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Physics Teachers' Behavioral, Control and Normative Beliefs about Teaching Physics According to the National High School Physics Curriculum in Turkey

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In Turkey, a new Turkish High School Physics Curriculum (THSPC) was put into practice, starting initially with the Grade 9 in the 2008-2009 education-year. When compared with the previous ones, this curriculum emphasized the importance of students' active involvement in learning, use of real-life contexts and development of new skills. Even though what is intended with the new curriculum reflects the global trends in science/physics education, its success (or failure thereof) depends a great deal on teachers since they are the main actors to put the curriculum into practice. Whether teachers can implement the curriculum as intended by the curriculum developers remains an important question. A teacher's belief is an important factor, among others, that affects his/her implementation of the THSPC. In this regard, the aim of this study was to investigate physics teachers' beliefs related to the teaching of physics according to the THSPC. Four physics teachers from different schools participated in this study. Data were collected through interviews, classroom observations and an open-ended questionnaire. According to our findings, physics teachers believed that teaching physics based on the THSPC helped students use their skills, become more interested in physics lessons, relate physics to their daily life and understand physics better. However, teachers believed that factors such as students' interest in physics, the university entrance exam, inadequate laboratory facilities, limited lesson hours per week, and lack of information and communication technologies affected the implementation of the THSPC. For more effective implementation of the THSPC, making some changes in the curriculum should be necessary.

Keywords: curriculum implementation, physics education, teacher beliefs, Turkish high school physics curriculum

Introduction

Advances in science and technology and changes in industry oblige educators to change the rather traditional purposes of education (Hurd, 1998). In traditional education, the purpose was the transfer of knowledge from teachers to students, if such is possible, without thinking much about students' active participation in learning (McDermott, 1993). Students were considered as passive recipients of knowledge with the source of knowledge being their teachers or textbooks. However, contemporary views of education and learning focus on construction and development of knowledge by students. Students learn best when they are actively involved in learning and connect their newly attained information to their previous knowledge (Hinrichsen & Jarret, 1999). In fact, students learn best when they use their knowledge in different situations and when they are intellectually active (Hake, 1998; McDermott, 1991, 1993). Traditional instructions, therefore, are inefficient in terms of overcoming certain conceptual difficulties and making connections between the concepts learned and the real world.

Due to the inadequacies of traditional approaches in helping students understand the concepts of science, and in remedying student difficulties, science educators advocate approaches that necessitate student involvement in the learning process (Parker, 2001). In recent years, science educators emphasize process skills such as making observations and measurements, articulating hypotheses, and designing and carrying out experiments (Duschl, Schweingruber & Shouse, 2007). As a result, curriculum developers around the world now try to incorporate these views into science curricula.

Similarly, curriculum developers in Turkey have modified all high school curricula during the last decade by considering the educational developments around the world. Turkish students' low scores in the international exams (i.e., TIMMS, and PISA) forced the Turkish Ministry of National Education to revise the primary and secondary school curricula. The Ministry thought that, with the new curricula, students would not orient towards memorization of facts anymore (Güven & İşcan, 2006). As with other subjects, curriculum for physics was also revised. The curriculum developers claim that they had prepared the new physics curricula by taking into account the needs of the society, the educational developments in the world and changes in science and technology (Ministry of National Education [MoNE], 2007). The new Turkish High School Physics Curriculum (THSPC) for the Grade 9 was put into practice in the 2008-2009 education-year in Turkey. In the following years, consecutively, the new curricula for the 10^{th}, 11^{th} and 12^{th} grades were also put into practice.

The vision of the THSPC centers around the idea that individuals' education should help them internalize physics into their life. With this internalization, students will be able to solve problems in their life by using scientific methods, analyze the interactions among physics, technology, society and environment, and have positive attitudes and values toward themselves and the environment. Moreover, they will be able to have information literacy, express their ideas effectively and objectively, and respect themselves and the environment (MoNE, 2007). To reach this vision, it is emphasized in the THSPC that students should acquire some skills. For example, the THSPC fosters the attainment of problem solving and information and communication skills. In addition, it encourages students to make connections between physics and society, physics and the environment, and physics and technology. It is also stated in the THSPC that students should have a positive attitude and values towards physics, the world around them, life-long learning, themselves, and others. Therefore, developing skills and attitudes, according to the THSPC, is as important as acquiring knowledge (MoNE, 2007).

In Turkey, none of the curricula prepared until 2007, except the Physics Curriculum of 1992 for the Grade 9, involved explicitly stated knowledge objectives let alone skill and attitudinal ones (MoNE, 2007). However, the THSPC clearly defines the knowledge, and skill objectives that students should attain by the end of secondary education. Learning outcomes included in the THSPC are stated as interrelated knowledge and skill objectives. According to the

THSPC, skill objectives are categorized into four areas: problem solving skills (PSS), information and communication skills (ICS), physics-technology-society-environment objectives (PTSEO), and attitude and values (AV). Each of the knowledge objectives is linked to some of these skill objectives. It is expected that teachers organize their teaching by considering these knowledge and skill objectives together (MoNE, 2007).

When examined closely, it is clear that the THSPC was prepared with good intentions and seems rather elaborate. However, no matter how well-prepared a curriculum for a subject is, its effective implementation is influenced by teachers (Kelly, 2009; Ogborn, 2002). For example, teachers' beliefs are one of the factors that affect the implementation of curricula in the desired manner (Anderson, 1996; Briscoe, 1991; Cheung & Wong, 2002; Grossman & Stodolsky, 1995; Kelly, 2009; Keys & Bryan, 2001). According to the National Research Council in the US (NRC, 1996), teachers' beliefs and decisions can affect the implementation of curriculum reforms in science education. Similarly, Kelly (2009) argued that teachers' beliefs and decisions might hinder the accomplishment of intended curriculum goals. For example, teachers can have beliefs about instructional strategies for delivering the curriculum, their roles and responsibilities (Levin & He, 2008) which might not necessarily be in accordance with the general goals of the curriculum. Teachers also take many decisions during the planning of their classroom instruction that influence how the curriculum is brought into being (Keys & Bryan, 2001).

Moreover, Pajares (1992) states that beliefs play a key role in shaping teachers' behaviors in the classroom. These beliefs influence teachers' perceptions and judgments thereby affecting their instructional practices (Pajares, 1992). Additionally, according to Fishbein and Ajzen (2010), beliefs provide basis for attitudes, which, in turn, affect actions and intentions. Therefore, understanding teachers' beliefs is important before evaluating their thought process and instructional practices (Zheng, 2009).

Teachers' beliefs about teaching and learning can seriously affect their instructional practices in the classroom (Beck, Czerniak & Lumpe, 2000; Haney, Czerniak & Lumpe, 1996; Lumpe, Haney & Czerniak, 2000; Mellado, 1998; Nespor, 1987; Olafson & Schraw, 2006; Pajares, 1992; Porlán & Martín, 2004; Tsai, 2002; Yerrick & Hoving, 2003). For example, teachers who have a constructivist perspective believe in the involvement of students in learning, group work, and student negotiation (Beck et al., 2000). In contrast, teachers who have a traditional perspective may not encourage group work as they believe in transmission of knowledge from teachers to students (Roehrig, Kruse & Kern, 2007). Additionally, although the expectation is that teachers move on from traditional instruction, many teachers believe that science is best taught by transferring knowledge from teacher to students (BouJaoude, 2000; Porlán & Martín, 2004; Tsai, 2002).

