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SCIENCE TEACHERS' BELIEFS AS BARRIERS TO IMPLEMENTATION OF CONSTRUCTIVIST-BASED EDUCATION REFORM

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Abstract. *A new Science and Technology program had been applied in Turkey since 2005. Constructivism has been the predominant influence on the program. Accordingly, science teachers are expected to have beliefs that are consistent with constructivism. However, the question of "what are the Turkish science teachers' beliefs" is important because, the success of the program is dependent upon the teachers' beliefs. This paper reports on the investigation of the science teachers' beliefs about teaching science, learning science and managing behavior problems and any relationships among these belief systems. Data were collected through interviews with 18 science teachers. Results indicated that most of the science teachers held transitive beliefs about teaching science, and traditional beliefs about learning science and managing behavior problems. While teachers with 1-10 years experiences held a constructivist belief, this belief gave way to traditional belief as the teaching experience advanced. Beliefs of teachers were both interrelated and nested.*

Key words: *classroom management, constructivism, learning science, teacher beliefs, teaching science.*

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Introduction

For many years, science educators have recognized the limits of traditional teaching methods, therefore, in many nations worldwide; science education is affected by reform movements (Cheung, 2007; van Driel, Beijaard & Verloop, 2001). The basic emphasis of these movements is constructivist learning, an approach bringing a new perspective to learning. For instance, Fosnot (1996) states that the US National Council for Teachers of Mathematics and the National Science Teachers Association advocates reforms that are mostly constructivist. In the Netherlands, a new curriculum reform whose central issue was promoting active and autonomous learning was launched in 1998 for upper secondary education (van der Valk & de Jong, 2009). The notion of constructivism has become an organizing framework in curriculum in many jurisdictions, including British Columbia (Wideen, O'Shea, Pye & Ivany, 1997). Another example of using constructivism in science education is Korea; constructivist approaches have been reflected in the science curriculum and teachers' guide to this curriculum since 1982 (Kim, Fisher & Fraser, 1999). Whereas traditional learning emphasizes conveying ideas to the minds of students from teacher or textbook (Hawkins, 1994; Treagust, Duit & Fraser, 1996), constructivist learning asserts that children actively construct their own concepts through interaction with physical and social environment surroinding them (Duffy & Cunningham, 1996; Treagust et al., 1996; Lunenburg, 1998; Marlow & Page, 1998, Fosnot, 1998). Therefore, curriculums adjusted in accordance with constructivism allow students to engage in scientific activities in which they can make sense of their learning (Kift & Nelson, 2005).

These advances achieved at international level regarding student learning in science education had broad responses in Turkey in 2005, when many reasons emerged regarding the need for changes the Turkish curriculum. Various studies, including the Third International Mathematics and Science Study (1999) and Programme for International Student Assessment (2009), reported that when compared with other countries, students in Turkey were less successful in science and mathematics in international exams

(Bağcı-Kılıç, 2002). It was also found that the attitudes of students became more negative together with the increases in grades (Külçe, 2005; Çakır, Şenler & Taşkın, 2007; Akpınar, Yıldız, Tatar & Ergin, 2008); and classes had teacher-centered structure (Ünal & Akpınar, 2006). Eventually, after reviewing many science curriculums currently used in developed countries and international science education literature, the National Ministry of Education has put a program into practice in 2005-2006 academic year. The curriculum basically regards constructivism as a learning theory (Ünder, 2010) and teaching strategies, and also teachers are supported to use constructivism in science lessons (Özdemir & Güneysu, 2008). In this way, targeted changes by the program were expected to be reflected to the classrooms by the teachers.

Despite the positive contributions of these changes encountered in Turkey and in other countries due to reform movements related to the curriculum, researchers should discuss these changes in order to understand whether the new curriculum is as successful as expected by reformers. The common view of this evaluation process is that reform efforts should take the beliefs of teachers into consideration since a teacher belief can lead a dynamic expression of reform in the classroom (van Driel et al., 2001; Powell & Anderson, 2002). Since a new curriculum had been applied in Turkey since 2005, teachers are expected to have beliefs that are consistent with constructivism; however, this raises the question; "what are the beliefs of teachers in reality?" This research reports on the investigation of science teachers' beliefs about teaching science, learning science and managing behavior problems in Turkey. Furthermore, any relationships between teachers' belief systems are determined. Additionally, this study investigates the difficulties teachers encounter with during the implementation of the new program. In this respect, many studies have focused on developing a variety of instruments for measuring teachers' educational beliefs (Tondeur, Hermans, van Braak & Valcke, 2008). Some researchers have advocated empirically assessing and describing teachers' beliefs is more general through using a Likert-type scale (e.g. Smith, 1997; Hermans, van Braak &Van Keer, 2008). Other researchers qualitatively have focused on revealing different categories of teacher beliefs that generally grounded in the research tradition of phenomenography (e.g. Koballa, Graber, Coleman & Kemp, 2000; Boulton-Lewis et al., 2001; Brown & Melear, 2006). This study could be viewed as an attemp to measure and classify teacher beliefs using a qualitative instrument. In this way, I think that teachers are given an opportunity to present examples of their beliefs with one-to-one classroom experiences.

