PHYSICS TEACHERS' BELIEFS RELATED TO TURKISH HIGH SCHOOL PHYSICS CURRICULUM: A MULTIPLE CASE STUDY

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submitted by **SERKAN KAPUCU** in partial fulfillment of the requirements for the degree of **Doctor of Philosophy in Secondary Science and Mathematics Education Department, Middle East Technical University** by,

Prof. Dr. Canan Özgen ________
Dean, Graduate School of **Natural and Applied Sciences**

Prof. Dr. Ömer Geban ________
Head of Department, **Secondary Science and Math. Edu.**

Assoc. Prof. Dr. Ayhan Kürşat Erbaş ________
Supervisor, **Secondary Science and Math. Edu. Dept., METU**

Dr. Ufuk Yıldırım ________
Co-Supervisor, **Secondary Science and Math. Edu. Dept., METU**

Examining Committee Members:

Prof. Dr. Ahmet İlhan Şen ________
Secondary Science and Math. Edu. Dept., Hacettepe University

Assoc. Prof. Dr. Ayhan Kürşat Erbaş ________
Secondary Science and Math. Edu. Dept., METU

Prof. Dr. Jale Çakıroğlu ________
Elementary Edu. Dept., METU

Assoc. Prof. Dr. Ali Eryılmaz ________
Secondary Science and Math. Edu. Dept., METU

Assist. Prof. Dr. Ömer Faruk Özdemir ________
Secondary Science and Math. Edu. Dept., METU

Date: 20.06.2012

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name: Serkan Kapucu

Signature:

ABSTRACT

PHYSICS TEACHERS' BELIEFS RELATED TO TURKISH HIGH SCHOOL PHYSICS CURRICULUM: A MULTIPLE CASE STUDY

Kapucu, Serkan
Ph.D., Department of Secondary Science and Mathematics Education
Supervisor: Assoc. Prof. Dr. Ayhan Kürşat Erbaş
Co-supervisor: Dr. Ufuk Yıldırım

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The purpose of this study was to investigate four in-service physics teachers' beliefs related to Turkish High School Physics Curriculum (THSPC) and to what extent these beliefs are reflected in their instructional practices. Data were collected through interviews, classroom observations and an open-ended questionnaire.

Teachers' responses to interview questions showed that they 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 have a permanent knowledge. Besides, teachers believe that they can teach physics according to the THSPC generally by giving examples from daily life and creating a discussion environment. The data obtained from classroom observations showed that the beliefs of teachers about how to teach physics according to the THSPC were reflected in their instructional practices.

Teachers' responses to open-ended questionnaire showed that teachers believed the necessity of attainment of majority of the skill objectives in the THSPC by students. However, they do not consider that students can attain many of the problem solving and information and communication skills. The data obtained from classroom observations showed that they seldom attempted to help students attain them or they never attempted.

The data gathered from interviews and an open questionnaire showed that there were some factors that influence teachers' instructional practices according to the THSPC. For example, they believe that students' interest in physics lessons and teacher's opportunity to give more examples about daily life made their teaching physics according to the THSPC easy. However, they believe that university entrance exam, inadequacy of laboratory environment and lesson hours, students' low economic status and lack of information and communication technologies affected their teaching physics according to the THSPC negatively.

Key words: Physics Education, Turkish High School Physics Curriculum, Teacher Beliefs.

ÖZ

FİZİK ÖĞRETMENLERİNİN ORTAÖĞRETİM FİZİK DERSİ ÖĞRETİM PROGRAMINA İLİŞKİN İNANÇLARI: ÇOKLU DURUM ÇALIŞMASI

Kapucu, Serkan
Doktora, Ortaöğretim Fen ve Matematik Alanları Eğitimi Bölümü
Tez Danışmanı: Doç. Dr. Ayhan Kürşat Erbaş
Ortak Tez Danışmanı: Dr. Ufuk Yıldırım

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Bu çalışmanın amacı, dört fizik öğretmenin Ortaöğretim Fizik Dersi Öğretim Programına ilişkin inançlarını ve bu inançların sınıf içi uygulamalara ne derecede yansıdığını araştırmaktı. Veriler; mülakatlar, sınıf gözlemleri ve açık uçlu anket ile toplanmıştır.

Öğretmenlerin mülakat sorularına vermiş oldukları cevaplar, fiziği Ortaöğretim Fizik Dersi Öğretim Programına göre öğretmenin; öğrencilerin becerilerini kullanmalarına, fizik derslerine ilgili olmalarına, fiziği günlük yaşamla ilişkilendirmelerine ve kalıcı bilgiye sahip olmalarına yardımcı olduğuna inandıklarını göstermiştir. Ayrıca, öğretmenler günlük yaşantıdan örnekler vererek ve tartışma ortamı oluşturarak fiziği Ortaöğretim Fizik Dersi Öğretim Programına göre öğretebileceklerine inanmaktadırlar. Sınıf gözlemlerinden elde edilen veriler, öğretmenlerin Ortaöğretim Fizik Dersi Öğretim Programına göre fizik dersini nasıl öğretecekleri hakkındaki inançlarının öğretimlerine yansıdığını göstermiştir.

Öğretmenlerin açık uçlu ankete vermiş olduğu cevaplar, öğretmenlerin beceri kazanımlarının büyük bir kısmının öğrenciler tarafından kazanılması gerektiğine inandıklarını göstermiştir. Ancak öğretmenler öğrencilerin problem çözme ile bilişim ve iletişim becerilerinin çoğunu kazanamayacaklarını düşünmektedirler. Sınıf gözlemlerinden elde edilen veriler, öğretmenlerin öğrencilere bu becerileri kazandırmak için sınıf ortamında nadiren çaba harcadıklarını ya da hiç çaba harcamadıklarını göstermiştir.

Mülakatlar ve açık uçlu anketten toplanan veriler, bazı unsurların Orta Öğretim Fizik Dersi Programına göre fizik öğretmeyi etkilediğini göstermiştir. Örneğin, öğretmenler öğrencilerin fizik derslerine olan ilgisinin ve öğretmenlerin günlük yaşantıdan bol örnek verilebilmesinin, Orta Öğretim Fizik Dersi Programına göre fizik öğretmeyi kolaylaştırdığına inanmaktadırlar. Ancak, öğretmenler üniversite sınavının, laboratuvar ortamı ve ders saati yetersizliğinin, öğrencilerin düşük ekonomik durumlarının ve bilişim ve iletişim teknolojilerinin eksikliğinin, Orta Öğretim Fizik Dersi Programına göre fizik öğretmeyi olumsuz yönde etkilediğine inanmaktadırlar.