In light of the discussions set out in the previous paragraphs, it is clear that teachers' beliefs about curriculum can affect their instructional practice in the classroom (Kindberg, 1999; Roehrig et al., 2007; Saez & Carretore, 2002). In this regard, identifying the beliefs of physics teachers related to the teaching of physics according to the THSPC can have invaluable contribution to the revision and development of the curriculum.

Since the THSPC informs teachers about what to teach, how to teach and how to assess their students' outcomes, it is one of the most important guides for teachers (MoNE, 2007). Therefore, it is crucial that teachers understand this guide. Due to the recent introduction of the THSPC, research studies related to the new curriculum are limited. As a result, there is little, if any, knowledge about whether physics teachers espouse the philosophy inherent in the THSPC. Although some researchers (Balta & Eryılmaz, 2011; Baybars & Kocakülah, 2010; Ergin, Şafak & İngenç, 2011) attempted to investigate teachers' views about the THSPC, no research studies on teachers' beliefs about teaching physics according to the THSPC have been conducted. This study aims to investigate teachers' beliefs about teaching physics according to the THSPC, thereby closing a significant gap in the literature.

Theoretical Background and Research Questions

According to Ajzen (1988), individuals can have many beliefs about objects; however, they are interested in only a small number of these beliefs. He named them as *salient beliefs*. Ajzen (1988) defined *salient beliefs* as "immediate determinants of a person's attitude" (p. 33). According to him, these beliefs determine the attitudes of a person and affect individuals' intention to engage in a certain behavior. The term 'salience' supplanted the term 'accessibility in memory' in contemporary social psychology. Little cognitive effort is needed to activate these accessible beliefs (Fishbein & Ajzen, 2010).

Ajzen proposed in 1985 the *Theory of Planned Behavior* to explain the behavior of individuals. This theory emphasizes that attitude and behavior of individuals are determined by their beliefs. According to this theory, three constructs affect the behavioral intention of people: *attitude toward behavior, subjective norm, and perceived behavioral control*. This intention affects individuals' actions and behavior (Ajzen, 1988).

Attitude toward behavior is determined by behavioral beliefs. *Behavioral belief* is related to results of a particular behavior. That is, they are related to advantages and disadvantages of performing a particular behavior. Subjective norm an individual's perception related to a specific behavior is determined by normative beliefs. *Normative beliefs* include perceptions about social pressures. They are related to other people such as parents, teachers and school principals who motivate or encourage the exhibition of a particular behavior. Perceived behavioral control is affected by control beliefs. *Control beliefs* include external factors affecting (facilitating or impeding) the performance of behavior (Fishbein & Ajzen, 2010).

Based on the above discussions, we think that the implementation of the THSPC in the desired manner might be influenced by the beliefs teachers have. For example, teachers might not believe in the effectiveness of the THSPC because they might believe in some factors impeding the implementation of the THSPC. These beliefs can have serious effects on teachers' instructional practices in the classroom. Therefore, they may think that it is impossible to teach physics according to the THSPC. The *Theory of Planned Behavior* will help us explain teachers' behaviors by associating them with the beliefs that they have about the THSPC. In this regard, the following research questions were constructed;

1. What are the teachers' behavioral beliefs about teaching physics according to the Turkish High School Physics Curriculum?
2. What are the teachers' control beliefs about teaching physics according to the Turkish High School Physics Curriculum?
3. What are the teachers' normative beliefs about teaching physics according to the Turkish High School Physics Curriculum?

Method

We used a qualitative research design to investigate four in-service physics teachers' beliefs related to the teaching of physics according to the THSPC. The data were collected through (1) interviews with participants, (2) classroom observations, and (3) an open-ended questionnaire. Using multiple case designs in educational studies enhances the external validity or generalizability of findings (Merriam, 1998). Therefore, multiple case study designs can be preferred for replication aims (Yin, 2003). Due to these benefits of multiple case study design, we selected four physics teachers as cases in this study.

According to Yin (2003), there are four types of case study designs. These are holistic single case study, embedded single case study, holistic multiple case study and embedded multiple case study designs. Our study was holistic multiple case study design because we followed same data collection procedures for each case in the data collection and tried to compare the data results for each case with each other.

Selection of the Cases

Stake (1995) argues that the first criterion for choosing a case is the concern to maximize what we can learn. Choosing cases is a critical issue before starting data collection (Merriam, 1998). Therefore, seven physics teachers in the public schools were interviewed to collect data in one of the Eastern Anatolia cities in Turkey. The first author initially talked with the seven teachers about the purpose of this study and data collection procedure. He asked each teacher how much he/she could contribute to the study during the data collection procedure. For example, when the first author explained what was entailed in the data collection procedure, two teachers did not want to be observed in their lessons during an entire semester. They said that they would allow him to observe their lessons only two or three weeks during one semester. Therefore, we excluded these teachers from the study. In addition, one of the teachers worked both as a physics teacher and a vice principle of his school. We also excluded him from the study thinking that, due to his workload, he might not contribute to the study as much as we deemed necessary. We decided to study the remaining four teachers to maximize the information we could collect. In so doing, we also managed to select teachers from different types of schools, since we considered that schools type could have an influence on the formation of beliefs. Two of the teachers worked in Anatolian High Schools having generally low-achieving students, and two worked in Anatolian Teacher High School and Science High School having generally high-achieving students. The third criterion in the selection of cases was whether teachers teach physics according to the THSPC. All indicated that they tried to teach physics according to the THSPC before the data collection. However, they also indicated that they sometimes could not teach physics according to the THSPC due to some factors.

Throughout this study, we used pseudonyms to refer to the participant teachers for the sake of anonymity. Table 1 presents detailed account of background information about each participant.

The case teachers happened to be the only physics teachers in their schools and therefore, they had to teach physics to all grade levels. At the time of data collection, two teachers had two years of experience in teaching the Grade 9 Physics Curriculum. We considered observing teachers' instructional practices at the Grade 9 an advantage, because the teachers were more familiar with the curriculum of the Grade 9, than those of Grades 10, 11 or 12. This would allow us to draw conclusions that are more trustworthy. In addition, we chose the 'nature of physics' and 'energy' units for classroom observations based on the fact that many of the skill objectives in the THSPC are included in these chapters.

Data Sources

Data were collected during the 2010-2011 education-year. Throughout the data collection, participants were interviewed, and their instructional practices during the teaching of 'nature of physics' and 'energy' units were video-recorded. Furthermore, an open-ended questionnaire was administered to the teachers. Each data collection procedure will be described in detail in the following headings.

Interviews. The primary data source in this study was the semi-structured interviews. Each case teacher was interviewed four times during the fall semester of the 2010-2011 education-year. The purpose of the interviews was to identify beliefs. The interview questions were prepared based on the suggestions made by Fishbein and Ajzen (2010).