Problem of Research

The following research questions are addressed in this study:

1. What are teachers' beliefs about teaching science, learning science and managing behavior problems held by the Turkish science teachers?
2. What relationships exist among science teachers' beliefs about teaching science, learning science and managing behavior problems?
3. What is the relationship between teachers' beliefs about teaching science, learning science and managing behavior problems according to their professional experiences?

Teacher Beliefs

Bandura (1997) asserts that beliefs are the best indicators of decisions people make throughout their lives. While Koballa et al. (2000) suggest that "teachers' beliefs about learning and teaching were not addressed as separate science subjects" in 1990s; literature includes several studies focusing on science teachers' beliefs about teaching and learning as different items in 2000s. Pajares (1992:327) states as follows: "It is important to think in terms of connections among beliefs instead of beliefs of independent subsystems". He defined belief as an "individual's judgment of the truth or falsity of a proposition, a judgment that can only be inferred from a collective understanding of what human beings say, intend, and do" (p. 316). As a result, the term belief refers to all mental representations that are held by teachers consciously or unconsciously. (Markic, Eilks & Valanides, 2008). Although Rokeach (1972) suggests that all beliefs have a cognitive component, representing a person's attitudes towards what is true or

false, desirable or undesirable; Nespor (1987) highlights the differences between knowledge and belief. According to him, beliefs have stronger affective and evaluative components than knowledge and typically operate independently from the cognition associated with knowledge (cited in Pajares, 1992 p.309). Similar to Nespor, Pajares (1992) argues that beliefs are "far more influential than knowledge in determining how individuals organize and define tasks and problems and are stronger predictors of behavior" (p. 311). The importance of teachers' beliefs is recognized but van Driel, Bulte and Verloop (2007) have argued that there is a lack of studies of teachers' domain specific beliefs, for instance, about the importance of teaching specific topics or curricular goals, and, in particular, the relation of such domain specific beliefs with general beliefs.

Researchers have identified a number of categories to describe teachers' beliefs regarding the domain specific beliefs such as learning and teaching of science. The results determine that traditional and constructivist beliefs are the most common categories. Teachers in the traditional category perceive teaching science as transferring knowledge from the teacher or textbook to students, learning science seen as acquiring or reproducing knowledge from credible sources (Prawat, 1992; Howard, McGee, Schwartz & Purcell, 2000; Kang & Keys, 2000). For instance, they believed that "for successful learning science, students, first, need to memorize relevant scientific formulas and definitions" (Tsai, 2002). Laboratories are used to obtain the confirmed facts or to visualize a concepts (Tsai, 2003). Before conducting the laboratory work, the teacher explains the processes of the experiment. The only purpose of school laboratory exercises is seen as to help students memorize the scientific truths (Tsai, 1999). As a result, students ritualistically follow the tasks which are listed in laboratory guides like a "cookbook" (Hofstein & Lunetta, 2003). The existing knowledge of students has little relevance with such learning environments (Windschitl, 2002). On the other hand, the teachers in the constructivist category perceive science as helping students construct knowledge, learning science through creating new understandings for them (Roehrig & Luft, 2004). Adams and Krockover (1997) defined a constructivist teacher with the following features; (a) negotiation of understanding of key ideas with students; (b) student-generated investigations; (c) leading students to reconstruct how evidence has been used to formulate scientific ideas; (d) utilization of student-centered methods such as group work, concept mapping, and writing to represent ideas; and (e) use of multiple forms of assessment that integrate with instruction. For instance Hashweh (1996) investigated science teachers' beliefs and found that when faced with alternative conception constructivist teachers' revealed richer and more effective teaching strategies than traditional teachers. Students are responsible for generating research questions, designing investigations and explaining results of their laboratory tasks in constructivist learning environments (Chinn & Malhotra, 2001).

Relationships among Teachers' Beliefs Systems

The findings of classroom observations and interviews with teachers by researchers revealed that most of the teachers had consistent beliefs about teaching and learning. These closely aligned beliefs are defined as nested beliefs (Bryan, 2003; Tsai, 2002). Nested traditional beliefs tend to transferring knowledge from teacher to pupils, and imply a more passive or rote view about learning science. On the other hand, nested constructivist beliefs tend to focus on the involvement of the teacher and student to the process, and working together to construct personal meaning during the teaching process. These beliefs also focus on the active involvement of the students in thinking, questioning, discussing and take account of what the student already knows in building new knowledge (Martin & Shoho, 1999; Koballa et al., 2000; Boulton-Lewis et al., 2001).

Researchers also noted the existence of teachers with inconsistent beliefs of teaching and learning (Tsai, 2002; Bryan, 2003; Ogan-Bekiroğlu & Akkoç, 2009), which means that a teacher with a constructivist belief about teaching science may have a traditional belief about learning science. In their study including six high school teachers, Wallace et al. (2004) found that while one of the teachers often used a student-centered approach as an integral part of physics education, the same teacher conducted a teacher-centered class in the chemistry lessons. These differences between the clusters which form the belief system of the teachers indicate that teachers' beliefs within a system do not require internal consistency (Nespor, 1987) unless they are examined comparatively (Green, 1971). Therefore, it can logically be

deduced the inconsistent beliefs of these teachers about teaching and learning may have resulted from their perception of their beliefs about science teaching and science learning as unrelated clusters.

