Science teachers' perceptions of the Turkish Elementary Science and Technology Curriculum

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Özet

Bu çalışmanın amacı öğretmenlerin 2006 Fen ve Teknoloji Programı'na ilişkin algılarını ve bu algıların programın içeriğiyle örtüşme düzeyini, programın uygulanma ve benimsenme düzeyinin daha iyi anlaşılması için ortaya koymaktır. 9 Fen ve Teknoloji öğretmeniyle derinlemesine mülakatlar yoluyla keşif odaklı niteliksel bir araştırma yürütülmüştür. Ego-tehdidi ile baş etmek için, veri toplama aracı olarak oyun etkinliği adı verilen görece yeni bir teknik geliştirilmiştir. Toplanan veri, içerik analizi kullanılarak analiz edilmiştir. Çalışmanın bulguları, öğretmenlerin programı uygulamak için çaba sarf ediyor olmalarına rağmen, programı dikkatli bir şekilde incelememelerinden kaynaklı olarak, bu çabalarının boşa gittiğini göstermektedir. Aynı yöntem ile değişen Fen ve Teknoloji Programına ilişkin öğretmen algıları da incelenecektir.

Anahtar Kelimeler: *İlköğretim; Fen programı; Öğretmen algısı,*

Abstract

The aim of this study was to reveal the science teachers' perceptions of the fundamentals of the 2006 Elementary Science and Technology Curriculum and the level of consistency of these perceptions with the content of the curriculum in order to get deeper understanding of the implementation and adoption level of the curriculum. An exploratory qualitative research was operated through in-depth interviews with 9 science teachers. To directly deal with ego-threat, a relatively new technique, game activity, was developed as the data gathering tool. The findings indicated that although

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teachers spend an effort to implement the curriculum, since they did not examine it closely, their efforts go in vain. The new curriculum also will be tested using the same method.

Keywords: *Elementary; Science curriculum; Teacher's perception,*

Introduction

Teachers are important agents of curriculum change (Fullan, 2007; McLaughlin, 2004). They help to overcome the problems with the theory and implementation of the curriculum and they are the key person to fill this gap (Elbaz, 1991). Teachers' beliefs and perceptions about curriculum or education reform affect their practice in the classroom (Yerrick et al., 1997; Ogborn, 2002; Barak and Shakman, 2008). Moreover, understanding teachers' attitudes and beliefs has an important role in the successful implementation of the curriculum in classroom (Crawley and Salyer, 1995; Olson, 1981; Tobin, 1987).

The 2004 Turkish Science and Technology Curriculum reform is a strong example to great curriculum changes. With this reform, many changes, especially in approaches towards teaching and learning process, took place. Moreover, relatively new concepts such as, student-centered teaching and alternative assessment appeared in both teachers' and students' agendas.

After the 2004 reform, the number of studies regarding the curriculum has increased in Turkey. In these studies, it was shown that teachers generally appreciate the curriculum in terms of its content and approach to teaching and learning process (e.g. Aydın, 2007; Değirmenci, 2007; Kara, 2008; Şeker, 2007; Tatar, 2007). However, in the studies that were based on interview data (e.g. Battal, 2008), it was revealed that teachers do not have as good a command of the content of the curriculum and its approach to teaching and learning process as quantitative results claimed to be. Moreover, many research studies showed that teachers had some serious problems with the implementation of the curriculum and thus, many teachers could not implement the curriculum at a satisfactory level (e.g. Gökçe 2006; Yangın, 2007).

In order to deepen the studies carried out in this field before and to take them one step further, the aim of this study was set to reveal the science teachers' perceptions of the 2006 Elementary Science and Technology curriculum in 6th, 7th and 8th grade levels and the level of consistency of these perceptions with the content of the curriculum. For this study, a relatively new qualitative interview technique was developed, which helped to gain a deeper understanding of teachers' perceptions and avoid the interference of ego-threat in qualitative studies. Therefore, this study has an importance in terms of reflecting teachers' perceptions of the 2006 curriculum by using an innovative methodological technique. It is expected that this study will be useful for curriculum development professionals, academicians and teachers who want to understand the dynamics of implementation and adaptation of the curriculum and who try to develop a new curriculum.

Framework

This section includes the summary and emphases of the 2006 Turkish Elementary Science and Technology Curriculum to provide a better understanding for a discussion.

Summary of the Curriculum

The scientific and technological literacy is the overall goal of the Turkish Elementary Science and Technology Curriculum. In order to achieve this goal, 11 general aims are listed in the curriculum (MNE, 2006: 9). Some of these aims are mainly related with improving students' understanding of the nature of science and technology such as "to make students understand the nature of science and technology and the mutual interaction among science, technology, society and environment" and some are mainly related with students' professional life and career choices such as "to provide a background for students which will help them develop information, experience, interest about topics like education and career choice, professions based on science and technology".

