	Visual-based, considers different intelligences, no memorization	Problems in selecting the activities
T2	Increase in student interest toward science	Time restriction
T3	Increase in science understanding	Time restriction, lack of computational skills
T4	Appropriate content load	Lack of computational skills
T5	Project assignments	Time restriction
T6	Appropriate content load	Insufficient infrastructure
T7	Appropriate content load and easy-found materials	Unclear measurement and evaluation criteria, inconsistency between the curriculum and textbooks, some unnecessary activities
T8	Appropriate content load	Insufficient infrastructure, time restriction
T9	Student-centered, Appropriate content load	Insufficient infrastructure, time restriction
T10	Easy to implement	Lacks of detailed information and more detailed activities
T11	Scientifically literate citizens	Some unnecessary activities
T12	Student-centered	Insufficient infrastructure

Feelings about the change

Public school teachers were asked about their feelings regarding the implementation of the new curriculum. Most of the teachers were enthusiastic about the classroom instruction with the new curriculum. The significant reason behind their feelings is the increasing success of the students. According to teachers who enthusiastically implement the new curriculum, students started to enjoy science; their understanding of science has increased. According to Teacher 1: "The new science and technology curriculum has helped to increase the understanding level of scientific concepts for students and this makes me so pleasant."

Teacher 6 stated similar expressions:

> *"Students enjoy science much more than they did in the previous curriculum, thus they are more interested. I feel satisfied as a science teacher because the outcomes of the classroom instruction are concurrent with the curriculum goals."*

Besides, almost half of the teachers mentioned that they feel tired while implementing the new curriculum. For instance Teacher 3 stated that:

> *"Teacher should be a maestro in the classroom. Since it is a student-centered curriculum, students should be active in the classroom and this brings problems in classroom management. This is a new process which is burdensome."*

Furthermore, public school teachers were asked about their memories concerning the implementation of the new curriculum. Most of them could not remember any interesting memory. Memories mentioned by the teachers were mostly related to the activities performed in the classroom. For instance, Teacher 7 shared one of her memories about an activity in the classroom as:

"In some activities, students have great fun. For instance, last semester they enjoyed even a simple acids and bases activity. Students performed the activity and realized that the color of the chemical in the tube turned into pink and students cried out "show time". They really got excited and this made them feel happy."

Personal accountability for the change

Public school teachers were asked whether they accomplished the necessary responsibilities in terms of learning and teaching in the current curriculum. In this regard, they were asked about the training they are involved (Table 4). Majority of them mentioned the seminars given by MoNE or inspectorates. These seminars lasted about 4-5 days and remain insufficient in fulfilling the teachers' needs. This training was mostly superficial and did not provide adequate perspectives for implementation in the classroom. For instance, sample cases about how to deal with the new constructivist teaching approaches or student centered classroom instruction were not presented in detail.

Table 4. Training that public school teachers participated (T = Teacher)

	Source	Quantity	Content	Opinions about the effectiveness
T1	MoNE Seminars	5 days	Current approaches in science education (concept maps)	Negative
		5 days	Integrated education	
	Public Education Center	5 days	Introducing the new curriculum	
		3 days	New curriculum	
T 2	MoNE Seminars	3-4 days	New curriculum	Negative
T3	Faculty Members	5 days	Activity preparation	Neutral
T4	MoNE Seminars	5 days	Introduction of the new curriculum	Negative
T5	Public Education Center	3 half days	Introduction of the new curriculum	Negative
T6	Inspectorates	3-4 days	Introduction of the new curriculum	Negative
T7	MoNE Seminars	3 days	Introduction of the new curriculum	Negative
T8	WorldBank	2 weeks	Active learning	Positive
	MoNE Seminars	1 week	Project preparation	
	Faculty Members	1 week	Nature of science	
T9	MoNE Seminars	1 week	Active learning	Positive
			Implementation of the curriculum	
T10	MoNE Seminars	1-2 days	Introduction of the new curriculum	Negative
T11	MoNE Seminars	1-2 hours	Introduction of the new curriculum	Negative
T12	MoNE Seminars, Inspectorates	1-2 days	Introduction of the new curriculum	Neutral

Majority of the teachers do not think that the training given by MoNE were effective for them. They mostly complained that even these instructors did not internalize new educational paradigms. They presented the content by using PowerPoint slides and most of the time they just read the content from slides. Teacher 11 said:

> *"The seminars were mostly superficial and just organized for reaching the required number of trained teachers as stated in the schedule of MoNE. In addition, teachers could not have the opportunity to become qualified enough in such a short timeline."*

Other teachers also criticized the training in terms of both quantity and quality. According to the teachers, they were trained in crowded groups and there were technical problems which affected the trainings' quality. They encountered difficulties such as problems in computers or the presentation files were not prepared in appropriate format in computers. According to Teacher 6:

> *"The curriculum started to be implemented with a sudden top-down decision. I think teachers should have been trained for three or four months at least and they should have been given opportunity to practice the new curriculum before the general dissemination."*

Teacher 8 and Teacher 9 spoke positively about their training. Teacher 8 found the training to be very effective and useful for her. She attended seminars related to active learning, project preparation and nature of science. One of the seminars which the teacher mostly mentioned was organized by World Bank. The seminars related to the nature of science were given by faculty members. The other teacher who found the training effective was Teacher 9. This teacher was working in a pilot school when he attended those trainings. He had opportunities to attend many activities related to program development, curriculum implementation and professional development.