Interview questions focused on revealing the participants' behavioral, normative and control beliefs about teaching physics according to the THSPC. Specifically, we asked the teachers what made teaching physics according to the THSPC easy and difficult. That is, interview questions focused on revealing the strengths of teaching physics by considering a real-life context-based approach, and integrating knowledge and skill objectives. Moreover, we asked teachers the strengths of teaching physics by considering PSS, PTSEO, and ICS. Learning about

the weaknesses of teaching physics according to the THSPC is as important as learning about the strengths. However, during the pilot study of interview questions, we saw that this question did not yield intended answers. Because, when the questions about weaknesses were asked, the interviewee in the pilot study talked more about the weaknesses of the THSPC instead of talking about weaknesses of teaching physics according to the THSPC. Additionally, we asked teachers what influenced their teaching physics using various teaching methods, considering the spiral structure, considering a real-life context-based approach, integrating knowledge and skill objectives, and considering PSS, PTSEO, and ICS.

Table 1. Background information of each participating case teacher in this study

Teachers	Background information of each case teacher
Sinan	• 27 years old • In the first year of teaching profession • Graduated from the department of secondary science and mathematics education as a physics teacher in 2009 • A master of physics student in the department of physics since 2009 • Not attended any in-service training programmes or seminars related to physics education and the THSPC
Fatih	• 35 years old • In the first year of teaching profession • Graduated from the department of physics in 1998 • Had a non-thesis master degree in physics education • Never worked as a physics teacher until January 2010 • Not attended any in-service training programmes or seminars related to physics education and the THSPC
Tarık	• 33 years old • Graduated from the department of secondary science and mathematics education in 2001 • Four years of teaching experience as a science teacher in primary schools and five years of teaching experience as a physics teacher in high schools • Not attended any in-service training programmes related to physics education and the THSPC
Cenk	• 29 years old • Graduated from the department of secondary science and mathematics education in 2006 • Worked as a physics teacher in private institutions offering private preparatory courses for two years before graduation and two years after graduation • Worked as a physics teacher for two years in public schools • A graduate student studying towards MS degree in the department of physics • Not attended any in-service training programmes or seminars related to physics education and the THSPC

Open-ended questionnaire. The second data source was an open-ended questionnaire. In this questionnaire, we asked teachers what they believed to be the strengths of teaching physics by considering specific skill objectives in PSS, PTSEO and ICS related to the 'nature of physics' and 'energy' units of the THSPC. The questionnaire also included questions about the factors that teachers believed to affect their instructional practices by considering these skills. For example, Table 2 presents some of these skills.

Table 2. Some of the problem solving skills, physics-technology-society-technology-society-environment objectives and information and communication skills in the THSPC

Skill Areas	Skills
Problem Solving Skills	• Distinguishing scientific knowledge, views and values from each other • Formulating a testable hypothesis for an identified problem • Determining appropriate measurement tools to measure variables • Recognizing appropriate experimental equipment or tools and using them safely • Making experimental setups to test the formulated hypothesis • Analyzing data collected in experiments and observations by using tables, graphs, statistical methods or mathematical calculations
Physics-Technology-Society-Environment-Objectives	• Knowing necessary basic principles for safe use of equipment and devices • Realizing that existing scientific knowledge, when a new evidence arises, is limited, corrected or renewed by testing • Determining and explaining with examples the contribution of a technological innovation to development of scientific knowledge in physics • Explaining the working principle and/or function of technological tools used in daily life by using scientific knowledge • Examining the past, present and future, positive and negative effects of physics and technology on the individual, society and environment (on social, cultural, economic, political, ethical etc. issues)
Information and Communication Skills	• Using different sources of information • Controlling whether the sources of information is reliable and valid • Using multiple search criteria • Synthesizing information and obtaining new information • Using different formats such as text, number, picture, graph, diagram or table as much as possible while preparing presentation

Video-recorded classroom observations. The third data source for this study included observations of the case teachers' instructional practices in one particular class during the entire semester. Teachers' instructional practices were video-recorded for the 'nature of physics' and 'energy' units. Since time allocated for the Grade 9 physics course is two hours per week, each was observed two hours per week during the data collection.

Data Analysis

Qualitative data analysis, according to Miles and Huberman (1994), consists of three components: data reduction, data display, and conclusion drawing and verification. We started our data analysis immediately after collecting our data. First of all, all the interviews and some of the talks in the video recordings were transcribed into documents. Then, a coding strategy for data reduction was used. Categories and codes after analyzing the transcripts of interviews and teachers' responses to an open-ended questionnaire were constructed by focusing on the research questions. For drawing conclusions and verification, codes were clustered under the categories. As the final step, the findings obtained from interviews were triangulated with an open-ended questionnaire and video-recordings.

Validity and Reliability

Issues such as conducting reliable and valid interviews, analyzing the content of documents properly and drawing valid conclusions related to the research questions need to be carefully

handled in qualitative studies (Merriam, 1998). Yin (2003) stated four criteria for judging the quality of case study research designs. These are construct validity, internal validity, external validity and reliability.

Yin (2003) defined construct validity as "establishing correct operational measures for the concepts being studied" (p. 34). Three tactics were suggested to increase the construct validity of the case studies. These are using multiple sources of evidence, establishing a chain of evidence and having key informants review the draft case study report (Yin, 2003). The first of the criteria was met since we used multiple data sources: interviews, classroom observation, and an open-ended questionnaire. Secondly, we constantly considered our research questions and revised them during the data collection. When any of the data we collected were not considered fruitful to answer our research questions, we added extra questions to the subsequent interviews.

Merriam (1998) suggested some strategies such as triangulation, member checks, long-term observation, and peer examination to enhance internal validity in qualitative studies. For triangulation we used multiple sources of data for the confirmation of our findings. As also suggested by Lincoln and Guba (1985), we utilized member checking. Having written the initial case reports, we requested one case teacher to examine his report and comment on it. He approved that the report reflected his views and experiences. The long-term observation criterion was also met since we worked with all case teachers during an entire semester.

External validity is the extent to which results a research study are generalizable to other situations (Merriam, 1998). We selected and used four cases so that they replicated each other to make the results of this study more generalizable (Yin, 2003). We chose four case teachers to compare the results obtained from open-ended questionnaires, classroom observations and interviews.

Yin (2003) explained reliability in case studies as conducting the same case study with the same procedures to reach the same result. Therefore, we followed the same procedure in the data collection for each participant to increase the reliability.

Results

Teachers' responses to interview questions showed that they believed that teaching physics according to the THSPC had some strengths. Furthermore, they also believed that there were factors facilitating and impeding their attempts at teaching physics according to the THSPC. Ajzen (1988) categorized beliefs related to advantages and disadvantages of performing a behavior as behavioral beliefs, external factors affecting the performance of behavior as control beliefs, and other people such as parents, teachers and principals who motivate or encourage the performance of a certain behavior as normative beliefs. In presenting our findings about physics teachers' beliefs related to the teaching of physics according to the THSPC, we will follow this categorization.

Teachers' Behavioral Beliefs

In order to answer Research Question 1, we asked teachers in the interviews what they believed to be the strengths of teaching physics according to the THSPC. This necessarily entailed asking their views about teaching physics considering a real-life context-based approach, integrating knowledge and skill objectives and considering PSS, PTSEO, and ICS. Additionally, in an open-ended questionnaire, we asked them the strengths of teaching physics by considering PSS, PTSEO and ICS. Table 3 presents, as revealed from the interviews, teachers' behavioral beliefs about the strengths of teaching physics according to the THSPC.