In the curriculum, 7 learning areas are separated into two main groups according to whether they are presented as units or not. Four learning areas that are presented as units, which are "Living Organisms and Life", "Matter and Change", "Physical Phenomena" and "Earth and Universe," come together under the topic "knowledge". The remaining three, which

are "Science-Technology-Society-Environment Relationships (STSE)", "Science Process Skills (SPS)" and "Attitudes and Values (AV)," are not presented as units because it is stated that predicted skills in these three learning areas are acquired through very long processes (MNE, 2006: 59). Learning outcomes of seven learning areas for each grade level are presented as yearly learning outcomes table in the curriculum.

Consistency with the principle of 'Little but essential knowledge' (fewer concepts rather than a lot of concepts and knowledge presented in a superficial and separate way), the learning outcomes in the units were selected in a way that would provide students with meaningful learning (MNE, 2006: 11).

The Emphasized Concepts in the Curriculum

The main emphasizes of the curriculum are about the concepts of scientific and technological literacy, constructivism, student-centered teaching strategies and alternative assessment.

Scientific and Technological Literacy

The 1990 UNESCO World Conference on Education for All maintains that science education should aim at forming a world community which consists of scientifically and technologically literate citizens (UNESCO, 1999). In the 2006 Turkish Elementary Science and Technology Curriculum, where the idea above is frequently emphasized as the vision, goal and one of the main principles, scientific literacy and technological literacy seem to be a single, combined concept. Moreover, for a scientifically and technologically literate person, 7 dimensions exist in the curriculum, which are the same as the scientific literacy framework established by The Centre of Unified Science Education (CUSE, 1974). This framework defines a scientifically literate person as one who: (1) understands the nature of scientific knowledge, (2) applies appropriate science concepts, principles, laws, and theories in interacting with his/her universe, (3) uses processes of science in solving problems, making decisions, and furthering his/her own understanding of the universe, (4) interacts with the various aspects of his/her universe in a way that is consistent with the values that underlie science, (5) understands and appreciates the joint enterprise of science and technology and the interrelationships of these with each other and with

other aspects of society, (6) develops a richer, more satisfying, and more exciting view of the universe as a result of his/her science education and continues to extend this education throughout his/her life, (7) develops numerous manipulative skills associated with science and technology (CUSE, 1974: 1, cited in UNESCO, 2008).

Constructivism

"Constructivism" means that students construct the knowledge; they do not receive it as it is but they re-form it. They learn the new knowledge by adapting it to the existing knowledge and their own situations. In the curriculum it is stated that although other learning approaches such as behaviorist approach and cognitive approach are not rejected, in order for students to achieve the learning outcomes in the curriculum, teaching strategies and learning experiences should concentrate on constructivist approaches as much as possible (MNE, 2006: 12).

Student-centered Teaching Strategies

Student-centered teaching strategies emerge as a requirement of constructivist approach. The fact that especially constructivist approach makes students active in learning process required the re-organization of teaching strategies accordingly. In the curriculum, teaching methods are listed from teacher-centered ones such as presentation and whole class discussions to student-centered ones such as discovery and independent study. Although teachers are given full authority to choose the teaching methods that they think are suitable for learning and teaching process, student-centered strategies have been suggested since they are suitable for constructivist approaches and they provide learning opportunities to reveal and develop high level thinking skills such as critical and creative thinking, analyzing and evaluating (MNE, 2006: 13).

Alternative Assessments

Cognitive and constructivist theory lead us to develop alternative assessment techniques instead of traditional ones. Popham (2006) indicated that in traditional approaches, the teacher tests students' learning as *assessment of learning*. In contrast, alternative approach is more instructionally oriented, in which testing plays a vital role in helping students learn, and the teacher regards it as *assessment for learning*. In the curriculum, almost all alternative

assessment techniques are explained in detail and some examples are given as well. Moreover, it is stated that students should be given the opportunity to be assessed through a wide variety of assessment techniques and thus teachers are recommended to use alternative assessment techniques.

Method

In this study, an exploratory qualitative research was operated through in-depth interviews with 9 science teachers.

Participants

Convenience and purposive sampling strategies were used to select the teachers to be interviewed. In other words, science teachers working at public schools in Ankara, Turkey were got in contact with because of the availability of the schools for the researchers. Among these teachers, the ones who declared that they had read and implemented the curriculum were selected for the interviews. Then, individual meetings were held with the teachers and appointments were made. After that, the interviews were started and they were stopped when it was realized that the information provided by the teachers started to be repetitive. Descriptive data of the sample is summarized in Table 1.