Linking between Beliefs and Classroom Management

Classroom management seeks to establish and sustain an orderly environment so students can engage in meaningful academic, social and moral learning (Evertson & Weinstein, 2006 p.4). Since it is argued that teachers' management strategies in the classroom have effects on student achievement and learning (Marzano & Marzano, 2003), researchers have addressed the question that what kind of approaches teachers adopt for classroom management.

Approaches to classroom management are based on constructivist or behaviorist theories (Brannon, 2010). Given these theories, it is recommended that classroom management approaches are categorized according to the level of teacher's or student's control over classroom issues (Yaşar, 2008). Dollard and Christensen (1996) stated that the constructivist approach is student-centered and allows students to have a voice in the structure and to participate in the control of the classroom, as well as in control of themselves and their own behavior (cited in Brannon, 2010). For instance, in the case of the learning cycle treatment, Lavoie (1999) concludes that learning cycle treatment involves dealing with management problems, using more wait time, using more probing/inquiry questioning techniques, and facilitating small-group discussion and work. In these classes, it is possible for students start and continue a discussion process rather than quietly sitting, listening or answering only when they are asked a question. They are both physically and mentally active in the class and they establish communication with their friends.

From this respect, these roles of the students in constructivist classrooms are in stark contrast to the center position of teacher's authority in the traditional approach, which supports that teachers have the primary responsibility for the control and they put the rules (Wolfgang & Glickman, 1986). In a traditional classroom the teacher is the authority and has a fixed way of doing the lesson; he generally began a unit by explaining to students what they will be doing over the next few lessons. Then he places on the board an hypothesis, a list of materials, and a list of steps to be followed. Once the students undertake the set activities, the teacher puts the expected results on the board and students copy these into their science books, regardless of their own findings or understandings (Peers, Diezmann & Watters, 2003). In such teacher centered classrooms, teaching strategies seem easy to manage for teacher (Bryan, 2003; Roehrig & Luft, 2004) but, in fact, this approach hinders student cooperation, and open-endedness of laboratory activities (Tsai, 2003). Therefore, teacher is expected to apply a student-centered classroom management approach when he/she encounters a behavior causing a problem in the class in order for students to achieve meaningful learning. Eventually, this can indicate a possible relationship between teacher's beliefs related to his/her managing behavior problems and his/her beliefs about teaching or learning.

Methodology of Research

For the purposes of investigating beliefs, descriptive method was used to describe the teacher beliefs about teaching, learning and managing behavior problems in science (Verma & Mallick, 1999). A semi-structured interview was selected to elicit teachers' beliefs.

Sample of Research

Participants were selected by the purposive sampling from 15 state primary schools in Turkey. A total of 18 teachers (8 female and 10 male) volunteered to participate in the study. Professional experiences of the teachers varied from 3 to 27 years. Fields in which participants had graduated were the primary science education program of faculties of education (n=10) and the physics, chemistry and biology programs of faculties of science and art (n=8). The teachers participating in the study taught science courses in the sixth, seventh and eighth grades in primary schools. On average the classes contain 30 students. All the schools in which the teachers worked there was a separate science laboratory.

Instrument and Procedures

The researcher interviewed each of the teachers individually to examine their beliefs. Three main areas were questioned in this study: beliefs about teaching, learning and managing behavior problems. In order to obtain better understanding of teachers' beliefs the use of direct or indirect questions is suggested (Kang & Wallace, 2005; Nott & Wellington, 1998). Direct questions were used in exploring teachers' beliefs about learning and teaching science. While forming these questions, six questions were included regarding the beliefs about teaching science and five questions were included regarding the beliefs about learning science in the interview form. These questions were collected from the studies in the literature (Tsai, 1998; Tsai, 2002; Kang & Wallace, 2005; Luft & Roehrig, 2007) and then translated from English to Turkish. The questions were selected to elicit teacher beliefs about teaching methods that the teacher employed, the impact of these methods on the students, the features of roles adopted by the teacher and the learning environment. The questions about learning science covered how learning in science occurres, role of the learner and indicators of learning.

In terms of indirect questions, I used critical incidents for that questions that explored the teacher's beliefs about managing behavior problems. Four critical incidents were created, the first being how the teacher would handle a student with a misconception who resisted accepting new knowledge at the end of a teaching event. The other three incidents concerned how the teacher would manage problems encountered in a class where experiments or practical activities were being conducted by student groups. (See Appendix for illustrative example of the critical incidents). Each interview lasted almost 40 minutes. All interviews were audio-recorded. Interviews were transcribed and these transcriptions were checked by comparison with the audio recordings.