When teachers were asked about their responsibilities in implementation of the curriculum effectively, the common answer was related to the preparation process. Most of them agreed that teachers should be prepared seriously in advance. Moreover, most of the teachers stated that teacher should be active and energetic in order to be facilitator in the classroom. However, Teacher 4 and Teacher 10 could not internalize the facilitator role that the curriculum impeded on them. Teacher 10 implied that: "My responsibility is simple; organizing everything, not trying to teach the content in detail, not pushing myself to teach the content."

Teacher 4 also considers the responsibility of the teacher in a similar way:

> *"At the beginning of the year, I explained the student roles and responsibilities in the new instructional style. From now on, I am, as a teacher, not responsible from your learning. You are expected to learn by yourself."*

Other teachers mainly listed understanding the curriculum by exploring the program book, updating their knowledge on educational technology, becoming aware of the individual differences and managing time and resources as the most important responsibilities of the teachers.

Implementation of the change

There are not any significant changes in some of the teachers' preparation process for courses. When we asked these teachers what they did and what kind of sources they used when planning their first course hours, they emphasized the pressure of high stake testing on their planning. Teacher 2 said that: "I always use different kinds of textbooks as sources apart from the curriculum change. I practice many different types of test questions regarding the subject matter."

Similarly, Teacher 1 used many textbooks including multiple choice questions or multiple choice test sheets as a supplementary source. Unfortunately, because of the high

stake testing pressure, teachers teach through multiple choice test questions as an approach in classroom teaching.

Some of the teachers among the others noted a big difference in lesson planning. What Teacher 9 implied was that:

> *"I sought for different activities, games and demonstrations from web and books in order to make students more active and curious when planning my first lessons in this curriculum. I designed my lessons in a different way in order to integrate the nature of science to the lessons."*

Teacher 6 also specified the difference in her lesson planning as: "My lesson plans are designed according to the principles of 5E learning model that includes exploration, engagement and so on."

Teachers were asked about the factors affecting their curriculum implementation. As it is seen in Table 5 most of them complained about the parental factors.

Table 5. Factors affecting public school teachers' curriculum implementation

	Positive (n)	Negative (n)	Neutral (n)
Students	1	6	1
Parents	2	8	1
Administrators	5	4	2
Physical conditions	5	4	0

They stated that parents are unaware of the current curriculum. Since parents misunderstood the aims of the performance tasks, they get involved in the preparation of the performance projects. When the students get low score from these projects, parents feel as if they also get low grades. Majority of parents dominate teachers for high grades for performance project assignments. Parents are generally in contact with teachers to talk about their children's grades instead of their developmental processes. Parents do not monitor students' out of school activities. Teachers mostly complain about students' readiness and background knowledge in curriculum implementation. Teacher 10 implied that:

> *"The main problem in curriculum implementation is the lack of student prior knowledge. In my opinion, even if you apply the best approaches to the educational practices, students should have some basic skills and prior knowledge for implementing the curriculum in the classroom without encountering any problems."*

Besides, although most teachers do not consider the administration as a negative factor affecting their implementation process, they regard the administrative support as a source of motivation. The main problem with administration is the lack of guidance in training for teachers. Physical conditions were not seen as a major problem in implementing the curriculum in most schools. However, teacher 11 stated an example of a specific design for science classroom. He implied that:

> *"In order to implement the curriculum properly, there should be a science classroom that is always ready for science courses. There is not such a chance."*

Teacher competency in change

Teachers' beliefs play crucial role in implementation of the curriculum (Guskey, 2002). Their beliefs about self-competency are also one of the key factors affecting the success in implementation. Therefore, their perceived competencies in three main aspects were investigated.

Table 6. Teacher competency

	Sufficient		Insufficient	
	N	Percent (%)	N	Percent (%)
Content knowledge	6	50	6	50
Activity preparation	6	50	6	50
Student-centered education	3	25	8	67

Teachers generally do not feel themselves sufficient in terms of content knowledge, activity preparation and student-centered education. As it is presented in Table 6 above, half of them were not confident in content area they taught. There are certain reasons causing this problem. Some of the teachers specialized in a certain discipline, so they feel insufficient in other disciplines. Teacher 2 explained her reason as: "Since I have graduated from physics department, I am more competent in physics topics rather than biology topics."

Teacher 11 concealed his inadequacy by blaming the science as an extensive knowledge area to cope with and implied that:

> *"This is science; the topic range of science is very broad. Thus, we do not do well on some scientific issues in the classroom."*

Other teachers feel insufficient because of the new content they encountered in the recent curriculum. Teacher 7 exemplified that:

> *"I do not feel self-sufficient in the new content since I have never taught those although I have 17 years of experience in the profession. For example, "Earthquakes, Natural Periods (e.g. plate motion) and so on."*

Teachers also have problems in activity preparation. Since teachers lack practical knowledge in implementing activities in courses, they have classroom management problems while performing the activities. Another common issue is the need for extra time and effort in designing activities. Besides, few teachers reported that they cannot have enough materials and physical conditions for effective activity implementation. Teacher competency in instructional design is one of the significant concerns because implementing the new student-centered instructional design requires proficiency in subject matter, classroom management, cooperation with stakeholders, and so on. Teachers are not well equipped in these constructs; therefore, performing student-centered education in classrooms becomes a problem not only for teachers but also for pre-service teachers (Elmas, Demirdogen, & Geban, 2011).