Table 3. Behavioral beliefs of teachers as strengths of teaching physics according to the THSPC

Beliefs		Code	Teachers			
			Sinan	Fatih	Tarık	Altan
Teaching physics according to the THSPC helps students	use their skills	SUT	√	√	√	√
	become interested in physics lessons	SIP	√	√	√	√
	relate physics to their daily life	SRP	√	√	√	√
	understand physics better	SUP	√	√	√	√
	participate in discussions or activities	SPD	√	√		√
	become more conscious individuals	SBC	√	√	√	
	overcome the problems encountered in their life	SOP		√	√	
	feel more self-confidence	SFS	√		√	
	develop study habits	SDS	√			
	have a general knowledge about physics	SGK			√	

As given in Table 3, all teachers believed that the THSPC helped students use their skills, become interested in physics lessons, relate physics to their daily life and have a better understanding of the physics topics. For example, Sinan believed that students became more interested in physics lessons and participated in discussions due to the emphasis given on physics-technology-society-environment relationship:

> This curriculum [referring to the THSPC] draws the attention of students more while we are giving examples from physics-technology-society-environment relationship. For example, when I asked questions related to physics-technology-society-environment relationship, everybody had an idea, everybody wanted to talk. Therefore, everybody wants to participate in discussion and activities. (Interview with Sinan)

Another belief held by all teachers was that the THSPC helped students use their skills due to its emphasis on PSS, PTSEO, and ICS. For example, Sinan believed that teaching physics by considering ICS helped students use their skills:

> First of all, students can learn using different sources of information. They investigate whether the information is reliable by asking questions to their teachers or investigating different sources such assome books and the Internet. In addition, we assign students research homework; they investigate information from the Internet… While preparing a poster, they can choose information according to their aims. They can use appropriate pictures or texts in the preparation. They develop their imagination skills. They organize the texts and pictures in the poster. (Interview with Sinan)

Additionally, in an open-ended questionnaire, Sinan indicated that helping students attain the skill *controlling whether the sources of information is reliable and valid* encouraged them to

develop their questioning skills: "Due to this skill objective, students should develop questioning skills." (Open-ended questionnaire of Sinan)

Teachers also believed that teaching physics according to the THSPC helped students relate physics to their daily life. They thought that the THSPC encouraged teachers to give more importance to the use of daily life examples in their instruction due to its emphasis on a real-life context-based approach.

Another important belief held by all case teachers was that teaching physics according to the THSPC helped students understand physics better. All teachers agreed that teaching physics by integrating knowledge and skill objectives helped students understand physics topics better. Teachers thought that since students were more active during the learning process due to this integration, they could learn better and would not forget what they learned. For instance, Altan thought that students could learn better and become more interested in the lessons due to this integration:

> …when practical knowledge [meaning to say skill objectives] is given to students in addition to theoretical knowledge [meaning to say knowledge objectives], they become more interested. This draws students' attention more. Therefore, students do not forget anymore. Because they apply and do it [meaning to say hands-on activity] themselves, they do not forget it until the end of their life. And, they become interested in this lesson. …when it is only a theoretical knowledge, it is like writing on the beach. Waves come and erase it… (Interview with Altan)

Teachers also thought that students could become more conscious individuals and participate in discussions and activities more because of the emphasis of the THSPC on real-life and physics-technology-society-environment relationships. According to teachers, conscious individuals are those who have socially conscious actions such as protecting the environment and saving energy. For example, Sinan thought that giving examples related to the physics and technology relationship would help students become more conscious individuals:

> … students will be more effective for their society. For example, we teach students renewable and non-renewable energy sources. They understand the importance of using renewable energy. Therefore, they will tend to use this energy in their life. For example, they will not waste electricity in their home… We also talked about the negative effects of non-renewable energy sources on environment. They will try to be more conscious in using and choosing energy sources. (Interview with Sinan)

Like Sinan, Fatih believed that talking about physics and technology relationship in the classroom encouraged students to become more conscious individuals. He thought that there was a strong relationship between physics and technology. Therefore, according to him, mentioning physics and technology relationship in the classroom will help students become aware of environmental issues:

> You cannot separate technology from the environment. Is the technology everywhere now? We use it for protecting our environment. However, we need physics to develop technology. Individuals become more conscious of environmental problems and try to protect their environment. For example, when students think how to increase their quality of life, they encounter physics and technology. People think how to consume water less, are aware of the use of A class of home appliances to save electricity, and buy cars which consume less gasoline. (Interview with Fatih)

Differing from the other teachers, Tarık believed that the content of the Grade 9 Physics Curriculum is itself an advantage. He believed that it would help students have a general knowledge about physics by including a wide range of physics topics (i.e., energy, waves, properties of matter, heat, temperature, electricity, magnetism, force and motion):

> Students can be aware of almost all of the physics topics especially in the Grade 9. I think that it is an advantage for students… Therefore, we can inform students about the physics world. For example, think about students choosing courses after the Grade 9. Students learned three or four physics topics before this curriculum was put into practice. For example, they were not aware of the topics related to waves and electricity… (Interview with Tarık)

Tarık also indicated this belief in his instructional practice in the classroom. He stated that talking about many physics topics in the classroom helped students have a general grasp of physics. Therefore, he thought that students could be more successful in preparing some projects related to physics:

> This unit [referring to 'nature of physics'] includes verbal explanations. That is what physics includes. In fact, I want to say again; I like the topics of the Grade 9 Physics Curriculum. For example, you [students] will prepare projects as a student of Science High School. However, in previous years before the current THSPC was implemented, when we wanted students to prepare projects in the Grade 9, they did not know anything about physics. They knew some topics, but they had never heard of some topics [meaning to say that the previous Grade 9 Physics Curriculum did not include many of the physics subjects, therefore, students had little knowledge about many of the physics subjects]. In this situation, how do they prepare projects? (Classroom Observation of Tarık)

To summarize, all teachers believed that teaching physics according to the THSPC helped students use their skills, become interested in physics lessons, relate physics to their daily life and understand physics better. Sinan, Fatih and Altan believed that teaching physics according to the THSPC helped students participate in discussions or activities. Moreover, Sinan, Fatih and Tarık believed that teaching physics according the THSPC helped students become more conscious individuals.

In addition to these beliefs indicated by most teachers, they had some different beliefs related to teaching physics according to the THSPC. For example, while Sinan believed that teaching physics according the THSPC helped students develop study habits, Fatih and Tarık believed that teaching physics according the THSPC helped students overcome the problems they encountered in their life. Sinan and Tarık believed that teaching physics according the THSPC increased students' self-confidence.

Teachers' Control Beliefs

In addition to the behavioral beliefs, we identified teachers' control beliefs (the beliefs related to external factors affecting the performance of behavior) related to teaching physics according to the THSPC as per Research Question 2. For this purpose, we asked teachers, in the interviews, what facilitated or impeded their attempts at teaching physics according to the THSPC. We also asked them what impeded their attempt at teaching physics by using various teaching methods, considering the spiral structure, considering a real-life context-based approach, and integrating knowledge and skill objectives; and what facilitated their attempts at teaching physics by considering PSS, PTSEO, and ICS. In Table 4, we present our findings obtained from the

interviews about factors that teachers believed to make teaching physics according to the THSPC easy.