Anahtar kelimeler: Fizik Eğitimi, Ortaöğretim Fizik Dersi Öğretim Programı, Öğretmen İnançları

To my wife and parents

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CHAPTER 1

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 without thinking much about students' active participation in learning (McDermott, 1993). Students were considered as passive recipients of knowledge, source of which is their teachers or textbooks; however, contemporary view in education focuses 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). Traditional instructions, therefore, are deficient in terms of overcoming certain conceptual difficulties and making connections between concepts and the real world. In fact, students learn best when they use their knowledge in different situations and when they are intellectually active (Hake, 1998; McDermott, 1991, 1993).

Due to these disadvantages of traditional education, educators left the traditional learning approaches in the curricula (Parker, 2001). Science curriculum developers begin to emphasize process skills such as making observations and measurements, articulating hypothesis, and designing and carrying out experiments (Duschl, Schweingruber, & Shouse, 2007). In this regard, science curriculum developers around the world now incorporate these views into the curricula, particularly for science.

Similarly, curriculum developers in Turkey prepared a new physics curriculum by considering the needs of the society, the educational developments in the world and rapid changes in science and technology (Ministry of National

Education [MoNE], 2007). In addition, Turkish students' low scores in the international exams (TIMMS, PISA) fostered Ministry of National Education in Turkey to change curricula. Ministry of National Education thought that new curricula would enable students to leave memorizing knowledge (Güven & İşcan, 2006). Due to such reasons, new Grade 9 Turkish High School Physics Curriculum (THSPC) was put into practice in 2008-2009 education-year in Turkey. In the following years, consecutively, new curricula for the 10^{th}, 11^{th} and 12^{th} grades were also put into practice.

According to the THSPC, advances and changes in science and technology have changed how a qualified person should be defined. Qualified person is defined as a person who is creative and productive, and learns learning and how to reach knowledge in addition to having information and communication skills and some other basic skills such as using technology effectively (MoNE, 2007). According to the THSPC, developing skills are as important as acquiring knowledge. Therefore, 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 environment, and physics and technology in their daily life. Having positive attitude and values toward physics, world, life-long learning, themselves, and others is another important emphasis in the THSPC (MoNE, 2007).

None of the curricula which was prepared in Turkey until 2007 involved neither knowledge nor skill objectives stated explicitly, except the Grade 9 Physics Curriculum of 1992 (MoNE, 2007). However, current physics curricula clearly defined some skills and objectives for students to attain. The THSPC is mainly composed of two learning outcomes: knowledge and skill objectives. These objectives are integrated with each other. According to classification of the THSPC, skill objectives consist of four areas: problem solving skills (PSS), information and communication skills (ICS), physics-technology-society-environment objectives (PTSEO), and attitude and values (AV). It is expected from teachers to organize their teaching by considering these objectives and skills (MoNE, 2007). Due to these important aspects of the THSPC, I think it as one of the important guide for physics teachers to help students learn physics and attain those skills.

Moreover, the THSPC argues and values the real-life context-based approach. Students are required to relate their learning with their life (MoNE, 2007). For example, according to Whitelegg and Parry (1999), students need real life context sources in classroom, if a meaningful classroom discussion is desired. In addition, as advantage of real-life context-based approach, students can observe and experience their understanding of science and make inferences from their experiences and observations about the world (Hollenbeck, 2006). Linking learning with its applications in the real life can also motivate students to learn (Whitelegg & Parry, 1999). Teachers are required in the THSPC to help students relate their daily life to their learning by starting the lessons with daily life examples and linking them with the learning activities (MoNE, 2007).

It is also expressed in the THSPC that teachers are required to help students achieve meaningful and permanent learning. Making students mentally and physically active, giving students immediate feedback and using approaches which lead to conceptual change are expectations of the THSPC from teachers. Additionally, in the THSPC, it is explicitly stated that attention should be given to students' prior knowledge, and use of various teaching methods or strategies. It also stresses spiral structure in learning of physics topics (MoNE, 2007).

Finally, the THSPC gives importance to use of various measurement and assessment techniques. It suggests teachers to use authentic measurement in the classroom for diagnostic, grouping and formative purposes, as well as for assigning grades. Additionally, the THSPC demands teachers having sufficient pedagogical knowledge and pedagogical content knowledge to reach its aims (MoNE, 2007).

As a conclusion, some of the expected roles for teachers indicated in the THSPC can be summarized as follows;

- help students attain the problem solving skills
- help students attain the physics-technology-society-environment objectives
- help students attain the information and communication skills
- help students develop positive attitude and values

- train productive citizens
- give students key concepts to learn how to reach knowledge
- use various teaching methods or strategies
- teach physics topics by considering spiral structure
- give importance to students' readiness level and prior knowledge in teaching
- try to remedy students' misconceptions
- emphasize meaningful learning
- base their instruction on real-life context
- make students mentally and physically active
- give students feedback
- use approaches leading to conceptual change
- use assessment techniques to measure readiness levels of students, control students learning and diagnose learning difficulties
- use assessment techniques not only for giving grades (summative) but also for grouping, diagnosis and giving feedback (placement, diagnostic and formative) (MoNE, 2007).

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 affects the implementation of curricula in desired manner (Anderson, 1996; Briscoe, 1991; Cheung & Wong, 2002; Grossman & Stodolsky, 1995; Kelly, 2009; Keys & Bryan, 2001). According to National Research Council (NRC, 1996) in the USA, teachers' beliefs and decisions can affect the implementation of curriculum reforms in science education. Curriculum reforms cannot reach their aims due to teachers' beliefs and decisions (Kelly, 2009). For example, teachers can have beliefs about instructional strategies for delivering curriculum, the general classroom environment, organization and planning of curriculum and their roles and responsibilities (Levin & He, 2008) which might not necessarily be in accordance with the general goals of curriculum. Teachers take an active role in the decision making and planning of science curriculum innovation, and determining the goals of their science instruction (Keys & Bryan, 2001). Therefore, curriculum reforms can be shaped and changed by teachers' beliefs (Cheung & Wong, 2002; 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 intensions. Therefore, understanding teachers' beliefs is important before evaluating their thought process, and instructional practices (Zheng, 2009). For example, teachers who have constructivist perspective believe in the involvement of students in learning, group works, and student negotiation (Beck, Czerniak, & Lumpe, 2000). In contrast, teachers who have traditional perspectives do not encourage group works and they believe in transmission of knowledge from teachers to students (Roehrig, Kruse, & Kern, 2007). Additionally, although it is expected from teachers to leave their traditional instruction, many teachers believe that science is best taught by transferring knowledge from teacher to students (BouJaoude, 2000; Porlán & Martín, 2004; Tsai, 2002).