Effects of change on teacher

According to teachers, their perspectives, teaching styles and research habits have altered drastically. Since their instructional design changed, they had chance to gain new and interesting experiences. Teachers also declared the technology usage as a drastic change. For example, for Teacher 4, with the change in the curriculum, the need for internet usage has increased. She became accustomed to the educational technologies such as projectors, computers and so on; therefore, started to integrate technology into her lessons. By improving themselves in technology usage, teachers began to do more comprehensive research in their field.

Observation Forms from the Public Schools

The researchers observed the schools from which the participants were selected by using observation sheets. The schools were observed in terms of two main categories which are portrayal of school and description of classroom. Within the portrayal of the school

category physical appearance of the schools, facilities such as science and computer laboratories, and the class sizes were noted in detail. In addition, in the second part of the observation sheets, physical conditions of classroom such as seating arrangement, the type of the board, and technological facilities of the classroom were investigated.

Table 7. Observation Forms

Schools	Portrayal of schools			Description of classrooms	
	Science lab	Computer lab	Class size	Seating Arrangement	Technological Facilities
1	+	+	18-20	Traditional	Whiteboard
2	+	+	25-30	Traditional	Whiteboard, Projector, Computer
3	-	+	17-18	Flexible-movable Chairs	Whiteboard, Projector, Computer
4	+	+	40	Traditional	Whiteboard, Projector, Computer
5	+	+	30-35	Traditional-movable Chairs	Whiteboard
6	-	+	25-30	Traditional-movable Chairs	Whiteboard
7	-	+	25	Traditional	Whiteboard
8	+	+	35-40	Traditional	Whiteboard
9	+	+	25	Traditional-movable Chairs	Blackboard, Projector, Computer

As displayed in Table 7, the class sizes range from 17-40 students. According to Gecer and Ozel (2012) and Guven (2008) crowded classrooms may not be feasible to implement the curriculum. The other factor which inhibits student-centered teaching is the seating arrangements in public schools. Most of the classrooms have traditional seating arrangement. Although there are movable chairs in some classrooms, there is not enough space to re-arrange the seating suitable for student-centered teaching. Regarding technological facilities, about half of the schools do not have computers or head projectors in the classrooms. However, all of the schools have computer laboratories. In addition, most of the schools have science laboratories, but in some of the schools, science laboratories are used as a science materials store instead of instructional purposes.

Private Schools

Structure of Change

PrS (Private School) teachers were asked what has changed with the current curriculum. Their answers revealed that they are aware of the changes in the paradigms of the curriculum. They were all asked about the changes in teacher role, student role, student activities, textbooks, and assessment. Regarding teacher and student role; they all mentioned the shift from teacher-centered education to student-centered education. PrS Teacher 1 defined the teacher role in the new curriculum with the chef analogy:

> *"… Teacher is just a chef, not the waiter or waitress. Teaching is like self-service. Students take the whole responsibility on their own learning. … I talk rarely in the class. Students discover by themselves. I just guide them in their learning."*

PrS Teacher 2 also focused on student-centered education by saying: "Teacher stays in the background. Students are more active comparing to the previous curriculum. The aim is to facilitate the learning process."

Although PrS Teacher 3 is the one who has the most difficulty in understanding and adapting to the new curriculum because of her long experience with former curriculum, she ultimately understood the teacher's role. She expressed her difficulty as:

> *"The center has moved. The teacher is the core of the instruction but all the authority and rights have been restricted with the current curriculum… Teacher should be a maestro in this setting."*

PrS Teacher 4 emphasized the teacher role as the main change in the curriculum reform. She said:

> *"…the curriculum reaches its expected aim as long as teacher regards herself as a guide. The crucial point is; teacher should be a facilitator…teacher should be the one who facilitates students for reaching usable knowledge rather than transfers his knowledge to students".*

All of the PrS teachers mentioned a change in their teaching style. Half of them started to use 5E learning cycle model with the change in the curriculum. Even one of them developed a new model with the program developer expert. This new model was constructed based upon the 5E and 7E learning cycle model. They started to use variety of instructional strategies such as drama, problem-based learning, inquiry-based learning or discussions in the classroom. They are all in search of activities that make students active and engaged; and create a flexible learning environment. However, teachers complained about the high stake testing pressure on implementing the above mentioned strategies. PrS Teacher 6 feels this pressure and expresses her feeling as:

> *"…since there is not much high stake exam pressure (High school entrance exam) in 6th grade, we are doing more activities. I give performance assignments. However, since there is higher high stake exam pressure in 7th and 8th grades, students and parents consider these activities as useless and unnecessary. If students were not obliged to be prepared for high stake exam, we could have felt less pressure".*

PrS Teacher 6 prefer to practice through multiple choice tests for high stake exam after doing the activities in the MoNE books in her teaching. Contrary to Teacher 6, Teacher 4 mentioned the ineffectiveness of practicing with multiple choice test questions in teaching to prepare students for high stake tests, instead, PrS Teacher 4 uses more activities rather than practicing with multiple choice test questions. While PrS Teacher 6 faced difficulties with assessment due to high stake testing, other teachers pointed out alternative assessment techniques. In this regard, PrS Teacher 1 and PrS Teacher 3 mentioned the activity based and skill based assessment in their schools. Since they have assessment and evaluation specialist in their school, they have chance to rewrite the course objectives aiming students to develop higher order thinking and scientific process skills. In order to reach their rewritten objectives, they use questions requiring higher order thinking skills in their exams and use experiments to assess students' learning. Moreover, they developed an observation sheet to evaluate their students' performances in the classroom. They also use feedback forms to inform both students and their parents about the students' performances in the exams. By the help of these feedback forms parents have the chance to monitor the progress of their children and also students are assigned additional homework according to their wrong answers in order to compensate their incomplete understanding. PrS Teacher 5 uses self-evaluation and peer evaluation. As they denoted, almost all of the teachers use alternative assessment techniques.