Table 4. Control beliefs of teachers that make teaching physics according to the THSPC easy

Beliefs		Code	Teachers			
			Sinan	Fatih	Tarık	Altan
It is easy to teach physics according to the THSPC due to	availability of a great number of daily life examples	FEDLE	√	√	√	√
	widespread use of internet	FEWUI			√	√
	feasible activities/experiments in the course book	FEFAE	√			√
	interesting pictures and examples in the course book	FEIPE	√			

As can be seen in Table 4, all teachers believed that it was easy to teach physics according to the THSPC due to the availability of a great number of daily life examples. They thought that the availability of a great number of daily life examples helped them particularly in teaching PTSEO in the classroom. For example, Tarık stated that he had no difficulty in talking about the daily life examples related to physics:

> We can talk about more examples from life. For example, when we talk about electricity, we mention the electrical installations, transformers and transfer of energy from hydroelectric power stations to our homes. Instead of telling directly how the electricity is produced, we try to discuss it. We have been teaching about satellite TV frequencies, the working principles of cars and how they pollute the environment. These are all good examples from life. We can talk about many examples from life. (Interview with Tarık)

Similarly, Fatih believed that he could have a lot of opportunities to give daily life examples in his teaching of physics according to the THSPC. He believed that PTSEO were part of the life:

> I think that physics-technology-society-environment objectives are part of the life. Therefore, we can talk about many examples which are related to life. For example, we can mention that a cell phone works by using electromagnetic waves. (Interview with Fatih)

In addition, Fatih asserted that availability of a great number of examples about daily life made teaching physics by integrating PSS easy. According to him, availability of many daily life examples related to physics made it easy for him to ask students questions. Therefore, he believed that asking questions facilitated the development of PSS:

> When we ask students how these tools work and why this machine does not work, students become interested. I mean that we can talk about more examples. For example, I ask students how they would overcome the global warming or why a lamp might not be working. You can find many examples which are related to physics. (Interview with Fatih)

Altan believed that some feasible activities in the course book made his teaching according to the THSPC easy. He stated that he could perform some activities which require less equipment: "For example, together we perform easy experiments [meaning to say that the activities in the course book] or we say to students that they will study this subject…" (Interview with Altan)

Tarık and Altan believed that accessing information technology whenever and wherever students want made teaching by taking PTSEO and ICS into account easy. For example, Tarık thought that information and communication technologies, especially the Internet, helped students locate information more easily.

> For example, students can reach the Internet everywhere. …we have been teaching energy sources. When we have the Internet, we can locate pictures or news related to energy sources via internet. Students can learn more easily. …when we give students homework, they firstly use the Internet. Nowadays, you can find the Internet everywhere… (Interview with Tarık)

In addition to these facilitating factors, teachers indicated in the interviews that some factors made teaching physics according to the THSPC difficult. Table 5 presents these factors.

Table 5. Control beliefs of teachers that make teaching physics according to the THSPC difficult

Beliefs		Code	Teachers			
			Sinan	Fatih	Tarık	Altan
It is difficult to teach physics according to the THSPC due to	university entrance exam	FDUEA	√	√	√	√
	inadequacy of laboratory facilities	FDILF	√	√	√	√
	inadequacy of lesson hours	FDILH	√	√	√	√
	lack of information and communication technologies	FDLIC	√	√	√	√
	a great number of students in classrooms	FDGNS	√			√
	limited coverage of physics and technology in the media	FDLCP			√	

As can be seen from Table 5, all teachers believed that the university entrance exam, inadequacy of laboratory facilities, inadequacy of lesson hours, and lack of information and communication technologies affected their teaching according to the THSPC negatively. For example, Tarık believed that the university entrance exam made his teaching with respect to the THSPC difficult. He complained about dershane (private institution offering special courses for the university entrance exam) and thought that it had negative influence on his teaching according to the THSPC:

> Students react negatively to the THSPC. There is a mismatch between what they learn in dershane and what we teach. Knowledge is transferred to students in dershane. Students solve multiple choice questions by using rules and formulas. (Interview with Tarık)

Similarly, Altan believed that the university entrance exam impeded his teaching according to the THSPC. He thought that the university entrance exam put pressure on him to teach in more detail. He could not teach by considering the spiral structure of the THSPC due to

the university entrance exam. According to the spiral structure of the THSPC, teachers are required to teach initially at a basic level without going into details, then introducing more about the topics in higher grades. The following excerpt from the interview with Altan illustrates his belief:

> Now, let's think the 'energy' unit. We only mentioned work, power and energy and gave some examples related to daily life about them. I gave some definitions. But, as I mentioned before, there are some problems. Students bought test books. They asked why I did not teach them [the topics in those books]. Students go to dershane and learn these topics in there. They ask why I did not teach them, and complain that they cannot solve problems. Then, students' family comes. They say that why students' scores are low in practice tests. There is a serious problem… If I do not teach in detail, student will begin to hate physics because they cannot solve the problems in the test book. (Interview with Altan)

Although Altan was aware of what they had to teach according to the THSPC, he could not teach according to the THSPC due to the university entrance exam. He complained about test books helping students be successful in the university entrance exam:

> In fact, I should not teach vectors in detail now [Altan was aware of what they teach by considering the THSPC. It is not expected that teachers teach vectors in detail in the THSPC]. However, in the test books, questions which are related to vectors are asked. Students cannot solve them if I do not teach them in detail. Therefore, I have to teach them. (Classroom Observation of Altan)

Like Altan, Sinan believed that it was difficult to teach physics by considering the spiral structure of the curriculum due to the university entrance exam. The following excerpt illustrates Sinan's ideas:

> … although I try to implement lessons by considering the spiral structure in Grades 9 and 10, you cannot implement by considering the spiral structure in Grade 11 due to the university entrance exam. A majority of students go to dershane. When they come to my class, what we teach becomes very easy for them. Therefore, we cannot implement physics lessons by considering the spiral structure in Grade 11. For example, I want students to do something in the classroom. I expect them to perform some activities. However, they do not want to carry out them. They complain that their teachers in dershane solve many questions. Why don't I also solve questions? They became used to solving physics problems. (Interview with Sinan)

Fatih, too, believed that the university entrance exam affected his teaching, and he ignored the spiral structure. Like other teachers, he felt that he had to solve physics questions related to the university entrance exam to meet the students' wishes:

> For example, some students solve questions in the test books. They ask me some questions from these books which they cannot solve. For example, we teach students heat and temperature without giving detailed information. We only talked about the transformation of Kelvin to Celsius by giving the formula $T(^oC)=T(K)-273$. However, students bring many questions from test books [test books which students used to prepareforthe university entrance exam] about the transformation of temperature units. You have to solve these questions. You cannot refuse to solve

> them. Therefore, we have to mention transformation of temperature units in detail in the classroom. (Interview with Fatih)

Another factor believed to make teaching physics according to the THSPC difficult indicated by all teachers was inadequacy of laboratory facilities. Fatih thought that there was a need to have some laboratory equipment to teach physics according to the THSPC effectively:

> There are many inadequacies in the physical facilities in my school. In fact, you [the researcher] saw our laboratory. We cannot use the laboratory. We only demonstrate students some of the laboratory equipment by bringing them into classroom. For example, in the Grade 9, it is expected that teachers demonstrate wave properties. However, we do not have a ripple tank. (Interview with Fatih)