Data Analysis

Teachers' beliefs were analyzed regarding the principles of qualitative content analysis (Chi, 1997). Schadewitz and Jachna (2007) argue that researcher might start with an inductive coding, trying to identify patterns in the data and establish categories by which the remaining data is coded. In this research, without developing any categories, the whole data was reviewed. Then, codes were generated from the thoughts of teachers that were similar. Some of the sample codes for teaching science were as follows: teacher-centered teaching, question-answer, lecturing, demonstration, closed-ended experiment, relationship between science and everyday life, discovery, associating the concepts, student-centered teaching, individual and group work assessment, open-ended experiment. Sample codes related to learning science were as follows: hands on learning, authority, transfer, scientific curiosity, repetition, listening and being hard working. Sample codes related to problem behaviors were: carefully listening to the lesson, noise, disrupting the class, directing the student, interest of the student, motivation of the student and monitoring the student.

Following this stage, the codes were merged and clustered basing on the perceived connections. The deductive approach was used to identify codes. In a deductive approach, researchers use some categorical scheme suggested by a theoretical perspective (Moretti et al., 2011). Four studies were selected to analyse (Keys, 2005; Brown & Melear, 2006; Ünal & Akpınar, 2006; Luft & Roehrig, 2007). According to the existing frameworks, constructivist, transitive and traditional categories were re-formulated. How each category specific to this study was defined and how the analysis applied to the interviews according to the teachers' views is presented in Table 1. In sum, although the categories reached by using inductive approach in content analysis show the theoretical perspective of four studies, the definition of the categories are modified in the light of this study's data. The reliability of coding categories before analyzing the data was ensured through presenting to the second researcher the transcriptions. The levels of agreement between researchers for the independent assessment were: beliefs about teaching '0.86', beliefs about learning '0.90' and beliefs about managing behavior problems '0.86'. The names of teachers were not revealed in the analyses and the teachers were labeled as T1, T2, T3…T18.

Table 1. Traditional, transitive and constructivist categories defined in this study and sample interview transcripts.

	Traditional	Transitive	Constructivist
Teaching Science	Teacher is at the center and knowledge is transferred from teacher to student	Although teacher does not desire to be at the center and transfer knowledge, it becomes important due to the aforementioned obstacles	It provides first-hand experiences for students to discover the knowledge.
Sample Interview Transcript	When the teacher lectures the lesson; science concepts are learnt very well… I conduct the experiment step by step before the class (T-11).	In fact, I must be guide, but I am still in the position of covering the topics rather than guiding (T-1).	Knowledge becomes more permanent when the student compiles it in his mind through self-comprehension process via discovery (T-2).
Learning Science	Obtaining knowledge from reliable resources or repeating the knowledge gained from these resources.	Although it is accepted that student is mentally active, knowledge transfer becomes important due to the aforementioned obstacles.	The student is mentally active while he/she is building the knowledge individually or socially.
Sample Interview Transcript	Science concepts are learnt best through repetition; underlying and writing (T-6).	Learning is better achieved when I cover the topic and support it visually… The best way is when students learn by themselves (T-9).	Science is learnt best via hands on learning and by using the sense organs (T-3).
Managing Behavior Problems	Teacher holds the authority and control. Attention is given to the inappropriateness of the problem behavior and the focus is on stopping the behavior as soon as it emerges.	The control is sometimes held by teacher and sometimes by the student. The authority and control is taken by the teacher when problem behaviors emerge.	Autonomy and self-control of the student is a priority. The focus is on causes of the problem behavior. Student opinions are applied to resolve the problem behavior.
Sample Interview Transcript	When we get them to conduct the experiments individually, this leads to the noise we do not desire (T-12).	When there are many students making noise during the experiment, it would just me who would conduct this experiment and I would ask them to watch me (T-7).	While students are conducting an activity they definitely to each other, ask each other questions… let let the students interact with each another, but let them learn something (T-1).

Results of Research

Teachers' Beliefs about Teaching Science, Learning Science and Managing Behavior Problems: An Overview

The categories in which beliefs of science teachers about teaching science, learning science and managing behavior problems is shown in Table 2. In teaching science, the transitive category included the highest number of teachers, which means that they have neither constructivist nor traditional beliefs, but the belief between them regarding teaching.

Table 2. The number of teachers with traditional, transitive and constructivist beliefs about teaching science, learning science and managing problem behavior.

	Traditional	N	Transitive	N	Constructivist	N
Teaching Science	T11, T12, T14, T18	4	T5, T6, T7, T8, T9, T10, T15, T16, T17	9	T1, T2, T3, T4, T13	5
Learning Science	T5, T6, T7, T10, T11, T12, T15, T16	8	T1, T9, T17, T18	4	T2, T3, T4, T8, T13, T14	6
Managing Behavior Problems	T5, T6, T8, T9, T12, T14, T17, T18	8	T7, T10, T11, T13, T15, T16	6	T1, T2, T3, T4	4

At this point, in order to understand teachers' transitive beliefs about teaching science, it is more beneficial to review the difficulties encountered by them during the implementation of the program. Teachers stated that their classes were crowded, there were insufficient equipment to conduct experiments at the school and students had difficulty in performing the task since they were used to multiple choice exams. Moreover, they encountered other difficulties such as lack of time. While the teachers appreciated constructivist teaching strategies in the new program, they also stated that these difficulties they encountered during the implementation prevented them from constructivist applications. In this situation, although teaching activities in the science program seem to have impacted the beliefs of teachers about teaching science in a constructivist way, it can be said that impacts of traditional beliefs still exist.