As I discussed before, the THSPC gives importance to teaching physics by considering real-life context-based approach (MoNE, 2007). However, implementing lessons by considering real-life contexts can also be affected by teachers' beliefs (Drake & Sherin, 2006; Lumpe, Haney, & Czerniak, 1998). The success of a course can be affected negatively by teachers' lack of enthusiasm to implement real-life context-based approach in classrooms due to having negative views and beliefs about the effectiveness of real-life context-based approach (Whitelegg & Parry, 1999).

In addition, one of the aims of the THSPC is to develop students' problem solving skills. Helping students attain problem solving skills is needed to think creatively, critically and scientifically (MoNE, 2007). Attainment of problem solving skills has a positive influence on students' science achievement (Ünsal & Moğol, 2006; Wallace & Kang, 2004) and, conducting lessons focusing on problem solving helps students involve in science learning and scientific processes actively (Luft, 1999). However, teachers' beliefs about problem solving can affect their instructional practice (Luft, 1999).

The THSPC also stresses physics-technology, physics-society and physics-environment connections and encourages students to analyze these connections (MoNE, 2007). According to NRC (1996) in the USA, science-technology and science-environment connections are critical issues in science learning. Science-technology-society (STS) practices in teaching give students more opportunities to see daily-life examples (Brusics, 1992; Carroll, 1999; Lumpe et al., 1998). Students within such practices are more active in learning and they have more opportunities to develop their decision making and process skills (Lumpe et al., 1998; Tsai, 2002). STS issues such as understanding positive or negative effects of technology and science on society seriously affect students' involvement and interest in science (Kumar & Atschuld, 2000). However, teachers play a critical role in shaping the science, technology and society issues in the classroom (Lumpe et al., 1998). For example, teachers can believe that lack of instructional materials and inadequacy of time can affect the teaching of science and technology issues (Lumpe et al., 1998).

Additionally, the THSPC advocates the attainment of information and communication skills, for these help students reach knowledge (MoNE, 2007). Using information and communication technologies (ICT) in science learning gives students more opportunities to see daily-life examples, share their knowledge with their peers and get more and immediate feedback from their teachers (Yoon, Ho, & Hedberg, 2005). Students become more active and improve their critical thinking skills in ICT instruction (Jimoyiannis & Kommis, 2007). Although many teachers believe the effectiveness of ICT in teaching on students' achievement, they do not know how to use ICT and integrate ICT with science teaching (Siorenta & Jimoyiannis, 2008). Teachers' beliefs and skill levels remain an obstacle for them to make effective use of information and communication technologies (Jimoyiannis & Komis, 2007).

Although anyone would expect teachers to teach physics according to the THSPC, physics teachers' beliefs, in light of above discussions, can affect their instructional practice, either positively or negatively. For example, some of the factors that teachers believed include professional development activities for teachers, hands-on science kits, class hours and supports from administrators (Lumpe, Haney, & Czerniak, 2000).

Physics curriculum developers in Turkey argue that they prepared a curriculum by considering needs and realities of Turkey. They took into account the views of teachers, students, families, school administrations and Ministry of National Education before the preparation of the THSPC (MoNE, 2007). However, how much attention was given to teachers' beliefs is still questionable even after the preparation of the THSPC. 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 THSPC can have invaluable contribution to the revision and development of the curriculum.

1.1 Problem Statement

As evident from the review of literature, teachers' beliefs are effective on implementation of curriculum. Coupled with the new introduction of a curriculum in Turkey, identifying physics teachers' beliefs, particularly about the newly introduced aspects of the curriculum, is deemed necessary for the future of physics education in Turkey.

1.2 Purpose of the Study

The purpose of this study is to identify four in-service physics teachers' beliefs related to the THSPC and investigate to what extent these beliefs are reflected in their instructional practices.

1.3 Research Questions

The research questions that guided this study are as follows;

1. What do physics teachers believe to be strengths of teaching physics according to the THSPC?

   1.1. What do physics teachers believe to be strengths of teaching physics by considering real-life context-based approach?
   1.2. What do physics teachers believe to be strengths of teaching physics by integrating knowledge and skill objectives?
   1.3. What do physics teachers believe to be strengths of teaching physics by considering problem solving skills?
   1.4. What do physics teachers believe to be strengths of teaching physics by considering physics-technology-society-environment objectives?
   1.5. What do physics teachers believe to be strengths of teaching physics by considering information and communication skills?
2. What do physics teachers believe to be weaknesses of the THSPC?
3. What beliefs do physics teachers have about how to teach physics according to the THSPC?
   3.1. What beliefs do physics teachers have about how to teach physics by considering real-life context-based approach?
   3.2. What beliefs do physics teachers have about how to teach physics by considering problem solving skills?
   3.3. What beliefs do physics teachers have about how to teach physics by considering physics-technology-society-environment objectives?
   3.4. What beliefs do physics teachers have about how to teach physics by considering information and communication skills?
4. To what extent are physics teachers' beliefs about how to teach physics according to the THSPC reflected in their instructional practices?
5. What beliefs do physics teachers have about the attainment of skill objectives in the THSPC?
   5.1. What beliefs do physics teachers have about the attainment of problem solving skills in the THSPC?
   5.2. What beliefs do physics teachers have about the attainment of physics-technology-society-environment objectives in the THSPC?

5.3. What beliefs do physics teachers have about the attainment of information and communication skills in the THSPC?

6. To what extent are physics teachers' beliefs about the attainment of skill objectives in the THSPC reflected in their instructional practices?
    6.1. To what extent are physics teachers' beliefs about the attainment of problem solving skills in the THSPC reflected in their instructional practices?
    6.2. To what extent are physics teachers' beliefs about the attainment of physics-technology-society-environment objectives in the THSPC reflected in their instructional practices?
    6.3. To what extent are physics teachers' beliefs about the attainment of information and communication skills in the THSPC reflected in their instructional practices?
7. What are the factors that physics teachers believe to be affecting their instructional practices in teaching physics according to the THSPC?
    7.1. What are the factors that physics teachers believe to affect their teaching physics by using various teaching methods?
    7.2. What are the factors that physics teachers believe to affect their teaching physics by considering spiral structure?
    7.3. What are the factors that physics teachers believe to affect their teaching physics by considering real-life context-based approach?
    7.4. What are the factors that physics teachers believe to affect their teaching physics by integrating knowledge and skill objectives?
    7.5. What are the factors that physics teachers believe to affect their teaching physics by considering problem solving skills?
    7.6. What are the factors that physics teachers believe to affect their teaching physics by considering physics-technology-society-environment objectives?
    7.7. What are the factors that physics teachers believe to affect their teaching physics by considering information and communication skills?