Fatih's belief was also reflected in the classroom. For example, he said he wanted to take his students to the laboratory, but he could not. It seems that he strongly believed that lack of laboratory equipment cannot be compensated by other means such as computer simulations. This belief impeded his teaching. This deficiency seemed to affect him so deeply that he even talked about it in the classroom:

> [Having brought a balance into the classroom and demonstrated it to students]… We tried to organize our laboratory with our chemistry teacher yesterday. We listed the equipment in the laboratory… I want you to give me some time to go to the laboratory. We will try to go to the laboratory in the second semester although we do not have enough materials. (Classroom Observation of Fatih)

The negative influence of inadequate laboratory facilities on teaching physics according to the THSPC was evident for other teachers as well. For example, Sinan wanted to teach in the laboratory; however, lack of appropriate laboratory equipment prevented him doing so:

> For example, I want to demonstrate to students how the volume of liquids and solids are measured in the matter and properties unit. I want to go to the laboratory with students… I sometimes use traditional instruction half-heartedly. For example, I want to teach by using student centered teaching methods; however, we do not have laboratory equipment. (Interview with Sinan)

He also indicated this factor in an open-ended questionnaire. He thought that students could not attain the skill *recognizing appropriate experimental equipment or tools and using them safely* because of the insufficient laboratory facilities. This can be seen in the following excerpt: "Due to inadequacy of laboratory facilities. Many of the laboratory equipment are broken. Therefore, we cannot bring them into the classroom. As a result, this skill cannot be attained in this situation." (Open-ended questionnaire of Sinan)

Another factor that all teachers believed to have impeded their teaching was inadequacy of lesson hours. The teachers perceived that they were required to teach physics sometimes by discussing some physical events in the classroom. Due to these classroom discussions, the case teachers faced a difficulty in finishing their lessons in time. For example, Sinan thought that more time was needed to be able to listen to the students' ideas: "…you [the researcher] saw that almost 90% of students participated in discussions. However, lesson hours are insufficient to deal with students." (Interview with Sinan)

Like Sinan, Altan thought that inadequacy of lesson hours made his teaching of physics according to the THSPC difficult. He thought that he had to listen to all of the students' ideas. Therefore, he could not finish teaching all the content in time: "…some classes are very crowded.

For example, we will discuss something in the classroom. We have to listen to the ideas of all students. Therefore, we cannot finish the curriculum in time. This is a problem for us." (Interview with Altan)

Another factor that all the case teachers believed to have an influence on teaching physics according to the THSPC was information and communication technologies. For example, they believed that students could not attain ICS without the presence of appropriate information and communication technologies. The following excerpt from the interview with Altan exemplifies why he could not help students attain ICS: "For example, one factor that makes it difficult [referring to teaching physics by considering ICS] is that there is no computer in the classroom environment." (Interview with Altan)

He also indicated this factor in an open-ended questionnaire. He thought that students could not attain the skill *using different formats such as text, number, picture, graph, diagram or table as much as possible while preparing presentation*: "It cannot be attained because there are no computers or over-head projector in the classroom for students." (Open-ended questionnaire of Altan)

In addition to these factors, Sinan and Altan thought that it was very difficult to teach physics according to the THSPC due to the large number of students in the classrooms. They thought that it was very difficult to conduct classroom discussions and perform activities because of the crowded classrooms.

An interesting factor was indicated by Tarık. Differing from other teachers, Tarık believed that limited coverage of physics and technology in the media hindered his teaching physics by considering PTSEO:

> There are not enough television programs which are related to physics and technology. It impedes. If students do not know anything about the physics and technology, we cannot draw the attention of students. If students know something, they raise their fingers and they want to talk. (Interview with Tarık)

As a result, teachers pointed to only a small number of factors that made teaching physics according to the THSPC easy. All teachers believed that availability of examples related to daily life facilitated teaching physics. Other factors that facilitated their teaching were widespread use of the Internet and feasible activities/experiments, interesting pictures and examples available in the course book. Impeding factors that teachers believed in this study outnumbered facilitating factors that they believed. All teachers believed that the university entrance exam, inadequacy of laboratory facilities, inadequacy of lesson hours and lack of information and communication technologies affected their instructional practices negatively. In addition, crowded classrooms according to Sinan and Altan, and insufficient coverage of physics and technology in the media according to Tarık were believed to have affected their instructional practices negatively.

Teachers' Normative Beliefs

The third category of beliefs according to Ajzen (1988) was normative beliefs, which are related to other people such as parents, teachers and principals who motivate or encourage the implementation of a behavior. With Research Question 3, we set out to investigate what normative beliefs physics teachers have related to teaching physics according to the THSPC. Table 6 presents our findings obtained from the interviews about people who encouraged teachers to teach physics according to the THSPC.

Table 6. Normative beliefs of teachers that make teaching physics according to the THSPC easy

Beliefs		Code	Teachers			
			Sinan	Fatih	Tarık	Altan
It is easy to teach physics according to the THSPC due to	students	FES	√	√	√	√
	teachers	FET		√		

As given in Table 6, all the case teachers believed that students encouraged teaching physics according to the THSPC. For example, Sinan stated that students' interest in participating in discussions and willingness to learn made his teaching physics according to the THSPC easy. He thought that lessons became more effective due to this: "Students' participation in discussions and willingness to learn really facilitates teaching. Lessons become more effective due to this participation. For example, when I say that I will carry out activities, the majority of the students are willing to perform activities…" (Interview with Sinan)

Sinan also thought that students' interest in using information and communication technologies made his teaching physics by considering ICS easy. He stated this in the interview: "Students like investigating something by using the Internet. When we assign research homework, they become more interested. Therefore, they become more willing to participate in discussions. Our lessons become more entertaining." (Interview with Sinan)

Altan thought that students' ability to use technology made his teaching according to the THSPC easy. He thought that students were more willing to learn because they liked technology: "When we assign students performance homework, they complete their homework willingly because this homework includes something students like, there is a visual and they can use technology." (Interview with Altan)

Fatih indicated an interesting factor in the interview. He believed that being a young teacher facilitated his teaching by considering communication skills. He thought that he could communicate with students more easily due to his age:

> Age difference between me and students facilitates learning. There is not a very big difference between my age and students. We [referring to the young teachers] can understand students' emotions better. We can easily communicate with students… Therefore, we can make students participate in discussion easily. (Interview with Fatih)

According to the case teachers, there were also some people who discouraged the implementation of the THSPC in the desired manner. Table 7 presents our findings obtained from the interviews about people who discouraged teaching physics according to the THSPC.