All of the PrS teachers use program book, textbook and student activity book for their planning and instruction. Besides, the PrS teachers stated their use of technology with the current curriculum. They use technology in all phases; preparation, implementation, and evaluation. They use technology to design instructional materials, to search for content and activities, to encourage student to search, to visualize their teaching, to create hands on activities and so on. Some of the teachers also use different supportive sources like program development specialists, assessment and evaluation specialists, educational experts, and lab assistants to help them in planning and instruction. PrS Teacher 1 also uses her university textbooks in order to complete her deficiency in content knowledge.

Acceptance of Change

Expecting an instant change from the teachers is unrealistic because change requires time and effort (Guskey, 2002). The change seems threatening especially for experienced teachers and brings anxiety for them. Teachers hesitate to accept new practices or procedures unless they feel sure that those practices can work better (Lortie, 1975). Similarly, the experienced teachers had more difficulty in accepting the changes in the curriculum. PrS Teacher 3 was the most experienced teacher and she had the most difficulty in accepting the changes in the curriculum due to her great deal of experience with the former curriculum; however, other teachers did not have such difficulty in adapting to the new curriculum. PrS Teacher 3 expressed her resistance to change with the sentences below:

> *"One year before the curriculum reform, we started to examine the curriculum with a program development specialist. After a few months, I realized that I was not talking that much. I had nothing to say, because everything contradicted my views. Okay, students should also talk but I am the one who teaches. Students are supposed to listen and take notes. They can only learn from me. I had difficulty in the first year, but especially the third year was very enjoyable both for me and for my students when I reconciled with the new curriculum."*

PrS Teacher 3 was the only teacher who had such trouble in accepting the paradigms of the new curriculum. However, even she got accustomed to the teaching in the way the new curriculum requires. Although she had some hesitation at first and could not accept the new perspective of the curriculum, she took the risk and changed her teaching practices. After realizing that the current curriculum works well in her classroom, she started to enjoy the change. She learned to understand and use the program book with the help of the specialists. Other teachers use the program book to some extent. Some of them use it just to look at the objectives, one of them uses it for planning, one for deciding how much content should be given to the students, another one uses it in all phases of classroom instruction. PrS Teacher 5 found the program book very useful and creative, and has indicated that she has learned much about the curriculum from it.

Opinions about the Change

PrS teachers were asked about their opinions on the content load of the curriculum. There were different views regarding the content load as it is seen in Table 8.

Table 8. Teachers' Opinions about Content Load

Content load is	Teacher						
	1	2	3	4	5	6	%
Quite heavy, difficult to follow the pacing	+	+	+				50
Appropriate for the grade levels					+		17
Not enough				+		+	33

As it can be seen from the Table 8, half of the teachers think that the content load was too heavy to implement the curriculum. The teachers who think the content load is heavy had difficulty in catching up with the time schedule. PrS Teacher 3 mentioned the difficulty in student-centered teaching due to heavy content load. She stated that while rushing from topic to topic, teachers are neglecting the student centered nature of the curriculum. Contrary to PrS Teachers 1, 2 and 3, PrS Teacher 6 thinks that content load is inadequate for the students' cognitive skills, especially in the sixth grade. She said that:

> *"I think content load in 6th grade can be more comprehensive. In this grade level, students have greater potential to deal with more complex concepts."*

Most of the teachers admired the curriculum organization; however, one of them criticized the repetitions of the content over the grades. Four of them stated that the content organization is spiral. Other teachers realized the spiral nature of the curriculum unconsciously even though they did not know its specific name. Although they are in favor of the spiral curriculum, some of the teachers criticized the order of the concepts in the topics. Moreover, some basic concepts were omitted from the topics for the sake of the spiral curriculum. For instance, PrS Teacher 1 thought that although the topics were organized from simple to complex, some of the basic concepts required for the complete understanding of the subjects were omitted. This is an obstacle for comprehensive understanding of the topics. She gave some specific examples: "Students do not have the notion of electron concepts when they are learning negative charges in atoms."

> *"In the 8th grade, the genetics unit starts with cell division, continues with genetics and afterwards, DNA comes. I believe this sequence is illogical. I am trying to ameliorate this problem."*

All the teachers admired the curriculum in terms of daily life connection. Although they have been already teaching the science concepts by making bridges with daily life examples to make the concepts meaningful, the current curriculum is also effective in relating science to daily life.

As a summary, private school teachers' opinions about the positive and negative sides of the curriculum are listed in Table 9. PrS teachers emphasized the daily life connection and student centeredness as the main strengths of this curriculum. On the other hand, content overload was the mostly stated negative side of the current curriculum.