1.4 Definition of the Terms

a) Teachers' beliefs: Propositions and ideas which are accepted as true in teachers' mind (Borg, 2001; Green, 1971, as cited in McGinnis et al., 2002; Zheng, 2009).

b) Problem solving skills: Skills related to problem solving steps such as defining problem, constructing hypothesis, performing an experiment, collecting data, and interpreting the results of the experiment (MoNE, 2007).

c) Physics-technology-society-environment objectives: Objectives related to making connections between physics, technology, society and environment while explaining and exploring physical events (MoNE, 2007).

d) Information and communication skills: Skills related to how to explore, find, and choose knowledge, developing and presenting knowledge, developing communication and using technology effectively (MoNE, 2007).

1.5 Significance of the Study

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). Due to the recent introduction of the THSPC, research studies related to the new curriculum are limited. Therefore, there is little, if any, knowledge about whether physics teachers espouse the THSPC, or to what extent they successfully implement it. As discussed previously, teachers' beliefs about the curriculum are important for the effective implementation of curriculum in the classroom. 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 the THSPC have been conducted. This study aims to investigate teachers' beliefs related to the THSPC, thereby closing a significant gap in the literature.

As important as it is to investigate whether physics teachers espouse the THSPC or they successfully implement it, it is equally crucial to reveal the factors that they believe to affect the successful implementation of it. How these factors affect the implementation of the THSPC has not been investigated in detail so far. Therefore, proposing solutions, regarding the elimination of the factors that physics teachers believe to affect their teaching physics according to the THSPC negatively, is required to improve physics instruction.

In addition, there were some studies related to teachers' beliefs about STS implementation (Brusic, 1992; Lumpe et al., 1998; Mansour, 2009, 2010; Rubba, 1991; Rye & Dana, 1997; Tsai, 2001), teachers' beliefs about ICT (Jimoyiannis & Komis, 2007; Pedersen & Liu, 2003; Siorenta & Jimoyiannis, 2008; Yerrick & Hoving, 1999; Zacharia, 2003) and teachers' beliefs about problem solving (Luft, 1999) in the literature. However, these studies do not allow us to compare teachers' beliefs about different skills. For example, teachers might not believe in helping students develop problem solving skills; however, they might believe in development of information and communication skills. Therefore, there is a need to investigate teachers' beliefs about teaching by considering specific skills and objectives.

Furthermore, finding physics teachers' beliefs related to the THSPC can help curriculum developers in revising the curriculum in the following years. Finding these beliefs can lead to profound changes in the activities or suggested instructional strategies mentioned in the THSPC.

Additionally, some teaching beliefs of teachers can affect the implementation of the THSPC negatively. They can teach according to what they believed instead of teaching according to the THSPC. This can cause students to attain small number of skills indicated in the THSPC. Therefore, in-service teacher training programmes can be organized to change or minimize such beliefs affecting the implementation of the THSPC in desired manner negatively.

CHAPTER 2

THEORETICAL BACKGROUND

Pajares (1992) stated that the term 'belief' was confused with other terms such as "attitudes, values, judgments, axioms, opinions, ideology, perceptions, conceptions, conceptual systems, preconceptions, dispositions, implicit theories, explicit theories, personal theories, internal mental processes, action strategies, rules of practice, practical principles, perspectives, repertories of understanding, and social strategy" (p. 309). Even though the list is long, I will, in this chapter, concentrate only on four most confused terms for the purpose of understanding better the term 'belief'. The other three are 'attitude;' 'knowledge;' and 'perception'. Understanding these terms is of vital importance for the accurate analyses of the data. Initially, I will start with a discussion of the term 'belief' and go on to discuss the other terms, first by giving a definition, and then describing how they differ from the term 'belief'.

2.1 Belief

There are some researchers (e.g., Fishbein & Ajzen, 1975; Nespor, 1987; Pajares, 1992) emphasizing the influence of belief on behavior. However, there is no consensus among researchers on the definition of belief (Pajares, 1992).

For example, Nisbett and Ross (1980, as cited in Pajares, 1992) defined belief as "reasonably explicit 'propositions' about the characteristics of objects and object classes" (p. 313). Similarly, Rokeach (1968, as cited in Pajares, 1992) stated that belief is "any simple proposition, conscious or unconscious, inferred from what a person says or does, capable of being preceded by the phrase, 'I believe that …'" (p. 314). These two researchers defined belief as propositions. Differently, Fishbein and Ajzen (1975) defined belief as a "person's subjective probability judgments concerning some discriminable aspects of his world; they deal with the person's understanding of himself and his environment" (p. 131). They emphasized judgment in their definition. Similar to definition of Fishbein and Ajzen (1975), Pedersen and Liu (2001) emphasized judgment in their definition. They defined belief as "mental constructions based on evaluation and judgment that are used to interpret experiences and guide behavior" (2003, p. 61).

Like Nisbett and Ross (1980, as cited in Pajares, 1992) and Rokeach (1968, as cited in Pajares, 1992), some researchers (Borphy & Everstson, 1981, as cited in Pedersen & Totten, 2001; Borg, 2001; Green, 1971, as cited in McGinnis et al., 2002; Zheng, 2009) emphasized proposition in defining belief. For example, Borg (2001) defined belief as "a proposition which may be consciously or unconsciously held, is evaluative in that it is accepted as true by the individual, and is therefore imbued with emotive commitment; further, it serves as a guide to thought and behavior" (p. 186). Green (1971, as cited in McGinnis et al., 2002) indicated belief as psychological proposition that the individual accepted as true (p. 717). Zheng (2009) described belief as "psychologically held understandings, premises, or propositions felt to be true" (p. 74).

Social construction and enculturation cause belief formation. For example, individuals can form some beliefs coincidentally by participating, observing and imitating some cultural elements. In addition, chance factor, experience of individuals and succession of events affect formation of beliefs (Pajares, 1992).