Table 7. Normative beliefs of teachers that make teaching physics according to the THSPC difficult

Beliefs		Code	Teachers			
			Sinan	Fatih	Tarık	Altan
It is difficult to teach physics according to the THSPC due to	teachers	FDT	√	√	√	√
	students	FDS	√		√	√
	school administration	FDSA	√		√	
	families	FDF			√	√

All teachers agreed that their ideas about the implementation of curriculum affected their instructional practices. For example, some teachers believed that teaching some topics was

necessary before moving on to related topics for students. Therefore, they sometimes taught what they believed instead of teaching according to the THSPC. For example, Sinan believed that he had to teach vectors in detail, which was against the Grade 9 Physics Curriculum:

> I could not implement my lessons by considering the spiral structure. In fact, for example, when I mentioned the vectors, I recognized that the course book did not mention many of the subjects. The course book only mentions vector quantity. However, we will use vectors in the'energy' unit. In addition, we will use vectors in 'force and motion' unit. Therefore, I considered the necessity of teaching the vectors in more detail. (Interview with Sinan)

In addition, Sinan believed that they did not have sufficient pedagogic training to teach physics according to the THSPC. He indicated that he was trained with traditional teaching approaches and imitated his teachers, and therefore, he faced some difficulties to teach physics according to the THSPC:

> … I do not have sufficient pedagogic training to implement this curriculum. I am unfamiliar with the implementation of this curriculum. We were trained with traditional teaching approaches. Our teachers in university did not inform us about this curriculum. Therefore, I tried to imitate my previous primary and secondary school teachers before [meaning to say that he tried to imitate his previous teachers until he understood the curriculum]; however, after some time passed, I believed the effectiveness of this curriculum. For example, I had never heard the 5E [learning cycle] until I examined the curriculum. At that time, I understood that I did not have sufficient pedagogic training. (Interview with Sinan)

Another important factor was related to students. For example, two teachers faced some discipline problems when they tried to conduct some activities. Therefore, they believed that it was difficult to teach physics by considering PSS due to discipline problems among students in the classroom. The following excerpt from the interview with Sinan illustrates his ideas:

> … I will separate students into groups in problem solving. There are discipline problems in the classroom. Therefore, some of the students lose focus. For example, everybody wants to talk. However, I cannot deal with each student. Therefore, some of the students do not become interested in the next activities. I cannot trust students. For example, we need some instructional materials while performing activities. I am afraid of students because we have students with disruptive behavior. They can harm their friends. Therefore, I do not want to bring some of the equipment such as a lighter and penknife. (Interview with Sinan)

Like Sinan, Fatih believed that students with disruptive behavior in the classroom affected his teaching of physics by considering PSS negatively. He indicated that he could not perform any activities due to students' disruptive behavior:

> In some classrooms, we cannot carry out any activities. When you try to perform some activities, you lose the control of students. I am afraid of bringing materials into the classroom because there are students with very disruptive behavior. For example, if you want to do something in the classroom, students and teachers in other classrooms can be disturbed. In addition, we spend much of our time trying to silence students. We cannot perform many of the activities. (Interview with Fatih)

In addition, Fatih indicated this factor in an open-ended questionnaire. For example he thought that students could not attain the skill *analyzing data collected in experiments and observations by using tables, graphs, statistical methods or mathematical calculations*: "Laboratory facilities are insufficient. In addition, we cannot use existing facilities because we have students with very disruptive behavior." (Open-ended questionnaire of Fatih)

Another student-related factor was students' lack of interest in activities. Altan indicated that students did not want to do easy activities in the classroom:

> We need more professional instructional materials. As I said before, when we demonstrate students meter rule and balance, students say that we know them. For example, we will demonstrate for students the use of the thermometer and meter rule in the teaching of 'energy' and 'nature of physics' units; however, they ask why I show them that. (Interview with Altan)

Like Altan, Tarık thought that students were not interested in activities. He indicated that students did not want to do such activities in the course book because they were very easy:

> I do not believe in their [the activities in the course book] effectiveness. I only like one or two of them. Others are very easy and ordinary. They are prepared by considering primary students' level. They are a waste of time for students. When they [students] perform these activities, they laugh. (Interview with Tarık)

In addition to these student related factors, Sinan and Altan believed that students' insufficient readiness level affected their teaching by considering ICS negatively. Sinan thought that students should have some skills such as being able to use some computer programs and organizing presentations:

> Students do not know how to use information and communication technologies. For example, some of the students do not know how to prepare posters by using MS PowerPoint. They do not know how to present knowledge. Sometimes we see that texts and pictures are not in harmony in the posters. We suggest students change the place of texts and pictures. (Interview with Sinan)

The teaching experiences of Sinan could cause the formation of this belief. For example, he wanted students to prepare a poster which was related to renewable energy sources in the classroom in the tenth week of the school. He warned students about how to prepare it because some of the students in previous homework (which was given in seventh week) could not organize the pictures and texts in the poster. However, some students insisted on their mistakes in the homework of tenth week:

> I do not want it [stick on prints on the paper]. You will prepare a poster. Is it understood? As I said, I do not want print. I want poster like posters of X and Y [referring to students' names]. Please write the names of the renewable energy sources which you investigated in the poster. And be careful in sticking pictures and text on the poster. They must be related with each other. (Classroom Observation of Sinan)

Similarly, Altan believed that students' insufficient level of readiness made his teaching physics by considering ICS difficult. He had found that some students lacked sufficient level of readiness in using computers because they had never used a computer before coming to high school:

> Some of the students cannot use a computer effectively. For example, there are some students who come from villages in our school. They are not able to use the computer. We can face some difficulties in the Grade 9 because students are not competent enough in using computer and they do not take sufficient computer courses. (Interview with Altan)

Other important factors that affected teachers' teaching according to the THSPC were school administration and students' families. Tarık stated that they complained about him because he was performing some activities:

> In fact, when I do not teach similar to the system of dershane, school management and families complain. Last year, I performed many activities in the classroom. However, students complained about me to school management. They said that I did not teach anything, made students peel potatoes in the classroom. Then, school administration got angry with me because they were not aware of the curriculum... (Interview with Tarık)

All teachers believed that students sometimes made teaching physics according to the THSPC easy. For example, students' interest in physics lessons and their willingness to learn facilitated teaching according to the THSPC. Additionally, Fatih thought that the small difference between his age and that of students facilitated his teaching by considering communication skills of the THSPC. However, some factors related to teachers, students, school administration and families made teachers' teaching according to the THSPC difficult. For example, some teachers thought that they did not have sufficient pedagogic knowledge to teach physics according to the THSPC. Some believed that there was a need to teach some subjects in detail. In addition, students sometimes affected the teaching according to the THSPC negatively. For example, teachers thought that some students were not interested in physics lessons because the activities were too easy. They also thought that students did not have sufficient readiness levels, especially, for the information and communication skills. Some teachers thought that school administration and students' families did not encourage them to teach physics according to the THSPC.

Conclusions, Discussions and Implications

The results of this study showed that participant teachers believed that teaching physics according to the THSPC had some strengths. For example, they believed that the THPSC helped students use their skills, become interested in physics lessons, relate physics to their daily life, and understand physics better. Based on Ajzen's (1988) Theory of Planned Behavior, these beliefs related to strengths of teaching physics according to the THSPC can be considered as teachers' behavioral beliefs about the THSPC.

There were no studies about teachers' behavioral beliefs related to the THSPC in the literature. However, the results of this study can be compared with the studies concerned with teachers' beliefs related to constructivism, inquiry, science and technology issues, and problem solving because the THSPC emphasizes these aspects. For example, Beck et al. (2000) found that the teaching of subcomponents of the Constructivist Learning Environment Survey helped students develop their skills, become interested in lessons and involved in learning. In addition, Haney et al. (1996) found that implementing lessons by considering the inquiry strand in the Ohio Science Model helped students increase their interest, learn independently and relate science to their daily life. Similar to the results of these studies, we found that participating teachers in this study believed that teaching physics according to the THSPC helped students become more interested in physics lessons, use their skills and relate physics to their daily life. We think that these beliefs related to teaching physics according to the THSPC are a reflection of

how the teachers see the THSPC as student-centered. The study of Levitt (2002) supports this idea. For example, Levitt (2002) asserted that hands on activities, active participation of students in learning and relating learning to students' life were reflections of student-centered learning.