In learning science, the traditional category has the highest number of teachers. It can be concluded that beliefs of teachers about "learning science" are old-fashioned compared to their beliefs about teaching. This indicates that teachers with transitive beliefs in "teaching science" shifts to the traditional belief. In a similar way, in their "managing problem behavior", the traditional category has the highest number of teachers, which means that when teachers encounter a problem in classroom management, they still approach the solution to the problem from a traditional perspective. The following sections contain more detailed beliefs about teaching science, learning science and approach to the problem behaviors in each category and Table 3 presents examples of the teachers' thoughts. The following sections contain more detailed for each category.

Beliefs of Science Teachers in the Traditional Category about Teaching Science, Learning Science and Managing Behavior Problems

Teachers in the traditional category believed that science teaching is the transfer of knowledge from teacher to student. For example, a teacher with a 27 years experience stated "When we do the lesson with the activities in the science text-book, science concepts are learned better by the students". Accordingly, teachers mentioned that they generally prefer the demonstration, that is to say, first they conduct the experiment in front of the class and then students carry out the experiment by repeating what their teachers did. A teacher with 20 years experience explained "I don't do a lot of experiments in my lesson. If I do an experiment I define my own rules and ask students to obey those rules. I do the experiment step by step in front of the classroom. When the students do the experiment by following me…". According to these teachers, students must be good listeners in order to learn the knowledge conveyed from these resources and they must regularly repeat what they learn so as not to forget it. A teacher with 27 years experience said "student must note down regularly the concepts s/he learned and s/he must often repeat them. Unless you revise newly learned information, you forget it in a short time. Thus, you must often repeat I say.

According to beliefs about managing behavior problems, teachers stated that students must listen to them carefully while they are lecturing the topic and they must be silent during the lesson. A 13 year teacher said "In the laboratory slackness is observed. There is certainly an uproar among them, what they talk about is off topic. That is unwanted noisy so I take the experiment materials from the laboratory to the class and try to do the experiment in there". They asserted that when the teacher repeats the scientific knowledge, they expect that this student has eliminated this misconception. A teacher with 15 years explained "If the students insist on not understanding the concept this is because of his/her misbehavior and this is not

something good. Although you show the right one and the student insist on not understanding, there is nothing to do. In other words, this student must understand the right concept. When you teach the right concept this student will understand it in time anyhow". They selected teacher-centered activities, which were demonstrated by the teacher or closed ended experiments, in order to prevent chaos emerging because of the noise. For example a teacher with 12 years experience stated "They (students) did not listen to me while I was lecturing. In this case instead of making them work as a group, I would have liked them to follow me first and then repeat what I have done".

Beliefs of Science Teachers in Transitive Category about Teaching Science, Learning Science and Managing Behavior Problems

These group teachers expressed dual ideas in teaching science. While they attached importance to the concepts of hands on learning, conducting experiments, guidance of teacher, student participation, relationship between science and everyday life; the examples they gave from the classroom practices did not support these ideas due to the above-mentioned difficulties. In this situation, while teachers appreciate constructivist teaching approach suggested in science program, the physical conditions prevent the realization of these beliefs. For example, a teacher with 14 years experience stated "Actually I should have been directing students but instead of directing I am still lecturing. For example I try to make them brainstorm but students cannot show this skill. Thus, most of the time I lecture. I sometimes try to make student centered activities but most of the time it's me who is talking". They focused on the importance of scientific curiosity, and establishing a relationship between science and everyday life for learning. From this aspect, the emphasis on meaningful learning, which was focused on the Science and technology program in Turkey, showed its effect on the beliefs of the teachers. On the other hand, in a similar way to the traditional belief, while explaining their beliefs about learning, they emphasized that the teacher is the one who transfers knowledge and the student is the passive recipient of knowledge. A teacher with 3 years experience said "Students should be curious. They need to believe what they learn is useful for them and they need to do some research. Furthermore, they should often repeat what they learnt because the more frequently they repeat the more permanent the information is".

In a similar way, these teachers regarded the situations in which student's misconceptions as a component that can disrupt the class and are therefore, problem behaviors. In cases where students had misconceptions, teachers focused on the reason for the students having these misconceptions were because they had not followed the teacher carefully. A 12-year teacher explained "The student did not understand the aim of the experiment as he did not listen to me carefully. On that day presumably I myself repeated the experiment. I should do the experiment again in the class and give them why that is important here" or "what it should be here" or "what we should expect" step by step". On the other hand, regarding the experiments or practical activities, they acknowledged the noise generated by group working but they concluded that this noise resulted from the inadequacy in the teacher's control or from lack of homogeneity in groups. For example a teacher with 14 years experience stated "Sometimes during group work students need to talk among themselves but I call this as noise. To prevent this noise you need to walk among the groups or form heterogeneous groups". Again in parallel with teachers in the traditional category, they switched to teacher-centered teaching methods in order to overcome classroom management problems. The same teacher continiued "While doing the experiment I remember that I have to cover the content and I stop group work and start lecturing".