Table 9. Mostly emphasized positive and negative sides of the new curriculum

	Positive sides	Negative sides
T1	Daily Life Connection, Student-centeredness, Objective Assessment	Time Restriction, Content Overload
T2	Student-centeredness	Content Overload
T3	Student- centeredness, Daily Life Connection, Spiral Content Organization	Content Overload, Repetitions in Content,
T4	Student And Teacher Role	Dependency on Teacher Competency
T5	Student-centeredness	Inconsistencies Between Disciplines
T6	Student-centeredness, Enjoyable, Interactive Teaching	Class Size

Feelings about the Change

PrS teachers were asked about their feelings regarding the implementation of the new curriculum. All the teachers feel enthusiastic about implementing the new curriculum because it enhances students' understanding of the scientific concepts. According to PrS Teacher 1:

"Thanks to the enhanced understanding of scientific concepts, science has become more enjoyable for the students. The increase in their enjoyment makes me satisfied."

"The new course design consists of many meaningful connections which let students perceive the course as a whole. In the classroom, I feel like I am in the middle of a theatrical play."

Although the outcomes of the new curriculum were satisfactory for the PrS teachers, half of them mentioned that it is very exhaustive. PrS teachers mentioned that they are always in a rush to keep up with the schedule of the curriculum.

Personal accountability for the change

PrS teachers with the exception of PrS Teacher 5 participated in the training programs. The details of training are displayed in Table 10.

Table 10. Trainings those private school teachers participated in

	Source	Quantity	Content
T1	Undergraduate lessons, Seminars	About 40 seminar hours which last 1 year	Multiple intelligence, problem-based learning, Constructivism, Evaluation and assessment
T 2	School, Faculty members	8 week	5E
T3	Program development specialist, seminars	About 100 seminar hours which last 1 year	Implementation of curriculum change
T4	MoNE seminars	1 month	Implementation of curriculum change
T5	No training	-	-
T6	Undergraduate lessons, MoNE seminars	1 day	Project preparation

Contrary to public school teachers, PrS teachers have the opportunity to participate in professional development programs from different sources. They get training from both their institutions' educational experts and the MoNE. Moreover, PrS teachers who are enrolled in a graduate program get additional support from the faculty members. Since PrS teachers (5 of them) were exposed to new educational paradigms in their bachelor education due to their recent graduation date, this made them advantageous in understanding the new pedagogies. However, only PrS Teacher 3, who is the most experienced, said that she learned many aspects of the current curriculum with these trainings.

Surprisingly, PrS Teacher 6 complained about the lack of administrative support about teacher training. She encountered problems with the administrators while participating in the in-service training of the MoNE. She said that administrators worry that when teachers are taking part in the training during school hours, there is a risk of missing classes. She also added that she wants to be informed by the administrators about the seminars and activities related to her field.

Teachers were aware that this new curriculum has laid a burden on them. Most of the teachers considered preparation for instruction as the most important responsibility of the teachers. They all stressed that teachers should be dynamic and active. Besides these, PrS teacher 4 mentioned another responsibility of the teacher:

"There are individual differences in students' learning capacities. Teachers should consider the individual differences in instruction. Teachers should develop necessary skills to accomplish this."

She also added that; "Teachers should be sufficient in terms of content knowledge because there are always curious students in the classroom." and mentioned the need for adapting to the changes in educational technology to guide and direct students' investigations.

Implementation of the change

PrS teachers were asked what they did differently while planning their first lessons. Teachers stated that they used different kinds of books compatible with the principles of the new curriculum, and shared ideas with the experienced teachers. Teachers, who are enrolled in a graduate program, took advice from university professors about the new perspectives.

Since they are teaching at private schools, economic and human resources, and overall school facilities are adequate enough to meet the goals of the contemporary educational paradigms. This provides opportunities for using variety of instructional strategies, activities and materials in the classroom. In addition, school administration simplifies the bureaucratic procedures for field trips and other outdoor activities in a way that let teachers use variety of contextual learning environments. School administration also assures the advancement and renovation of existing materials.

The only inhibiting factor for the implementation is the parental behavior. According to teachers, some parents are aware of the benefits of changes in the new curriculum while there are parents who hinder the implementation of the new curriculum. For instance, PrS Teacher 6 mentioned the parental factor in the following words:

> *"Many parents are worried about their children's success in high stake testing exams; the more activities are done in the classroom, the less time left for practicing multiple-choice test questions."*

According to the teachers, students became more motivated to learn science in active learning environments, which is one of the fundamentals of the new curriculum. Their motivation, in turn, affects the implementation of the curriculum positively. Table 11 displays teachers' opinions about the factors influencing the implementation of the new curriculum.

Table 11. Factors affecting teachers' implementation

	Students	Parents	Administration	Physical conditions
Positive	5	4	5	6
Negative	0	0	0	0
Neutral	0	1	1	0

Teacher competency in change

Similar to public school teachers, PrS teachers were not much confident in all aspects of the implementation as it is presented in Table 12.

Table 12. Private School Teachers' Competency

	Sufficient		Insufficient	
	N	Percent (%)	N	Percent (%)
Content knowledge	2	33	4	67
Activity preparation	4	67	2	33
Student-centered education	4	67	2	33

Majority of the teachers encountered unfamiliar content in the current curriculum, although they did not face with serious problems in meeting their inadequate content knowledge. They listed many topics newly added to the curriculum. Teacher 1 exemplified that:

> *"In my undergraduate education, I did not learn about heat and matter topic. Moreover, our teacher education program did not cover optics, earth sciences and geology or evolution. These topics are unfamiliar to me. I had to improve myself by reviewing university textbooks."*

Another teacher referring to her inadequacy in content knowledge was Teacher 3:

> *"In some topics such as light and voice, I do not have in-depth knowledge. I have never been learned about the voice. I had to spend extra effort to learn these topics. Moreover, I have got out of practice in teaching heat topic throughout years. Then, this topic was included in the curriculum again."*

Although these teachers have inadequate content knowledge, they can cope with this by reading supportive or curriculum materials. PrS Teacher 3 spend considerable amount of money to the additional materials about the new curriculum. She also got professional support from secondary school teachers in related field. However, PrS Teacher 3 still feels herself uncomfortable in teaching those topics. Contrary to these teachers, PrS Teacher 5 feels herself competent in the content. She thought that since the topics are not so detailed (just the main issues are given to the students), she does not have any difficulty in the content.