We also found similar results in this study to that of Tsai (2002). He found that the teacher in his study believed that implementing lessons by considering STS practices which are similar to PTSEO in the THSPC encouraged students to be willing to attend discussions and use their skills. Similar to the results of Tsai (2002), some participants of this study believed that teaching physics by considering PTSEO helped students participate in discussions. Therefore, teaching science related topics by integrating technology and society might increase students' interest in lessons, and as a result, they might participate in classroom discussions more.

Another research question in this study was related to factors that affect teachers' instructional practices according to the THSPC. Our results were similar to those of Lumpe et al. (2000) and Mansour (2010). For example, they found that participants believed that lack of technological and physical facilities, and inadequacy of lesson hours affected their teaching by considering science-technology-society issues negatively. Similarly, some of the case teachers in this study believed that these factors negatively affected their instructional practices. For example, they indicated that the time allocated to the Grade 9 physics course was not enough to discuss physics and technology relationships because everybody in the classroom wanted to say their ideas in the classroom.

Some of the results of this study related to PSS were also similar to the findings of the study of Luft (1999). He investigated teachers' salient beliefs about problem solving. He found that participants believed that insufficient class hours and materials negatively affected their teaching by using SSCS (search, solve, create and share) problem solving instruction. In addition, participants believed that they were not competent enough in their instructional philosophy and science background to teach according to SSCS problem solving instruction (Luft, 1999). Similarly, some of the participants of our study believed that inadequacy of lesson hours and inadequacy of laboratory facilities negatively affected their instructional practices by considering PSS.

Additionally, when the studies related to the THSPC were examined, there were some similarities between the results of our study and these studies although they were not directly concerned with teachers' beliefs. For example, Ergin et al. (2011), and Baybars and Kocakülah (2010) found that teachers thought that that allocated time was not sufficient to teach physics according to the THSPC. Baybars and Kocakülah (2010) also found that teachers thought that lack of instructional materials affected their teaching according to suggested activities in the THSPC.

The outcomes of this study differed from other studies in some aspects. We found that teachers who were in different types of schools sometimes had different beliefs. Briscoe (1991) and Mellado (1998) found that although previous teaching and learning experiences of teachers influenced their formation of beliefs, they did not mention the effect of school types where teachers worked on the formation of beliefs. We found that Tarık and Altan who worked in Science High School and Anatolian Teacher High School which were composed of mainly high-achieving students emphasized the factor 'the university entrance exam' more than Sinan and Fatih who worked in the schools which were composed of mainly low-achieving students. In addition, Tarık and Altan believed that families' insufficient knowledge about curriculum and students' lack of interest in activities affected their teaching negatively. However, Sinan and Fatih did not mention these factors. We think that students' ideas about learning physics could affect the formation of these beliefs. Students might want to be successful in the university entrance exams which measure only students' cognitive skills and not the skills contained in the THSPC. Because of this, they might want to develop their skills in solving questions in the test books instead of performing hands-on activities in the classroom. In this regard, they could ask

their teachers to teach physics by solving physics problems similar to those asked in the university entrance exam.

In addition, Sinan and Fatih who were in the first year of teaching experience believed that it was difficult for them to teach physics according to the THSPC due to their insufficient pedagogic background. However, Tarık and Altan did not mention this factor. We think that the number of years of teaching experience could affect the formation of this belief. They could believe that they did not have sufficient knowledge about the teaching methods and how to help students attain skill objectives. In this regard, they could think that they did not have sufficient preparation in pedagogy. In addition, their anxiety about teaching because they were in the first of year of their teaching profession could affect the formation of this belief. Another difference between teachers' beliefs was that Sinan and Fatih believed that it was difficult to teach physics due to discipline problems among students in the classroom; however, Tarık and Altan did not mention this. This difference can also be attributed to the types of schools case teachers worked in. The schools of Sinan and Fatih had students with some discipline problems. They indicated that they faced some discipline problems while performing some hands-on activities in the classroom.

This study also showed us that there were some differences between physics teachers' beliefs related to PSS, PTSEO and ICS. Although, participants of this study generally had similar beliefs for each skill area, there were sometimes differences. For example, one of the participants of this study believed that 'being a young teacher' facilitated his teaching physics according to ICS. However, this belief was not mentioned for other skill areas. The teacher thought that the small age difference between him and his students facilitated his communication with students. In this regard, he could believe that being a young teacher facilitated his instruction by considering ICS.

Moreover, according to Ajzen's Theory of Planned Behavior, behavioral, normative and control beliefs of individuals affect their behavior. Although this theory was used only for identifying teachers' beliefs related to teaching physics according to the THSPC in this study, the results showed that beliefs, especially the control beliefs related to teaching physics according to the THSPC affected the implementation of the curriculum in the desired manner. As participants indicated in the interviews and an open-ended questionnaire, they could not teach physics according to the THSPC due to some factors such as inadequacy of laboratory facilities and lack of information and communication skills. This might imply that teachers' control beliefs could be more influential than their behavioral and normative beliefs.

As a conclusion, this study supports the findings of previous studies (e.g., Kindberg, 1999; Roehrig et al., 2007; Saez & Carretore, 2002) which stated that teachers' beliefs might have a significant impact on their implementation of curricula. For example, the data obtained from the classroom observations showed that teachers sometimes did not teach physics according to the THSPC. There was an inconsistency between what teachers did in the classroom and what is required from teachers in the THSPC. For instance, in the classroom, one of the participating teachers had to explain why he taught some topics in detail. According to him, if he did not teach in detail, students would fail in the university entrance exam. We think that the main obstacle in front of the implementation of the curricula is the university entrance exam because it only measures students' cognitive skills. Teachers may overcome the other problems such as limited lesson hours and inadequacy of physical and technological facilities more easily than the problem of the university entrance exam. The effective implementation of the THSPC seemed impossible according to the participating teachers if no changes were made to the content of the university entrance exam. Therefore, the university entrance exams should be prepared by considering not only for measuring knowledge objectives but also for measuring skill objectives. In fact, more questions related to skill objectives should be asked to students in these exams because the THSPC gives importance to the attainment of quite a number of skills. In addition, either lesson hours should be increased or some content should be removed to fit the existing time allocation

available for physic. Physical and technological facilities of schools should also be improved for more effective implementation of the THSPC.

Some of the beliefs of participants may also affect teaching physics according to the THSPC negatively. For example, they believed that it was difficult to teach physics by considering PSS due to inadequacy of laboratory facilities and ICS due to lack of information and communication technologies. However, teachers can help students attain some of PSS without using laboratory and some of ICS without using information and communication technologies. Therefore, in-service teacher training programmes should be prepared to change teachers' beliefs that affect their teaching physics according to the THSPC negatively and research studies on how to change teachers' beliefs related to teaching physics according to the THSPC should be conducted. Some participants also thought that families and school administrations had a serious negative effect on the implementation of the THSPC. Families and school administrations should be informed about the THSPC for its more effective implementation.

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