Beliefs of Science Teachers in Constructivist Category about Teaching Science and Learning Science and Managing Behavior Problems

According to teachers who held constructivist belief, the main focus in teaching science is on the active participation of student in the lesson. They described the role of teacher as preparing learning environments where students are active, guiding the students rather than directly transferring the concepts to them. Teachers pointed out that they preferred the teaching methods suggested in the program in order for students to construct the knowledge by themselves. For example a 4-year teacher explained:

> "As a teacher I see myself like a guide. This is the aim of the new program. You (teacher) stay in the background while learning students do everything. When a student had a problem in a subject or did not understand something you will help him/her with questions or some clues. In other words you will not directly give the knowledge when a student does not understand something. You will help him to discover it. That means you will not give them fish but you will teach them how to fish".

Also these teachers commented that the student is mentally active in learning. They emphasized the importance of establishing relationship between what the students' learnt and their everyday lives and associating the concepts with one another. In addition, teachers explained the experiments, which enabled students to have first-hand experience about the concept to be learnt, within a scope where the student is active. A teacher with 5-years experience said:

> "If you are learning something by doing this is the most permanent learning. You (the teacher) say when you blow lime water it blurs but you want the student to learn that there is CO_2 by doing. When the student see the lime water blurs as s/he blows both you and the student will never forget this. The child will always remember the activity all the time….. Associating concepts by using concept maps what I mean when you say "heat" if the child can write the concepts about heat on a piece of paper and associate their relationships with arrows. I believe that s/he can learn the concepts".

These teachers noted that the fact that students have misconceptions is something to be expected in the classroom. They stated that in order to overcome these misconceptions, students should conduct the experiment themselves via different trials or methods. Students also should compare the result they obtained from their misconceptions. For examle a teacher with 4 years experience stated "In this situation the best thing to do is to make the student who has a misconception do the experiment himself again. When the student does the experiment again s/he will see where s/he makes a mistake and will understand the subject better". Teachers stated that they determined rules before conducting the experiment in the laboratory and they did not start the experiment before motivating their students. Teachers described their roles during the experiments as monitoring the groups' progress and offering guidance about the problems they experienced in the learning process. A 5-years teacher stated "Before I started carrying out the experiment, first of all by asking them why the subject was important and where they would come across this in real life. I would get their attention and motivate them. After the experiment I ask questions appropriate to each student's levels. By this way, I wanted them to feel that they had understood the subject and they could succeed". Those teachers aimed to decrease the possible problems during the experiment by enabling students to understand the aims of the experiment. More importantly they are more tolerant of the student talk that occurs during group work. Teachers think that these talks provide a discussion atmosphere to share students' ideas so they improve their learning. For example a teacher with 3 years' experience stated:

> "When you are doing an activity in the classroom students certainly speak among themselves. In a silent classroom environment you (the teacher) lecture and students listen to you and they think they understand. In my opinion thus there might be noise but there should be learning too. Instead of a quite classroom without learning the class can be noisy; students can interact among themselves as long as they learn something. Eventually students' each behavior there (in the group) helps them to learn. They will run the cable and break the lamp there, put the batteries in the wrong directions, discuss, ask but in each step they will learn something. When the batteries are places it won't work in the same way when the lamp blows it won't work, when they run the cable in the wrong order it won't work and students will see this. In each step children will discuss and this is a cause to learn a new thing".

Distributions of Beliefs of Teachers about Teaching Science, Learning Science and Managing Behavior Problems According to Professional Experiences

The distribution of the beliefs of teachers about teaching science, learning science and managing behavior problems according to the professional experiences of teachers is shown in Table 3.

Table 3. The number of teachers' beliefs about teaching science, learning science and managing behavior problems according to the teaching experiences.

		Teaching Science	Learning Science	Managing Behavior Problems
1–10 year	Traditional	-	-	-
	Transitive	1	2	2
	Constructivist	5	4	4
11–20 year	Traditional	1	3	4
	Transitive	5	-	2
	Constructivist	-	3	-
20 and more	Traditional	3	2	3
	Transitive	3	3	3
	Constructivist	-	1	-

According to Table 3, while 1-10 year teachers held a constructivist belief in their teaching science, none of the teachers with 10 and more years of professional experiences had constructivist beliefs. This can be interpreted as "teaching science" beliefs of teachers, who can be considered newcomers to the profession, are in more accordance with constructivism; and as professional experience of the teachers increase, they move further away from teaching applications based on constructivism. Except for two teachers having transitive belief, all the teachers with 1-10 years professional experience held constructivist beliefs towards "learning science". These teachers mentioned that they participated in instructional activities suggested in the program during their pre-service training. Therefore, it can be said that the impact of undergraduate university education still continues among these teachers. Three of the teachers with 11-20 years professional experience, held constructivist and traditional beliefs. To sum up, teachers consider learning as an individual or social construction of information in the first years of their professions and believe that the student is mentally active in learning. On the other hand, as they advance in their professional experience, they regard learning as obtaining knowledge from reliable resources or repeating the knowledge obtained from these resources. Examining the beliefs about their "managing behavior problems", it is seen that teachers with 1-10 years professional experience considered the autonomy of the students, through focusing on the reason for the behavior and attempted to ask the student's opinion as to the cause of a problem. It was seen that after 10 years' experience, belief in the teacher control rather than student control and a traditional belief begin to attach importance to the inappropriateness of the problem behaviors.