Table 1. *General profile of the interviewees*

No.	Gender	Age	Education	Experience in Teaching in terms of years
1	Female	50	Chemistry Educ.	20
2	Female	37	Chemistry	15
3	Female	51	Science and Nature Educ.	30
4	Male	56	Physics	34
5	Female	37	Chemistry Educ.	14
6	Male	60	Science and Nature Educ.	30
7	Male	44	Biology	7
8	Male	45	Chemistry Educ.	15
9	Female	43	Biology Educ.	20

Determining the Data Gathering Method

In this study, in order to directly deal with ego-threat during data collection, a relatively new technique, which is named game activity, was developed as the data gathering tools. Regarding ego-threat, Gorden (1956: 159) stated that:

The strongest tendency to withhold information is often referred to as "repression." The respondent not only refuses to admit the information to the interviewer but also hides it from himself, to preserve his self-esteem and escape a guilty conscience. He is perfectly honest when he says that he does not know or that he has forgotten. This dimension has primarily occupied the psychiatrist, psychoanalyst, and clinical psychologists…. If he [the interviewee] is made to feel confident that the interviewer will not condemn him, he may welcome the opportunity to "tell all".

The game itself, which has some general characteristics such as having a solvent and relaxing effect on people, helps interviewers to provide an environment for the interviewee where he/she can express his/her emotions, viewpoints and perspectives more easily, which is consistent with the aim of in-depth interviews. Plato stated that "you can discover more about a person in an hour of play than in a year of conversation (Garner, 2009). Furthermore, according Freud, with the help of games, one can overcome their fears, blockages and social conflicts.

Game activities prepared by the first author of this study do not have a single solution and they were designed in a way that this characteristic of the game activities could easily be recognized by the interviewees. Furthermore, the teachers were supplied with opportunities to talk about the topics such as the role of the teacher spontaneously rather than having them answer direct questions such as "What is the role of the teacher?" By this way, the pressure that the interviewees might feel during the interviews was substantially minimized and teachers were provided with an environment where they could easily "tell all."

Data Gathering tools

In this study, 6 game activities were developed. Each game activity was constructed so as to focus on certain dimensions of the curriculum but

they were not limited to its own dimensions. The main aim in the game activities was to provide the teachers with an environment where they could talk about the dimensions in the curriculum. Game activities used in this study are explained below.

The School Alive

The teachers were asked to place the slips symbolizing the parent, student, school principal, inspector, teacher and society onto the school layout (see Figure 1). After that, the slip symbolizing the teacher was removed from the picture and the teachers were asked to put other slips to fill up the space of the teacher. Lastly, the teachers were asked to place all the slips again according to the curriculum. As a result, both the teachers' perceptions of parents, student, school principal, inspector, teacher and society and their perceptions of the references in the curriculum regarding the interrelationships among these, and thus the correspondence level of their perceptions with the curriculum were understood.

Fig. 1. *A snapshot from a teacher's placement in the School Alive game activity*

The Education Balloon

According to the scenario where the education balloon was falling down, the teachers had to 'save' the balloon by throwing 4 weights symbolizing the school, curriculum, teacher and textbook one by one (see Figure 2). The teachers were provided with an environment where they were expected to make a priority order among the school, curriculum, teacher and textbook. By this way, how these teachers perceived the relationship among the concepts above, how much and for what they needed the curriculum and how they perceived the role of the teacher in education and teaching were understood.

Fig. 2. *A snapshot from a teacher's way of saving the balloon by throwing the weight symbolizing the school in the Education Balloon game activity*

The Warriors

Two warriors in green and blue color supporting different views met in the battlefield three times (see Figure 3). The discourses of the blue warrior were directly taken from the curriculum and the discourses of the green warrior were organized in opposition to the discourses of the blue warrior.

The warriors and the discourses supported by the warriors in three rounds are given in Table 2. At first, the teachers were expected to take the side of the warrior that they supported and then they were asked which warrior's side the curriculum takes. As a result, the teachers provided information especially on how they perceived Scientific Knowledge, The Principle of 'Little but Essential Knowledge' and constructivism and they questioned the internal consistency of the curriculum concerning these.

Fig. 3. *A snapshot of the moment that a teacher was making an explanation regarding the warrior that she supported in the Warriors game activity*

Table 2. *The discourses that the warriors supported in the Warriors game activity*

Round	Green warrior	Blue warrior
I	Detailed knowledge is essential!	Little but essential knowledge!
II	Science is a collection of stable and certain pieces of knowledge!	Science is not a collection of stable and certain pieces of knowledge!
III	Students receive the knowledge as it is!	Students cannot receive the knowledge as it is!

The Meal for a Year

The teachers had to form an imaginary sandwich by matching the given food ingredients (4 types of bread with a group of 3 ingredients: tomato, cheese, salami) with 7 learning areas in the curriculum (see Figure 4). After matching, teachers were given scenarios to solve where students refused to eat sandwiches or got sick after eating them. By this game activity, it was mainly aimed to understand the teachers' perceptions of the relationship among the learning areas (organizational structure of the curriculum) and the problems in learning process and the sources of these problems.

Fig. 4. *A snapshot from the Meal for a Year game activity when a teacher was matching learning areas with the ingredients*

The Card Game

There were three kinds of cards, red for general aims, green for teaching strategies (whether teacher or student centered) and blue for assessment techniques (whether traditional or alternative) in the curriculum. For every general aim, teachers selected appropriate teaching strategies and assessment techniques (see Figure 5). By this way, the perceptions of the teachers about the general aims, teaching strategies and assessment techniques were understood and the teachers' frequently used teaching

strategies and assessment techniques were determined. Thus, teachers' perceptions of compatibility among aims, teaching strategies and assessment techniques were put forth.