According to Fishbein and Ajzen (1975), people construct beliefs in their mind about objects, actions and events with their experiences. For example, they on the subject of belief formation explained that people constructed beliefs in their minds toward objects in three ways: 'direct observation;' 'information received from outside;' and 'various inference processes'. According to Fishbein and Ajzen (1975), people can form some beliefs by observing something. They stated that direct observation (e.g., seeing or feeling that a table is round) resulted in descriptive beliefs about the object. However, people can have some beliefs without observing something. For example, considering obese people as jolly or considering a person who is crying as sad result in inferential beliefs. Moreover, according to Fishbein and Ajzen (1975), people can sometimes form their beliefs without observation and inferring. They can accept some information without inquiring. For example, an individual can believe in what they read in the magazine or newspaper. Fishbein and Ajzen (1975) named these types of beliefs as informational beliefs.

According to Ajzen (1988), individuals can have many beliefs about objects; however, they are interested in only a small number of them. He named these beliefs as *salient* beliefs. Ajzen (1988) defined salient beliefs as “immediate determinants of a person’s attitude” (p. 33). According to him, these beliefs determine attitudes of person and affect individuals’ intention to engage in behavior. The term ‘salience’ supplanted the term ‘accessibility in memory’ in contemporary social psychology. Much cognitive effort is not needed to activate these accessible beliefs (Fishbein & Ajzen, 2010).

Ford (1992) proposed two types of personal agency beliefs: *capability* and *context* beliefs. While capability beliefs refer to “evaluations of whether one has the personal skill needed to function effectively”, context beliefs refer to “evaluations of whether one has the responsive environment needed to support effective functioning” (pp. 123-124). Ford (1992) gave an example to clarify the distinction between capability and context belief. If a person feels incapable of picking up a snake, this results in capability beliefs, and if a person expects that picking up a snake results in fatal bite, this results in context belief. These two, capability and context beliefs, form personal agency belief system. This system is necessary for individuals to reach their desired goals and plays a crucial role in reaching challenging but attainable goals.

Finally, Pajares’s synthesis of characteristics of beliefs is important to be able to differentiate belief from the other terms. Main points can be summarized as follows;

- Beliefs are formed early and it is not easy to change them.
- Individuals have a belief system. This system is necessary for people to understand and define their world.
- Thinking styles of people may be precursors to and creators of beliefs.
- Some beliefs are more incontrovertible than others.

- Beliefs have serious influence on individuals' behavior, perception and organization of knowledge and information in individuals' mind (Pajares, 1992).

2.2 Belief and Attitude

Fishbein and Ajzen (1975) differentiated attitude from belief by stating that "whereas attitude refers to a person's favorable or unfavorable evaluation of an object, beliefs represent the information he has about the object" (p. 12). Beliefs are prerequisite for attitude formation. The sum of the beliefs compose attitude (Fishbein & Ajzen, 1975). To be able to compare and contrast belief with attitude, it is necessary to lay down some definitions of attitude. According to Simpson, Koballa, Oliver, and Crawley (1994) attitude is "a predisposition to respond positively or negatively to things, people, places, events or ideas" (p. 212). Ernest's conceptualization of attitude includes liking, enjoyment in, and enthusiasm for something (1989, p. 25).

According to Pratkanias, Breckler, and Greenwald (1989), "attitudes are enduring systems of positive and negative evaluations, emotional feelings and pro or con action tendencies with respect to social objects" (p. 6). Similar to Pratkanias et al. (1989), Petty and Cacioppo (1981) also emphasized feelings in their definition. They defined attitude as "a general and enduring positive and negative feeling about some person, object, or issue" (p. 7).

Simpson et al. (1994) also compared four terms attitude, value, belief and motivation. According to them, more emphasis is given to cognitive acceptance or rejection when the term 'belief' is considered. While beliefs include general acceptance or rejection of basic ideas (Simpson et al., 1994), attitude includes positive and negative feelings (Petty & Cacioppo, 1981; Pratkanias et al., 1989), tendencies (Pratkanias et al., 1989; Simpson et al., 1994), and evaluations (Fishbein & Ajzen, 1975; Pratkanias et al., 1989).

2.3 Belief and Knowledge

Pajares (1992) stated that 'knowledge' and 'belief' were the most confused terms. Differentiating these two from each other is important to determine clearly the purposes of education research (Alexander & Dochy, 1995). According to Calderhead (1996, as cited in Ertmer, 2005), “whereas beliefs generally refer to suppositions, commitments, and ideologies, knowledge refers to factual propositions and understandings” (p. 28). Nespor (1987), for the purpose of making a distinction between belief and knowledge, identified four characteristics of beliefs: ‘existential presumption;’ ‘alternativity;’ ‘affective/evaluative loading;’ and ‘episodic structure’.

Existential presumption is unquestionable personal truths. Changing them with persuasion is difficult and they are deeply personal. For example, teachers who believe practice and drilling to be successful in mathematics can emphasize seatwork more in teaching. However, some can believe that maturity is important for students to be successful in mathematics. Therefore, they can emphasize group work by assuming that it is needed to have small maturity difference between students for more effective communication. Changing these beliefs is difficult because they are not under the control of teachers (Nespor, 1987).

The second characteristic of belief which differentiates it from knowledge is ‘alternativity’ according to Nespor (1987). He defined ‘alternativity’ as “conceptualization of ideal situations differing significantly from present realities” (p. 319). For example, according to him, teachers can try to create alternative situations that are parallel to their thoughts. They can leave effective classroom practices and they can behave like what they want to actually do in the past. Teachers can behave according to their ideas so they can reshape their lessons’ goals and tasks. As a consequence, teaching practices can be different from what is requested from teachers. Whereas beliefs influence describing the tasks and goals of the lesson, knowledge system comes on the scene when the goals of the lesson are clearly defined (Nespor, 1987).

Another distinction between belief and knowledge is affective and evaluative aspect of beliefs. Beliefs depend on more evaluative and effective component when compared with knowledge. Feelings and moods are little influenced by knowledge. For example, knowledge about how to play chess does not depend on liking or disliking chess; however, beliefs are influential in the attainment of knowledge about how to play chess. Like in this example, subjective evaluations and feelings of teachers can affect their teaching. For instance, the affective and evaluative characteristics of teachers' beliefs can affect their energy which is expended and their time which is used in the class (Nespor, 1987).