In activity preparation, more than half of the teachers felt competent. Especially, PrS Teacher 1 and PrS Teacher 3 got support from program development specialists in their schools. Therefore, they did not have much difficulty. Surprisingly, teachers who felt themselves not competent in activity preparation have graduate degrees. PrS Teacher 2 got help from her colleagues to gain adequate skills in activity preparation. PrS Teacher 6 became competent in activity preparation and implementation by the help of curriculum materials. By using the curriculum book in deciding activities or materials to be used, she become more confident in this issue. Moreover, she became more comfortable in implementing the activities with the development in her classroom management skills.

Regarding student-centered education, most of the teachers thought they are implementing student-centered education in their classrooms successfully. They described the classroom environment as comfortable for discussing students' ideas. They mainly commended the new curriculum in terms of the opportunity to implement student-centered education. There are proper activities for student-centered lessons. On the other hand, there is a high stake exam pressure which hinders the implementation of the student centered education on students and teachers. Since students should be prepared for high school entrance exam, teachers sometimes prefer the way they traditionally taught, as PrS Teacher 4 stated:

> *"I am not satisfied with the implementation of the student-centered education in my courses. Although I try to be a facilitator in the classroom as far as I can be, occasionally, I have to prefer direct teaching."*

PrS Teacher 3 also cannot implement student-centered education, but her concern is different:

> *"I am really successful in 6th grade. In 7th grade, due to the entrance to adolescence, students' personal characteristics are not mature enough. Therefore, some students are shy to engage swiftly to the activities or some of them are more extroverts and want to*

be the center of attraction in group works. Concerning these issues, I am successful only in 6th grade in implementing student-centered education."

Effects of change on teacher

The curriculum reform has changed the teachers' views about scientific knowledge and science teaching. PrS Teacher 2 implied that:

"The curriculum reform has made a drastic change on me. For example, my acceptance of knowledge is not direct any more. I am more sensitive and critical to the sources of knowledge."

Teachers involved in more research processes related to many aspects and issues of new style of classroom instruction. Besides, the reform required new skills which compelled the teachers to participate in variety of training programs.

Observation Forms from the Private Schools

Similar to public schools, private schools were also observed by means of the same observation sheet. Observation results were displayed in Table 13.

Table 13. Observation Results

Schools	Portrayal of schools			Description of classrooms	
	Science lab	Computer lab	Class size	Seating arrangement	Technological facilities
1	+	+	23-25	U shaped	Projector, blackboard
2	+	+	20-23	Traditional, movable chairs	Projector, blackboard
3	+	+	12-15	Traditional	Projector, blackboard, whiteboard, smart board, computer
4	+	+	20-25	Rectangular	Projector, blackboard

In most of the private schools (School 1, School 3, and School 4) science lessons are always carried out in science laboratories. The science laboratories include both desks and laboratory benches. All science laboratories are equipped with the materials necessary for science lessons. Both the existence of necessary materials and the seating arrangement make the physical environment appropriate for different kinds of learning activities. School 2 is the only exception in which science lessons are carried out in classrooms with traditional seating arrangement. However, to some extent, movable chairs give teacher flexibility to modify the seating for different purposes. Besides these, class size in private school classrooms, ranging from 12 to 25, is lower comparing to public school classrooms which may enable teachers to implement activities in a more convenient way.

In terms of technological facilities, private schools which included in the present study are not well equipped with technological tools as expected. Not all of the private school classrooms possess computers and smart boards, but they all have computer laboratories.

Discussion and Conclusion

Public and private school teachers' perceptions and implementations in the curriculum change process have both similarities and differences. For instance, regardless of the school type, all of the teachers are aware of the paradigm shift in teaching and learning process. This

finding is parallel with the previous studies conducted in Turkey which revealed that teachers noticed the major principles of the constructivist approaches in the current curriculum (Aydin & Cakiroglu, 2010; Erdogan, 2007; Guven, 2008). This, in turn, promotes the implementation of the new curriculum in the intended way. As Smith and Southerland (2007) emphasized, teachers' perceptions of the reform determine their practices of the implementation. In the present study, there are some minor distinctions among the perceptions of public and private school teachers with respect to the teacher roles. PrS teachers emphasized the changing role of teachers more in a way that teachers have become the facilitator in the current curriculum comparing to public school teachers. Not surprisingly, PrS teachers' perceptions influenced their practices as inferred from the interview scripts.