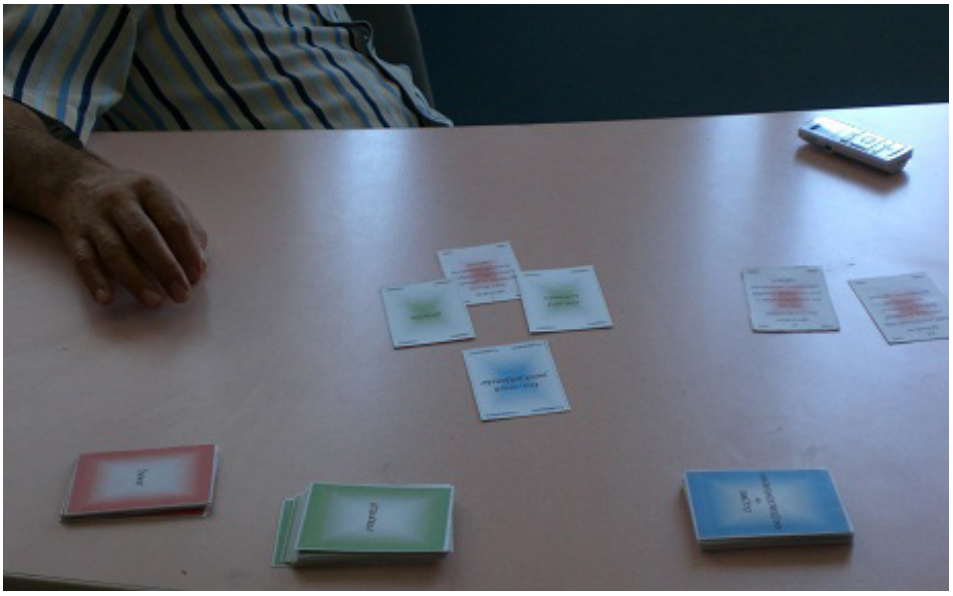

Fig. 5.*A snapshot from the Card Game game activity when a teacher is thinking the appropriate assessment techniques for the teaching strategies he has chosen*

Free Throw

Seven professional competency areas (knowledge of students, subject matter knowledge, knowledge of instructional strategies, pedagogical knowledge, knowledge of assessment, knowledge of curriculum and context knowledge) were selected from the literature (Magnusson, Krajcik, and Borko, 1999) and represented by arrows. The teachers determined a misconception and placed it at the target board. Then, they tried to eradicate it by choosing the arrow that they felt most confident with (see Figure 6). Scenario required a wind which made the teachers fail to hit the target, so they had to choose another arrow. By this way, how the teachers perceived professional competency areas and in which situations, how often and how they used them were understood.

Fig. 6.*A snapshot from the Free Throw game activity when a teacher is trying to hit the misconception she has identified by the professional competency she has chosen in order to eradicate the misconception*

Analysis of the Data

In order to reach the concepts and the connections which are successful in explaining the data, content analysis was used. To achieve intercoder reliability, more than 10% of the data obtained from interview transcription was randomly chosen and themes that explain the data were established by two different coders. Then, the established themes were brought together for comparison. Thus, the reliability of the study was checked as over 90% and it was decided to continue the analysis with the rest of the data.

Analyses

The main findings of this study regarding all dimensions of the curriculum are given below.

Teachers' General Perceptions about the Curriculum

When the data gathered by the *Education Balloon* game activity was analyzed, it was understood that the teachers thought that the importance of the curriculum in educational system was less than the importance of both the school and the teacher, whereas it was more than only that of the textbook. In fact, 4 teachers firstly threw the curriculum and while doing this, they did not have much difficulty. This situation showed that the degree of curriculum adoption of majority of the teachers was low although they have still tried to implement it. The teachers' critical statements regarding the curriculum are given in Table 3.

Table 3. *Teachers' critical statements about the curriculum*

Curriculum is not sufficient because:	Frequency
Students do not understand without formulas	3
There are unnecessary details in some topics	3
Time is limited for the implementation	3
Students do not do their homework by themselves and become dependent on their parents	2
It puts more weight on the students' shoulder than they are able to lift	2
Its approach to learning is not functional on central exams	2
Alternative assessment techniques take too much time and cause waste of paper	2
The number of units are more than necessary	2
It leaves the teacher out of the system	2
It causes some misconceptions	1
It does not take the society into consideration	1
It is not suitable for Turkish educational system	1

The vision of the curriculum "the scientific and technological literacy" and scientific knowledge

Four teachers declared that scientific and technological literacy was a necessity for all students. One of the teachers explained the reasons as:

Teacher 7: Each and every student should learn the life, they are in the life itself, an element of the society, and the members of the society have to know the changes happening within its own body. They have to know what is happening around them… the experts would deal with the details, it is not our business. But being a scientifically and technologically literate is not in terms of dwelling on the details.