Combinations between Beliefs of Teachers about Teaching Science, Learning Science and Managing Behavior Problems

The distributions of the relationships among teachers' beliefs about "teaching science", "learning science" and "managing behavior problems" is shown in Table 4.

Table 4. The number of the relationships among teachers' beliefs about teaching science, learning science and managing behavior problems.

Relationships	Teaching Science	Learning Science	Managing Behavior Problems	N	Total
Nested	C	C	C	3	5
	Ts	Ts	Ts	1	
	Tr	Tr	Tr	1	
Related	Tr	Tr	Ts	1	12
	C	Ts	C	1	
	Ts	Tr	Ts	2	
	C	C	Ts	1	
	Tr	C	Tr	1	
	Ts	C	Ts	1	
	Tr	Ts	Tr	1	
	Ts	Tr	Tr	3	
	Tr	Tr	Ts	1	
Divergent	Ts	C	Tr	1	1

Note. C: Constructivist, Ts: Transitive, Tr: Traditional

While 3 of these teachers had constructivist beliefs in relation to "teaching science", "learning science" and "managing behavior problems", 1 teacher had a traditional and 1 teacher had a transitive belief. The compliance of the beliefs of these teachers indicates that they consider teaching, learning and managing behavior problems as a whole. It was seen that, in dual categories, 12 of the teachers had believes complying with each other's', but there was no belief in accordance with this belief in the third category. Apart from this similarity seen in these dual beliefs, 1 teacher was totally divergent among three beliefs. The number of the relationships among teachers' beliefs is shown in Figure 1. Where the balloons intersect show teachers have the same belief about science teaching, science learning, or problem behavior. The most remarkable number is 8 because two of his beliefs in three areas are both transitive and both traditional. Consequently, it can be said that, constructivism emphasis which appeared in Turkey with renewed program hasn't come into prominence in teachers beliefs.

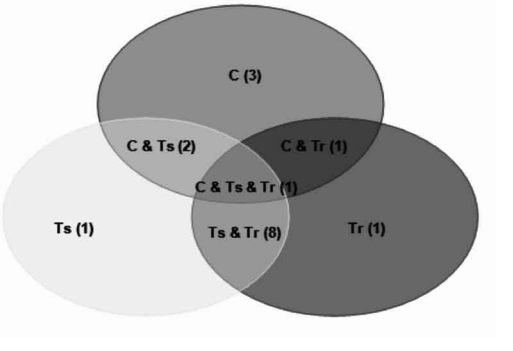

Figure 1: T he distributions of the relationships among teachers' beliefs.

Note. C: Constructivist, Ts: Transitive, Tr: Traditional, the numbers in the parentheses represent the numbers of teachers

Discussion

This study investigated teachers' beliefs about teaching, learning and managing behavior problems of science teachers' and also established the relationships among teachers' beliefs systems. Firstly, the teachers' beliefs identified in this study were found to be similar to the findings in other studies on beliefs about teaching (Koballa et al., 2000; Levitt, 2001; Tsai, 2002; Roehrig & Luft, 2004; Ünal & Akpınar, 2006). Although some of these studies indicated that science teachers held traditional beliefs (Koballa et al., 2000; Tsai, 2002; Ünal & Akpınar, 2006) most of the science teachers in this study held transitive beliefs about teaching science. This finding indicates that, although teachers emphasize the importance of hands on and minds on science as suggested in the science program, they shift to teacher-centered teaching when they encounter difficulties in the classroom. This finding seems to confirm the idea of Levitt (2001) that at least some of the beliefs expressed by the teachers emerged as a result of implementing a program of science education reform (p.19). Accordingly, it can be concluded that although teachers appreciate the constructivist teaching approach of new program, they do not completely comply with the teacher role suggested by the program because of the problems they encounter in practice.

Findings related to the beliefs about "learning science" indicated that traditional category has the highest number of teachers. The interesting point is that one teacher, who held constructivist belief in teaching science, and four teachers, who held transitive beliefs in learning science, shifted to the traditional belief, which means that since teachers displaying constructivist beliefs in science teaching could not acutally internalize this belief (Haney & McArthur, 2002). Contrary to this finding, Koballa et al. (2000) revealed that in some cases the development of advanced conceptions of teaching may not comply with the development of conceptions of learning. Considering the finding by Koballa et al., which offers a different perspective, it can be concluded that science teachers are exposed to the language of constructivism in the context of teaching, but they are not reflecting constructivist beliefs on their own personal learning. In other words, although the emphasis made on constructivist teaching in the program seems to have affected teachers' beliefs about teaching, this emphasis did not lead their beliefs about learning to a constructivist one. The adoption of any innovation within an educational system is a lengthy and complex process, it is suggested that teachers must be given sufficient time and opportunity to understand, become comfortable with, and finally internalize the proposed belief change (Sakui & Gaies, 1999 p. 487). Therefore, science teachers in Turkey need to appreciate and feel confident about the new program and then they are expected to internalize constructivist beliefs in learning.