In terms of assessment, while public school teachers focused on ineffectiveness of performance and project assignments as in the study of Aydin and Cakiroglu (2010), private school teachers remarked the effectiveness of observation sheets, feedback forms, self and peer evaluation. The reason behind this is that private school teachers get support from specialists in each step of lesson preparation. According to Jaworski (1998, 2003), the most effective learning of teachers may take place in a supportive community rather than within the practice of individuals. Therefore, in private schools, teachers learn the effective use of strategies with the help of educational specialists by getting immediate feedback concerning their practices. According to Fernandez, Ritchie and Barker, (2008), support from other stakeholders and specialists is one of the crucial factors for teachers in internalizing the curriculum documents. However, with the exception of some private schools, support from other stakeholders and specialists is not very common in Turkish schools.

In terms of the acceptance of the current curriculum, experienced teachers in both public and private schools encountered difficulties in adapting to the current curriculum. The experienced teachers have a sense of teaching emerging from their former practices. Therefore, changing these practices means risking failure for them (Guskey, 2002). This may cause experienced teachers to be resistant to any change in the implementation. This is not the case for only Turkish teachers. As Henke, Chen and Goldman (1999) and Ross, McDougall and Hogaboam-Gray (2002) pointed out, more experienced teachers are less likely to use the innovative practices and prefer traditional practice compared to the less-experienced teachers. If the collaboration between teachers and other stakeholders such as program developers, researchers and other teachers is enhanced, the process of acceptance and adaptation may become easier (Ward & Tikinoff, 1982). Besides, if experienced teachers' beliefs about the outcomes of their efforts on changing their practices are altered, the use of new practices may be sustained and endured (Guskey, 2002). In the present study, private school teachers cope with this problem in a way that experienced teachers receive help from program developer specialists to make them understand and internalize the changes in the curriculum. That might be why the experienced teachers in private schools encountered less difficulty in the adaptation process comparing to experienced teachers in public schools.

Public school and private school teachers have similar opinions regarding the current curriculum. Teachers from both school types consider the student-centeredness as an important strength of the current curriculum. Teachers in other studies emphasized the student-centered nature of the curriculum (Aydin & Cakiroglu 2010; Erdogan 2007; Guven 2008). Although the teachers from both school types were aware of the student-centered teaching strategies, most of them were not fully adapted these strategies into their classrooms. For instance, in the present study, public school teachers focused on the importance of student-centered education, but some of them complained about the fewer amount of topics covered in the curriculum contrary to private school teachers. According to them, there should be more science concepts to be taught. Actually, the student-centered education requires using

many teaching and learning strategies such as inquiry, discussion, role-play, cooperative learning instead of direct teaching (Felder & Brent, 1996). Intense content load may not be very feasible for the effective student-centered education by using such strategies. This may be an indication that some of the public school teachers are not sufficiently aware of student-centered education principles.

Besides, according to public school teachers, time restriction and insufficient infrastructure are the two main obstacles hindering the implementation of the current curriculum (Gecer & Ozel, 2012; Balta & Eryilmaz, 2010). Teachers encounter difficulties in covering all the content in the expected time duration. Still in some of the public schools, science laboratories, and technological tools are not enough in number, and class size and seating arrangement are not suitable for the implementation of the current curriculum. These findings are similar with the findings of the studies conducted by Gecer and Ozel (2012) and Guven (2008). In both studies, crowded classrooms are one of the problematic factors affecting the implementation. The study of Gomleksiz and Bulut (2007) also indicated the lack of infrastructure in the Turkish schools. There is still need for improvement of buildings, libraries, and science and computer laboratories as the research studies revealed out. Daily life connection is the other positive aspect of the current curriculum mostly stated by the PrS teachers. According to teachers, current curriculum constitutes a bridge between real life and science. This gives opportunity to enhance student understanding of science and increase their interest toward science. Therefore, daily life connection is one of the most important strengths of the recent curriculum as the teachers stated.

Teachers' feelings regarding the current curriculum did not differ with respect to school type. Teachers' feelings evolved over time with the increase in familiarity with the current curriculum. Although they felt frightened and uncomfortable and had serious concerns about the implementation when they first examined the current curriculum, they developed positive feelings toward it in time (Bulus Kırıkkaya, 2009). Actually, it is a common teacher change process in which it takes time for the teachers to adapt to a current curriculum to feel comfortable (Troudi & Alwan, 2010). When the teachers begin to realize the positive outcomes of the current curriculum, their enthusiasm has increased with the enhanced student success and interest (Bulus Kırıkkaya, 2009). On the other hand, teachers feel frustrated due to the restricted time to cover all the content with the new student-centered activities.

All the teachers participated in different kinds of training programs with different durations. However, the teachers did not benefit from these training in the same extent. The quality and quantity of the training programs differ for the public and private schools. While the training supported for private school teachers were from different sources, public school teachers were provided with only MoNE seminars. This presents that private school teachers were more advantageous in terms of in-service training comparing to public school teachers. This inequity in access should be remediated so that public school teachers also have a chance to attend different kinds of in-service training programs.

Despite its well-known importance in teacher change, in-service training is one of the major problems in Turkish educational system (Aydin & Cakiroglu, 2010; Ercan & Altun, 2005; Erdogan, 2007; Gozutok, Akgun & Karacaoglu, 2005). However, it should be recognized that change is a gradual and difficult process, and teachers need a long-run and progressive professional development (Guskey, 2002). In order to reach a level that renovations are successfully implemented in the classrooms, teachers should internalize the changes in and major principles behind the current curriculum. This goal may be accomplished through efficient in-service training programs. However, in the present study, teachers complained about the superficial training programs. They mostly emphasized the lack of examples of good practices which serves as a model, and insufficiency and inadequacy

of infrastructure such as technological facilities. Also, they pointed out that trainers are not proficient enough to reflect the changes to teachers. Therefore, teacher training programs should be revised according to the emerging needs of the teachers such as expecting to learn new instructional strategies or expanding their content knowledge (Paik, Zhang, Lundeberg, Eberhardt, Shin, & Zhang, 2011).