However, 5 teachers did not agree with the idea that scientific and technological literacy is a necessity for all students. The explanations of the teachers regarding the issue are listed in Table 4. They usually mentioned that it was directly related with students' interest. For example, one of the science teachers with over 30 years of teaching experience stated that:
Teacher 6: Everybody should be guided towards their own interest. You cannot make a student who doesn't like science like science by forcing him.

Table 4. *Teachers' perceptions why scientific and technological literacy is not necessary for all students*

Scientific and technological literacy is not necessary because it is	Frequency
related with student's interest	4
related with student's capacity	2
only for the researchers	1

Moreover, the teachers tried to define the term of scientific and technological literacy through associations, which are listed in Table 5, instead of giving a proper definition.

Table 5. *Teachers' perceptions for the meaning of scientific and technological literacy*

Associations for scientific and technological literacy	Frequency
an ability	4
reading scientific articles	2
following scientific and technological improvements	2
a thing which is done by everyone whether consciously or not	2
making investigation	1
readiness and problem solving	1
a consciousness	1
a competency	1
a process	1
sensitiveness for the environment	1
consciousness about the environment	1
the learning techniques based on observation and using these learning techniques	1

Furthermore, teachers had some difficulties to identify the nature of science as well. While most of the teachers stated that scientific knowledge was not stable and certain as an initial reaction, only two of them were able to maintain this first reaction by giving consistent explanations. Especially the perception of one of these two teachers about scientific knowledge was almost fully aligned with the explanations about scientific knowledge stated in the curriculum as it is seen in the following quotation:

Teacher 8: I think science is not a compilation of certain pieces of knowledge. There is nothing certain; everything in the nature is in a process of transformation. The reason why science says that it is certain is that it considers everything by experiments, observations and by analyzing and touching. In that respect science is correct, but saying that it is certain knowledge is wrong.

Remain 7 teachers continued their speeches by supporting the opinion that scientific knowledge includes both certain and uncertain components. Most of them stated that while scientific laws such as gravity, heredity and principals of Archimedes were stable and did not change in time, scientific theories such as the origin of the humankind, evolution and models of the

atom were not stable and would change in time. The characteristics of scientific knowledge according to the teachers are listed in Table 6.

Table 6. *Teachers' perceptions of characteristics of scientific knowledge*

Characteristic	Frequency	Teachers' Explanations	Frequency
It includes both certain and uncertain components	7	Science and Technology is in a continuous transformation.	7
		Some knowledge is stable and some knowledge is not stable.	7
		Scientific laws are stable.	4
		Theories are not stable.	3
		Accessing certain knowledge is the aim.	1
		Knowledge is added in science after gaining certainty.	1
		Some knowledge is still in a research process.	1
It is unstable and uncertain	2	Science and Technology is in a continuous transformation.	2
		What is certain and stable is basing on scientific methods.	1

General Aims of the Curriculum

6 teachers found all general aims as meaningful for science and technology education. However, 3 teachers stated that aims especially related with students' career development were irrelevant to science and technology education. For example, one of these teachers took out the aim, to make students increase their economic efficiency in their professional lives by using their knowledge, understanding and skills, among the other aims and explained his reason as follows:

Teacher 4: Elementary students' career choices haven't settled yet. I leave it to high school.

The aim, to encourage students to develop a sense of curiosity towards scientific and technological developments and events at each grade level, was also found to be much more important than the other aims generally by all teachers.

The majority of the teachers mentioned that they could partially cover these aims in their lessons especially because of limited time and lack of equipment. Moreover, 4 teachers mentioned that no additional importance to these general aims was given in the curriculum apart from just being written in the curriculum. They supported their opinion by stating that there were not sufficient guidelines for these general aims. Two representative quotes are given in the following:

Teacher 5: According to what is stated here, it [curriculum] seems unsatisfactory I guess. It might encourage [students] a bit more; it might provide examples that would develop their curiosity.

Teacher 6: They [these aims] are in it. But the latest curriculum is not comprehensive. It should be revised. Yes these are in the curriculum but they are just written there. This does not mean that they are fully functioning.

The Principle of 'Little but Essential Knowledge'

Seven teachers supported the principle "little but essential knowledge" by the reasons listed in Table 7. They generally mentioned that detailed knowledge was boring for students and it was easily forgotten whereas "little but essential knowledge" increased the success of all students and it was necessary and satisfactory for elementary education.

However, 2 teachers, both of whom had 30 years of experience in science teaching, supported the opinion that detailed knowledge is necessary as little knowledge might be insufficient and wrong; however, a student with detailed knowledge would probably be more successful.