A final characteristic of belief differentiating it from knowledge is episodic structure (Nespor, 1987). Whereas knowledge is primarily stored in semantic memory, beliefs are mainly located in episodic memory. Episodic structure consists of previous experiences, episodes or events. Although the distinction between these two types of memory is not clear enough to differentiate belief from knowledge, it is obvious that beliefs take their power from these previous episodes. For example, a teacher who experienced that students could learn mathematic by practicing can continue to teach according to this assumption. Nespor (1987) stated that "some crucial experience or some particularly influential teacher produces a richly-detailed episodic memory which later serves the student as an inspiration and a template for his or her own teaching practices" (p. 320).

Additionally, Smith and Siegel (2004) identified nine terms to find the difference between the terms 'knowledge' and 'belief'. While knowledge was considered as: 'objective;' 'rational;' 'public;' 'verified;' 'verifiable;' 'certain;' 'static;' 'not a basis for action;' and 'low commitment;', belief was considered as: 'subjective;' 'irrational;' 'personal;' 'unverified;' 'unverifiable;' 'tentative;' 'dynamic/chancing;' 'a basis for action;' and 'high commitment' (Smith & Siegel, 2004).

Smith and Siegel (2004) gave same sample statements to indicate the difference between the terms 'knowledge' and 'belief'. For example, while they considered the statement "the planets travel in elliptical orbits around the sun" as knowledge statement due to its objective aspect, they considered the statement "there should be no private ownership of firearms" as belief statement due to its subjective aspect. They also indicated the statement "the boiling point of water is 100^{o} Celsius" as a knowledge statement due to its verified aspect; however, they indicated the statement "UFOs have landed on Earth and have temporarily taken humans for examination" as a belief statement due to its unverified aspect. I think that these statements clearly show the difference between knowledge and belief. For example, everybody can accept the truth of the sample knowledge statements;

however, somebody can advocate the opposite of the sample belief statements above.

2.4 Belief and Perception

Differentiating the term perception from the term belief is also needed to analyze the data more accurately in this study. Perhaps it is more important to do so considering the fact that these terms are used interchangeably. Perception was defined as "a process which involves recognition and interpretation of stimuli which register our senses" (Rookes & Willson, 2005, p. 1). In addition, Yaman (2010) defined perception as "recognition and understanding of events, objects, and stimuli through the use of senses" (p. 26) in their study. According to these definitions, it is obvious that perception includes recognition by using senses.

In addition, long time is not needed to form perceptions. Perceptions are specific events that appear at specific moments (Smith, 2001). As Pajares (1992) pointed out, long time can be needed to form beliefs and they are affected seriously by previous experiences of individuals.

Nanay (2010) discussed the difference between perception and belief. He claimed that beliefs could have indexical and nonindexical contents. Some beliefs can have indexial content which means that context of the forming of the beliefs influence the correctness of them. For example, believing that Today is Sunday has indexical content. The correctness of this belief depends on when people experience this belief. However, believing that Paris is the capital city of France does not have indexical content. When or where you formed this belief is not important. However, perception has always indexical content. For example, when you see a cat in front of you, you always see it as in front of you. However, somebody can see this same cat on his/her right or left. Although they see the same cat, their contents of perceptual state are different from each other.

Moreover, belief can be different from perception because the content of the beliefs is conceptual. For example, one cannot believe that Paris is the capital city of France if he/she does not know the concept of capital. However, there is no need to know any concepts to perceive a cat. The differentiating characteristic of belief from perception is that beliefs depend on each other. For example, believing that

Paris is the capital city of France depends on believing that Paris is a city. However, this is not true for perception. Perceptions cannot be affected easily by beliefs. For example, because people believe or know the lines are same length in the Müller-Lyer illusion, it is difficult to persuade them to see them as having different length (Nanay, 2010).

Differences between perception and belief and their relationship with each other are still unresolved in the literature. For example, Pajares (1992) indicated that beliefs affected perceptions, Fishbein and Ajzen (2010) defined normative beliefs as perceptions, and Nanay (2010) mentioned that perceptions affected beliefs. I think that all of the ideas are true. What individuals perceive can affect beliefs and what individuals believe can affect their perceptions. Beliefs can be a part of perception or vice versa.

2.5 Identifying Belief

There is no consensus among researchers on how to find and assess teachers' beliefs (Pajares, 1992). Beliefs cannot be easily assessed by empirical investigation. Observations and interviews are the tools to investigate teachers' beliefs (Pajares, 1992). For example, there are two groups of researchers who study the beliefs qualitatively (e.g., Eick & Reed, 2002; Luft, 1999; Simmons et al., 1999), and quantitatively (e.g., Haney, Czerniak, & Lumpe, 1996; Haney, Lumpe, Czerniak, & Egan, 2002) in the literature. However, these two groups of researchers followed similar methodology to identify teachers' beliefs. They used interviews or open-ended questionnaire to identify beliefs.

Researchers in the second group used theory of planned behavior which was proposed by Ajzen in 1985 to explain teachers' behavior. This theory emphasizes that attitude and behavior of individuals are determined by their beliefs. It includes three constructs 'attitude toward behavior;' 'subjective norm;' and 'perceived behavioral control'. These three constructs affect behavioral intention of people. Then 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. They are related to advantages and disadvantages of performing a particular behavior.

Subjective norm is determined by normative beliefs. Normative beliefs are perceptions about a specific behavior. They are related to others such as parents, teachers and principals who motivate or encourage the implementation of behavior.

Perceived behavioral control is affected by control beliefs. Control beliefs include factors that facilitate or impede performance of behavior. They are related to external factors affecting the performance of behavior (Fishbein & Ajzen, 2010). In addition, Ford (1992) argues that environmental factors influence the goals to be reached. The construct 'perceived behavioral control' is the same as the 'context belief' which was proposed by Ford in 1992 (Lumpe et al., 2000). Figure 2.1 illustrates the theory of planned behavior which was proposed by Ajzen in 1985.