For the factors affecting the implementation of the new curriculum, while public school teachers stated the lack of guidance and encouragement from the administration, private school teachers do get support from the administration. According to Scott (1994), one of the problems in curriculum change is not to relate curriculum change to organizational structure and school administration. Therefore, administration is one of the crucial stakeholders involved in the process of successful implementation of the current curriculum. Hence, administrational support in public schools should be improved. In addition, physical conditions, as one of the factors affecting implementation are not a major problem for both schools. To be more specific, with the exception of some public school teachers, all the teachers mentioned that they had enough physical conditions for the implementation of the current curriculum because teachers do not need complex materials or science laboratories. The reason is that, the activities in the current curriculum are more related to daily life and can be conducted in classrooms with simple materials (Aydin & Cakiroglu, 2010).

On the other hand, public school teachers generally mentioned student readiness as one of the most important factors inhibiting the implementation of the current curriculum. As some of the public school teachers complained, student readiness is not concurrent with the activities implemented. Hence, teachers encounter difficulty in delivering the instruction as a response to student readiness. In order to overcome this challenge, teachers should design the classroom instruction considering both student readiness and instructional goals. Moreover, some of the public school teachers stated the students' socioeconomic background as an obstacle in implementation while some other public teachers did not. Actually, this problem cannot be generalized to every public school. As it is stated in the PISA results, what makes difference in student achievement is not the school type, but the socioeconomic status of the students and if students in public schools had similar socioeconomic context with private school, they can also perform well (OECD, 2011).

The other factor mostly stated by the teachers as a challenging one for the implementation of the reform was the high-stake testing pressure. Teachers hesitate to do all the activities since they want to allocate time to practice with multiple-choice test questions. Since the only way for the entrance to a quality high school is high-stake exams, there is a huge pressure on students which in turn affects teachers. In addition, parents put pressure on teachers to prepare their children for the high-stake exams. For most of the parents, children's conceptual understanding is not so crucial and they value the results of the high stake exams. Emphasizing high stake exams in designing instruction narrows the curriculum by focusing merely on the information that will be tested and prevents the development of higher order and problem solving skills (Jones, Jones, Hardin, Chapman, & Yarbrough, 1999). This issue obviously revealed that in order to decrease the negative impact of high stake exams on the curriculum implementation, the importance attributed to high stake exams should not be at such a level that it gets ahead of everything.

Regarding the content knowledge, both public and private school teachers do not feel much competent. Teachers in public schools attributed this insufficiency to be teaching outside their areas of license which is a frequently encountered problem in public schools as in the study of Taneri and Engin-Demir (2011). Also, the experienced teachers from both school types were not familiar with the topics newly added to the curriculum because it has been a long time since they graduated from university. These revealed that, teachers who feel

insufficient in content knowledge should be supported with in-service training to enhance and update their content knowledge.

However, regarding the activity preparation and student-centered education, private school teachers perceive themselves more competent comparing to the public school teachers. The reason behind this maybe that, private school teachers have chance to get assistance from the program development specialists. Also, private school teachers attend more in-service training programs to develop their pedagogical skills. This intensifies the need for in-service training which are sufficient in quality and quantity for the public school teachers (Aydin & Cakiroglu, 2010; Ercan & Altun, 2005; Erdogan, 2007; Gozutok et al. 2005; Guven, 2008).

Finally, for both public and private schools, the effects of the current curriculum were mostly seen on the experienced teachers. The major effects were the change on the views about science teaching and learning, and their research habits. Differently, the experienced teachers in public schools implied the increase in technology usage as one of the effects of the current curriculum on them. According to Davis (2002), to see the effect of curriculum reform on teachers, it would be better to consider not only which point they have reached by implementing the current curriculum, but also where they were at the starting point. In the present study, it is not possible to see a drastic change on inexperienced teachers because they were already familiar with the new teaching strategies and educational technologies.

Aforementioned differences in both school types can generally be attributed to four main reasons. Teacher training, existence of specialists, teachers' licensure and student readiness emerge as the important factors causing these differences. Which factors affected these differences can be concluded as;

✓ Teacher training: Internalizing the paradigm shift and the new teacher role was achieved by effective training in private schools.

✓ Specialists: Private school teachers get assistance from the specialists to improve themselves in terms of assessment, activity preparation, and student-centered education.

✓ Teachers' licensure: Teachers have licensure in fields other than their field of specialization. They encounter difficulties in adapting to the curriculum due to their lack of knowledge about different teaching strategies.

✓ Student readiness: Teachers blame lack of student readiness for their ineffective implementation of student-centered education.

To sum up, while making big innovations in educational settings, innovators take into account of the all stakeholders, physical settings, and all resources. Imitating some educational product from other countries' contexts may not probably fit to your educational system. There need to be a flexible timeline to follow and reforms have to place into solid grounds in your countries realities. Flexible time line is espoused with quality teacher training and additional support such as educational specialist and others. Moreover, mostly students are neglected but students' ideas and interests are needed to take into account in the reform process because they are the customers and consumers of the educational product (Siry & Kremer, 2011).

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