Table 7. *Teachers' perceptions about "Little but essential knowledge"*

Teachers' Opinion	Teachers' Explanations	Frequency
Little but essential knowledge is necessary	Little but essential knowledge is necessary especially for elementary education	3
	With little but essential knowledge, all students' success increases	3
	Detailed knowledge is easily forgotten	3
	Detailed knowledge confuses students / makes them get bored	3
	Little but essential knowledge is more permanent	2
	Little but essential knowledge is necessary / satisfactory	2
	Little but essential knowledge is headed towards a target; it is not superficial	2
Detailed knowledge is necessary	A student dwelling on the details might miss the essence	2
	One who knows the essence can access to the details	2
	Detailed knowledge is necessary for intelligent students	2
	One who has detailed knowledge becomes more successful	2
	Details are important	2
	Little but essential knowledge atrophies creativity	1
	Little knowledge is insufficient/wrong knowledge	1
	With the help of details technology develops and standard of living increases	1

Interestingly, five teachers mentioned that in the curriculum the idea that detailed knowledge is necessary was dominant. One of these teachers said that:

Teacher 2: When we analyze the curriculum, we can see that there is nothing there in terms of content, there is really little knowledge there. However, when you want to do the activities suggested in the curriculum with the students, you have to give detailed information to the children because the children get confused with the activity and cannot do the activity, or performance, or project with their limited knowledge. You feel you have to give the details.

Learning Process Approach

Only one teacher stated that students received knowledge as it is. Moreover, 5 teachers, generally by emphasizing the capacity of students, stated that some students received the knowledge as it is and some did not. For example, one of the teachers made following explanation about the issue:
Teacher 2: Because it is related to the student's capacity. The one with a high capacity receives the knowledge as it is but some students, because of their capacity and carelessness, cannot receive the knowledge as it is.

Furthermore, 3 teachers declared that students could not receive knowledge. While two of them attributed the reason to a failure in the transfer of knowledge or students' forgetfulness, one of them made an explanation regarding this issue which was in alignment with the constructivist approach to a great extent:
Teacher 1: It depends on whatever they have in their mind, as they feelings or thoughts.
Moreover, when all the teachers' opinions concerning learning process were completely analyzed, it was understood that the student profile put forward by the teachers which is listed in Table 8 was far from the student profile aimed at in the curriculum.

Table 8. *Teachers' perceptions of general student profile in learning*

Consistency with the Curriculum	Perceptions of General Student Profile	Frequency
	Students obtain knowledge in an unexpected way	3
	When they become unsuccessful they put the blame on the teacher	3
	They are dependent on the teacher when learning is concerned	2
	They are afraid of science, especially physics	2
inconsistent	They have a tendency to memorize	2
	They cannot do their homework by themselves; they get help from their parents	2
	They learn better through formulas	2
	They accept what they have learnt as absolute truths	1
	They get confused since they do not know what to do in education system	1

	They learn according to their own needs	3
consistent	They learn better when something is presented visually	2
	They learn better through doing and experiencing	2

In addition, in the *School Alive* game activity, the majority of the teachers put the figure symbolizing the student at the center of the picture and declared that the curriculum was prepared as student-centered although they were not asked a direct question. Moreover, it was understood that teachers use teacher-centered and student-centered teaching strategies equally in their lessons. However, 4 teachers associated the active role of the student in learning process frequently with students' homework and classroom presentations. For example, one of the teachers put his student-centered teaching understanding as follow:

Teacher 6: In my lessons first I want my students to come to school prepared. Secondly, I want them to present the topics of the day, [which is] student-centered. When they cannot present the topics, I try to present them by both doing some experiments and asking them some questions. If they haven't understood, I feel the need to explain the topic again because our students usually come to school unprepared.

Assessment and Evaluation

2 teachers stated that they used assessment techniques to give some feedback to their students related with the issue. However, 7 teachers used assessment techniques only to determine the students' mistakes or cognition levels. Moreover, all the teachers frequently mentioned questioning as an assessment technique for learning process. Some of the teachers even almost never mentioned any technique other than asking questions. A teacher with an experience of over 30 stated that:

Teacher 6: To be honest, my best assessment technique is this one: I assign some topics to students and if I cannot get any answers for the questions about the topics I have given, I understand that the student came to class unprepared, without studying. We have years of experience, is it possible for me not to understand that? When I ask 2-3 questions to the student, I can understand how much they know about that topic.

All assessment techniques that the teachers said to be using are listed in Table 9.

Table 9. *Assessment techniques that teachers frequently use*

Assessment Technique	Frequency
Question-answer (giving examples, making comments, summarizing)	9
Multiple choice questions	3
Asking students to construct questions or problems	3
Students' presentations	2
Fill in the blanks/completion questions	1
Matching questions	1

Furthermore, majority of the teachers, in a very subjective way, made their evaluations only on their own without using any evaluations tools. In fact, 2 teachers directly stated that they understood everything "from the eyes of the student" with the help of many years of experience. For example, one of the teachers who advocated the importance of the constructivism in teaching-learning process seemed to be far from alternative assessment techniques:

Teacher 1: I cannot go even one step further unless I see what's happening in the eyes of the student. If the student understands and then I understand that he learns something, I can go one step further. I can also understand what he has understood and what he hasn't.