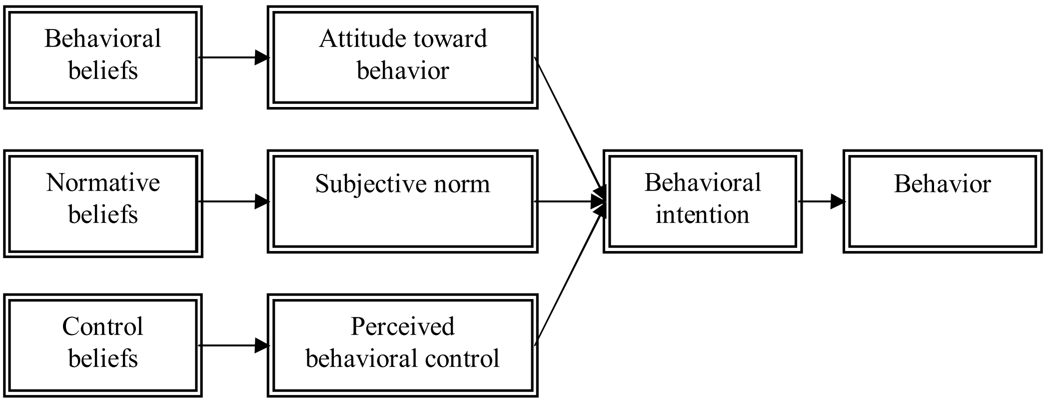

Figure 2.1 Theory of Planned Behavior.

Fishbein and Ajzen (2010) proposed some types of questions to elicit behavioral beliefs of individuals as follows;

1. What do you see as the advantages of _____?
2. What do you see as the disadvantages of _____?

In addition, according to Fishbein and Ajzen (2010), such questions should be asked to elicit control beliefs as follows;

1. Please list any factors or circumstances that would make it easy or enable you to _____?
2. Please list any factors or circumstances that would make it difficult or prevent you from _____?

In the light of the above questions, some researchers (Beck et al., 2000; Haney et al., 1996; Lumpe et al., 1998, 2000) found some beliefs in the literature by using the theory of planned behavior. Like these researchers, I followed the same procedure to identify teachers' beliefs in this study. Some of the beliefs which they found in the literature are as follows;

- Teaching student negotiation in the classroom can help students work in group situations (Beck et al., 2000).
- My implementing the inquiry strand of Ohio Science Model would increase student interest and enjoyment in learning science (Haney et al., 1996).
- Implementing STS in the classroom helps students become decision-making citizens (Lumpe et al., 1998).
- Support from other teachers would enable me to be an effective teacher (Lumpe et al., 2000).
- Hands-on science kits would enable me to be an effective teacher (Lumpe et al., 2000).

I think that all of the statements mentioned above are belief statements. We cannot think these statements as 'knowledge', 'perception' or 'attitude'. For example, the sentence "my implementing the inquiry strand of Ohio Science Model would increase student interest and enjoyment in learning science" (Haney et al., 1996) is not a knowledge statement. Firstly, somebody can advocate the opposite of this sentence easily. However, if it is a knowledge statement, it will be difficult to refuse the correctness of this statement. In addition, as I discussed before, Smith and Siegel (2004) identified some terms to express the difference between knowledge and belief. For example, this sentence is subjective, personal and unverifiable. This sentence includes some of the characteristics of a belief statement.

In addition, I think that this sentence is not an attitude statement. This sentence can be seen as an attitude statement at the first glance. Somebody can think that it includes positive feelings and evaluations. Therefore, they can claim that it is an attitude statement. However, beliefs are affected seriously by experiences of individuals as discussed before. After teachers implemented the inquiry strand of Ohio Science Model, they can reach this judgment. Therefore, I consider it as a belief statement on the assumption that teachers have implemented inquiry strand of Ohio Science Model.

Another important term confused with belief was perception (Pajares, 1992). Maybe, somebody can affirm that the sentence discussed above is a perception statement. However, I think that it is not a perception statement. For example, one teacher can perceive that students' interest and enjoyment in learning science increased when he/she was implementing the inquiry strand of Ohio Science Model. I think that this is a specific event that appeared at specific moment as Smith (2001) indicated. However, after some times passed, this can be belief. Therefore, he/she can reach a judgment that is 'my implementing the inquiry strand of Ohio Science Model would increase student interest and enjoyment in learning science'. I think that perception leads to formation of this belief in this situation.

To sum up, the common view among researchers about the term belief is that it is a physiological construct and it affects actions of people (Nespor, 1987; Pajares, 1992). Changing beliefs is difficult due to effect of cultural factors and previous experiences on formation of them (Pajares, 1992). Beliefs influence actions of people and people interpret or perceive their world according to them (Pajares, 1992). The main distinction between belief and knowledge is the evaluative component of belief (Nespor, 1987). Belief includes rejection and acceptance (Nespor, 1987; Simpson et al., 1994) and it is subjective and personal (Alexander & Dochy, 1995; Smith & Siegel, 2004). Additionally, belief is different from attitude because beliefs play a key role in the formation of attitudes (Fishbein & Ajzen, 1975). Whereas attitudes include positive and negative feelings (Petty & Cacioppo, 1981; Pratkanias et al., 1989; Simpson et al., 1994), beliefs include judgments (Fishbein & Ajzen, 1975; Pedersen & Liu, 2003) and propositions (Borg, 2001; Borphy & Everstson, 1981, as cited in Pedersen & Totten, 2001; Green, 1971, as cited in McGinnis et al., 2002; Nisbett & Ross, 1980, as cited in Pajares, 1992; Rokeach, 1968, as cited in Pajares, 1992; Zheng, 2009). It is obvious that beliefs include propositions and judgments. In this study, I used the definition of belief which many of the researchers had consensus. Belief was defined as propositions and ideas which are accepted as true in teachers' mind (Borg, 2001; Green, 1971, as cited in McGinnis et al., 2002; Zheng, 2009).

CHAPTER 3

LITERATURE REVIEW

In this chapter, firstly, I reviewed the studies on relationship between teachers' beliefs and their instructional practices. Secondly, I discussed the studies on teachers' beliefs about curriculum/education reforms. Thirdly, I presented the studies on teachers' beliefs and perspectives about problem solving, science-technology-society issues and information and communication technologies. Fourthly, I examined the studies which focus on the effect of previous experiences of teachers on their beliefs and instructional practices. Then, I reviewed the studies related to Turkish High School Physics Curricula in Turkey. Finally, I presented a summary of the findings from the literature review.

3.1 Belief and Instructional Practices

There is a strong relationship between teaching practices of teachers and their beliefs (Pajares, 1992). Teachers' beliefs are the one of the most fundamental factors affecting their behavior in the classroom (Nespor, 1987; Pajares, 1992). Nespor (1987) argues that beliefs are independent of knowledge and teachers' beliefs are more influential than their knowledge in determining their actions in the classroom. For example, the study of Czerniak and Lumpe (1996) supported the ideas of theorist Nespor (1987). According to their study, although many teachers had a repertoire about constructivist teaching methods, they did not believe that students learned by constructing their own understanding (Czerniak & Lumpe, 1996).