The third finding of the present study shows that, in managing problem behaviors, adoption of the traditional belief is numerically higher among teachers. This finding suggests that they return to traditional classroom management approaches, because they think that they have difficulty in the arrangement of classroom management. That teachers have difficulty in classroom management while implementing constructivist teaching strategies is a general finding also obtained from previous studies (e.g. Haney & McArthur, 2002; Tsai, 2002; 2003; Bryan, 2003; Pea, 2004; Roehrig & Luft, 2004; Brown & Melear, 2006; Cheung, 2007). Teachers' management beliefs in a constructivist manner such as control without closed-ended experiments or not perceiving misconceptions or laboratory works of students as a component disrupting the class are among the problems that need to be solved in order that a teacher can successfully implement a new curriculum (Bryan, 2003).

Another finding of this study was that while teachers with 1-10 years experiences, who can be considered as newcomers to the profession, held a constructivist belief in "teaching science", "learning science" and "managing behavior problems", this belief shifted to traditional belief as the professional experience advanced. Tsai (2002) suggested that the fact that these newer science teachers may have encountered more constructivist ideas in teacher education program or relevant workshops may be influential on their constructivist beliefs in early years of their professional life. Similar to Tsai, many researchers concluded that pre-service teacher education programs play a role in the development of teachers' beliefs about teaching and learning (e.g. Northfield, 1998; Hancock & Gallard, 2004). The belief of teachers with 10 and over 10 years' experience shifted from constructivist to traditional. The reason of this shift makes us think that they may lack knowledge about new activities and because of this lack they couldn't overcome the difficulties they came across in the class. In Turkey findings of Nazlıçiçek and

Akarsu (2008) justifies this finding. Unfortunately teachers knowledge about "traditional" teaching and assessment methods based on transferring information to the student is higher than their knowledge about constructivist methods proposed in the program. Therefore, although the program changed with a constructivist emphasis teachers' beliefs fell behind this change.

It is seen that beliefs of teachers about "teaching science", "learning science" and "managing behavior problems" are interrelated. However, the interrelatedness of teachers in two belief groups is more than their nestedness. The finding related to both the interrelated and the nested situation in beliefs of teachers was similar to the findings in other studies investigating relationships between beliefs (Boulton-Lewis et al., 2001; Tsai, 2002; Haney & McArthur, 2002; Bryan, 2003; Ogan-Bekiroglu & Akkoç, 2009). These results re-emphasized that if teachers hold in isolated beliefs about teaching, learning and problem behavior; these beliefs are not expected to be a completely congruent (Boulton et al., 2001; Mewborn, 2002). It may be possible that since the constructivist approach is emphasized in the program in relation to the teaching, therefore the teachers displayed a constructivist belief in teaching, but they did not associate this belief with the dimensions of learning and the way to managing behavior problems. Thus, it is concluded that the teachers considered teaching, learning and classroom management as different clusters. Therefore, while trying to solve contradictory situations he/she encountered during the implementation of constructivist teaching, teacher may have made his/her belief congruent with these conflicts rather than attempting to overcome these conflicts in contradictory situations which he/she encountered in learning or in the problem behaviors.

Conclusions

This study is the first attempt to identify science teachers' beliefs in Turkey. Although it has the limitations of consisting of a small sample from two cities in Turkey and without any data triangulation, the beliefs held by the teachers in this study are similar to those reported by various researchers. Results of the present study show that these three beliefs fall behind the constructivist belies suggested by the program and teachers' adherence to traditional beliefs still continues. Therefore, researchers or program developers should implement professional development programs considering that many teachers still hold traditional belief. Considering that it is highly unlikely that there will be a rapid and immediate transition in teachers' beliefs from a traditional to constructivist, professional development programs in collaboration with teachers and researchers would be beneficial to lead about the change in teachers' beliefs about teaching.

At this point, an answer is expected for the question as whether professional development through formal in-service training is not sufficient for teachers with advanced professional experience to be convinced to adopt a constructivist belief. The present study aimed to carry out the first stage of the process; diagnosing the teachers' existing beliefs about teaching, learning and problem behavior. The following purpose should be to promote disequilibrium and conceptual change in traditional beliefs of teachers and then to launch an in-service training program to assist the teachers in the reconstruction and reform of their beliefs.

Although the science teachers in this study provided many experiences from the classroom environment in the interview, these relatively small experiences do not give direct evidence of what is happening in the classroom. Finally, the success of program reform depends on both in-service teachers and pre-service teachers. For that reason, besides informing pre-service teachers about ideal class environments, their awareness should also be raised in terms of the lack of equipment, over-crowded classes and the problems they will face in terms of classroom management. By discussing these issues and helping pre-service teachers to find ways of dealing with these situations, teachers may retain their constructivist beliefs rather than given them up when they encounter difficulties in their teaching.

Appendix

The topic of this week is that frictional force is independent of the surface area. Firstly, teacher distributes worksheets to the students. Secondly, the teacher elicits predictions from student groups about the relationship between friction and a surface area. The teacher distributes materials to the students for them to carry out the experiment. If this is not possible he/she conducts demonstration experiment. The teacher asks students to interpret the experiment results. Towards the end of the class, a naughty student in the class not listening to the lesson argues that material with higher surface area has a higher friction force. Under these circumstances, what would you do if you were this teacher?

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