In fact, most of the teachers were well aware of alternative assessment techniques, but they did not prefer to use these techniques since they found them unnecessary and demanding.

The Organizational Structure of the Curriculum/Seven Learning Areas

It was seen that all teachers were aware of the learning outcomes in the curriculum and they spent an effort to apply them. However, 7 teachers did not recognize the names of learning areas stated in the curriculum. One teacher who had received in-service education on the curriculum made the explanation below before matching the learning areas stated in the

curriculum with the food ingredient in *the Meal for a Year* game activity: Teacher 9: I believe that I apply them in my learning outcomes but now I am confused about which one is which one… I think the names of what we did in the past have changed.

The teacher had difficulty in especially understanding and giving meaning to STSE and AV learning areas.

The teachers viewed STSE as a natural result of science and technology lessons rather than as a learning area because of its scope. During their talk, the teachers felt the need to give examples but they avoided going into the details of STSE learning outcomes. Teachers' perceptions about STSE learning outcomes are listed in Table 10.

Table 10.*Teachers' perceptions about STSE learning outcomes*

Students:	Frequency
develop environmental awareness.	3
understand the effects of scientific and technological developments on the society and environment	2
understand the reason why they come into existence	1
apply in their daily lives what they have learnt in science and technology	1
contribute to their own society	1
adapt more easily to the environment they live in	1

It is observed that during the interviews most of the teachers tended to explain other cards instead of the AV card, putting this one on the table back and trying to get another one. As seen in Table 11, almost all the teachers associated AV only and directly with social values and thus thought that it did not contain learning outputs of great importance regarding science and technology lessons.

Table 11. *Teachers' perceptions about AV learning outcomes*

Students	Frequency
learn social rules/values	4
develop appropriate attitudes and values	4
develop scientific attitudes and values	1

Implementers of the Curriculum

Although none of the teachers said that parents were the implementers of the curriculum, they talked about the importance of parents in a student's education. For example, one of the teachers explained the issue as:

Teacher 8: Parents are not the implementers [of the curriculum] but they can contribute to the implementation of the curriculum. The implementers is teachers, the guide is teachers. Parents can only help their children. They can help to manage the parent-teacher association.

Six teachers claimed that parents must be in cooperation with teachers. For example, one of the teachers, who previously stated that because of the implementation of the curriculum, students became dependent on their parents, made the explanation below for the role of parents in education:

Teacher 1: If the parents cannot overcome the deficiencies or if they are late to deal with those problems, or they are not in cooperation with you, then you cannot increase those student's achievement.

Discussion

It was understood the teachers need school more than they need the curriculum for education and they gave more importance to school. Thus, it can be concluded that the problems in the proper implementation of the curriculum might also be rooted in teachers' belief that they do not really need the curriculum. In the literature it is stated that teachers' attitudes and values play an important role in the successful implementation of the curriculum in educational settings (e.g. Crawley and Salyer, 1995; Olson, 1981; Tobin, 1987).

As for teachers' perceptions about scientific and technological literacy, it was realized that some of the teachers did not find educating all students

as scientifically and technologically literate people as meaningful for all students. Furthermore, these teachers generally did not have the necessary terminological knowledge regarding scientific and technological literacy as they tried to define the term through associations instead of giving a proper definition. Among these associations were an ability, reading scientific articles, following scientific and technological improvements.

Moreover, teachers also perceived nature of science differently from what is stated in the curriculum. One of the most striking problems was related to characteristics of scientific laws and theories. They considered the scientific knowledge derived from laws as certain and stable and the scientific knowledge derived from theories as uncertain and unstable. Moreover, some of them even stated that some certain and stable knowledge was given in the curriculum as well, which means that they misinterpreted the nature of science approach in the curriculum. In a similar vein, Çakıroğlu and Köksal (2010: 206) stated that "science teachers had many naive understandings about the aspects of NOS" and they specifically emphasized that "[teachers] had the most extreme naive understandings regarding relationship between theory and law." Many teachers thought that there was a hierarchy between a theory and a law, whereby theories become laws with the accumulation of supporting evidence (Abd-El-Khalick, and BouJaoude, 1997; Lederman, 2007).

The teachers found the curriculum insufficient in representing these general aims of science and technology education. Moreover, some teachers have not internalized the some aims especially related with "students' career development," because they believed that those aims were not suitable for elementary level students. It can be concluded that the teachers had some difficulties in figuring out the importance of elementary education in students' future professional life and they missed out the emphasis on students as life-long learners. Dindar and Yangın (2007), in their study on 4th and 5th grade level teachers, found that the teachers had a tendency towards the aims that include behaviorist approach. Moreover, teachers claimed that they had not been informed about the curriculum at a satisfactory level. Therefore, teachers could not understand and differentiate the aims presented in the curriculum.

The teachers generally adopted the principle of "little but essential knowledge;" however, they stated that this principle was not successfully highlighted in the curriculum. This opinion results from the fact that they perceived the aims of science and technology lesson different from the curriculum itself. Therefore, they missed out the emphasis made on this principle in the curriculum and thus they could not conduct their lessons in line with this principle. In the literature, it is seen that teachers faced some problems related with this principle during the implementation of the curriculum. For example, Boyacı (2010) stated that most of the teachers fully agreed with the idea that although in the curriculum the principle of "little but essential knowledge" is mentioned, the number of existing units and learning outcomes are quite high.

Although the teachers were aware of the dominance of the constructivist approach in the curriculum, when the fact that they talked about knowledge within a structure where knowledge is transferred from the teacher to the student was considered, it was seen that their understanding was quite far from constructivism. For example, some teachers believed that student-centered learning could take place through the presentation of the lesson by students. Moreover, even though the teachers stated that they allocated space to student-centered teaching strategies in their lessons, they implemented these strategies by putting the teacher at the center. It was clear that the teachers have not perceived constructivist approach correctly and as a result, they could not implement it properly. Similarly, Şeker (2007) mentioned that teachers turned to old teaching strategies from time to time and they were not fully aware of the real philosophy and dimensions for implementation of the underlying constructivist theories of the curriculum. Penick (1995) stated that although curricula changes took place, the teaching habits of the teachers did not change and they continued to teach through traditional methods.

It seemed that most of the teachers could not understand the link between the alternative assessment and student-centered structure, showing that their competency in assessment was quite limited. Most of the teachers used assessment techniques to determine the students' mistakes related with the lesson. Moreover, they found alternative assessment techniques unnecessary and demanding and felt competent themselves in assessment

just through question and answer. Similarly, in the literature, teachers' perceptions of alternative assessment are quite negative (e.g. Çengelci, 2008; Gökce, 2006; Özdemir, 2006; Şeker, 2007). For example, Kırıkkaya (2009) mentioned that the teachers used very few of the alternative assessment techniques and they had never practiced some of the alternative assessment types suggested in the curriculum such as structured grid and descriptive branched tree, self and peer assessment. She also indicated that the most important problem which the teachers faced while they were implementing assessment activities was spending too much time.

Moreover, the teachers have not internalized the content of 7 learning areas and the interrelationship among these learning areas at a satisfactory level. Even, they had difficulty in giving meaning to STSE and AV learning areas. However, the teachers were in an effort only to put into practice the learning outcomes in the learning outcomes tables especially to the ones concerning science content area rather than dealing with the curriculum as a whole. Furthermore, the teachers looked at the curriculum almost only to review the learning outcomes of that day and to understand the flow of the lesson. In other words, it seemed that they perceived the curriculum rather as 'a TV guide' showing the stream of the lesson and did not feel the need to examine it closely. In the literature, it is stated that teachers achieve the learning outcomes regarding 7 learning areas in the curriculum, but they do not have sufficient knowledge regarding SPS and AV learning areas. Bulut and Gömleksiz (2007) studied the effectiveness of the elementary science and technology curriculum in implementation and found that teachers achieved the learning outcomes in the curriculum at a high level. As for implementers of the curriculum, this study showed that although the teachers did not consider parents as one of the implementers of the curriculum, they thought that in order for the curriculum to be implemented in a proper way, parents have some certain responsibilities. Altun and Ercan (2005) stated that parents' attitudes concerning education and their openness to change in education had an important role in the effective implementation of the curriculum. On the other hand, in the present study, some of the teachers satirized the curriculum for being "parent-centered" instead of student-centered by making references to this increasing burden on parents.

Conclusion

Although the teachers spent an effort to implement the curriculum, since they did not examine the curriculum closely and did not perceive the curriculum as a whole with its educational philosophy, their efforts went in vain. The only real novelty that the curriculum is able to incorporate into the classroom environment was that learning activities are given more time in the class than they were in the past. Still, it was seen that the aim of educating students as scientifically and technologically literate people was not taken into consideration and student were not put at the center during these activities.

In the light of this study, it can be suggested that in in-service training of teachers, more attention should be given to the unity of the curriculum and more time to introduction of the foundations of the curriculum such as its philosophy, vision and general aims. In the process of educating pre-service teachers, more importance should be given to the subjects about philosophy of education and educational approaches. By this way, the implementation of the curriculum can be more sufficient and adaptation level of the curriculum can be improved. Furthermore, internet-based interactive activities should be prepared to revise and refresh teachers' knowledge regarding the curriculum and should be served to all teachers. By this way, thousands of teachers will probably be adapted to the novelties more quickly.

As for curriculum developers, they should take into consideration much more the insufficiencies and they should give more space in the curriculum to learning activities applicable to crowded classes. By this way, until physical facilities of all schools have been improved, effectiveness of the curriculum will increase in a short period of time.

To put forth the problems concerning the implementation of the curriculum in a more intensive way, more qualitative studies in international area should be carried out and these qualitative studies should be varied in terms of their methodology and scope. Since 2013, a new science curriculum have been implemented in Turkey. A similar study, which will be more powerful with the same methodology, can be conducted on the 2013 science curriculum in order to establish a better linkage between teacher perception and curriculum itself.

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