Many studies were conducted about the relationship between teachers' beliefs and their practices in the classroom. For example, a study which was conducted with 37 Taiwanese science teachers showed that many of the teachers had a traditional or transmission belief about the nature of science, learning science and teaching science (Tsai, 2002). The researcher categorized teachers' beliefs of teaching science as 'traditional;' 'process;' and 'constructivist'. For example, traditional teachers believed in the transmission of knowledge in teaching. Process teachers gave more importance to the scientific processes or problem solving procedures in teaching. Constructivist teachers believed in the construction of knowledge with the assistance of teachers in teaching (Tsai, 2002).

For example, teachers who have traditional beliefs transferred knowledge to students by giving students definite answers, clear definitions and definite explanations in addition to practicing tutorial problems (Tsai, 2002). On the other hand, teachers who have process beliefs valued teaching of scientific method by engaging students in problem solving, discovery and verification process. Finally, teachers who have constructivist beliefs gave importance to cooperative learning and discussion, daily life examples, interaction with students, assisting students, and prior knowledge and misconceptions of students in teaching. In his study, Tsai (2002) found that only six teachers had constructivist beliefs about teaching science. On the other hand, 21 teachers believed that science was best taught by transferring knowledge from teacher to students (Tsai, 2002).

Another categorization of teachers' beliefs about science teaching was made by Porlán and Martín (2004). Researchers studied with 265 in-service and pre-service teachers from different areas to describe their conceptions of teaching and learning science. Teachers' beliefs about science teaching were defined as 'traditional;' 'technical;' and 'alternative' in their study. Teachers who have traditional beliefs believed teaching as a transmission of content like in the study of Tsai (2002). For example, teachers who had traditional beliefs thought that a good textbook must be used in science teaching, students were not responsible for their evaluation, and classroom work was organized around the content. According to technical model, teaching was defined as an organization of content. Teachers stated the objectives before starting the lesson, organized objectives from simple to difficult and evaluated their students according to these objectives in this model. Final model was alternative which was based on pupil participation and encouraged teachers as an investigator. Science teaching was also based on practice and theory in this model. It was found that in-service teachers mainly had a traditional and pre-service teachers had a technical view of teaching.

Olafson and Schraw (2006) investigated the relationship between elementary teachers' beliefs and instructional practices. Like other studies (Porlán & Martín, 2004; Tsai, 2002), Olafson and Schraw (2006) classified teachers' beliefs. Teachers' beliefs were classified under three constructs 'realist;' 'contextualist;' and 'relativist'. For example, conducting hands-on activities and collaborative group works, thinking student choice and considering teacher as a facilitator were parts of the contextualist. Many of the participants indicated their position as a contextualist and they stated that their instructional practices were consistent with this position. Few participants who have relativist view were found in their study. This view supported the idea that students must construct their own learning. None of the participants indicated realist position based on teacher-centered view.

In addition to these classifications for beliefs, Uzuntiryaki, Boz, Kirbulut, and Bektas (2010) classified pre-service teachers' beliefs as 'weak;' 'moderate;' and 'strong' conceptions of constructivism. They investigated eight pre-service chemistry teachers' beliefs about constructivism and effects of these beliefs on their teaching practices. They used interviews, lesson plans and observations as means of data collection. They found that that many of the pre-service teachers had a weak and moderate conception of constructivism. Teachers who have weak conception of constructivism believed the transmission of knowledge, passive learning and transferring facts to students. On the other hand, teachers with strong conception of constructivism believed the active learning, the importance of prior knowledge, sharing ideas, group work, and the importance of interaction among students. Researchers concluded that teachers' practice and their beliefs were not consistent. Although participants indicated constructivist ideas in interviews, their instructional practices were not aligned with constructivism.

Another study about effects of beliefs on teaching was conducted by Hashweh (1996) with 35 science teachers. He compared constructivist teachers' and empristic teachers' teaching strategies to handle alternative conceptions of students. It was found that constructivist teachers were stricter than empristic teachers in evaluating student responses consisting of some alternative conceptions. In addition, they were more successful in identifying students' alternative conceptions. Constructivist teachers had richer information of teaching strategies than empristic teachers. For example, they frequently chose the strategies 'convincing;' 'refutation;' and 'cognitive restructuring;' and used combination of these strategies to handle alternative conceptions of students. In addition, constructivist teachers perceived science learning and teaching as a conceptual change. Therefore, they developed more effective strategies for conceptual change in their lessons.

Haney et al. (1996) examined 800 teachers' salient beliefs to determine their contribution to three constructs 'attitude toward behavior;' 'subjective norm;' and 'perceived behavioral control' in theory of planned behavior which was proposed by Ajzen in 1985. In addition, they tried to determine the factors which affect teachers' intentions to implement the four strands proposed by Ohio Science Model: 'inquiry;' 'knowledge;' 'conditions;' and 'applications'. They found some salient beliefs which affect teachers' implementation of four strands. For example, some of the salient beliefs indicated from participants were related to 'drawing attention of students toward learning science', 'assisting students to learn independently', and 'relating science to students' daily life' contributed to the attitude toward behavior for inquiry strand. They found that all primary constructs 'attitude toward behavior;' 'subjective norm;' and 'perceived behavioral control' contributed significantly to behavioral intention of at least one of four strands. Gender difference was also found for behavioral intention toward inquiry strand. Female teachers had higher scores in behavioral intention than male teachers.

Mellado (1998) investigated four primary and secondary pre-service science teachers' conceptions and beliefs about science teaching and learning. In addition, they explored relationship between these conceptions and beliefs and teachers' instructional practices in the classroom. They found that many of the participants thought that university education little affected their learning about teaching. Their ideas about teaching were mostly shaped by their previous teachers' actions. They tried to behave like their previous teachers who followed a traditional instruction which included asking questions to students and explaining events. In addition, although many of the participants had a view of constructivism toward teaching, inconsistency in their responses to questionnaire and interview was found. For example, participants agreed on many of the items in the questionnaire, however, their actions in the classroom resembled more traditional teaching models contrary to their ideas about teaching.

Simmons et al. (1999) conducted a large-scale research project with beginning math/science teachers to investigate their beliefs, perceptions and classroom performances about their teaching philosophies and content pedagogical skills. Although undergraduate programs' aim was to make teachers adopt a student centered approach in their teaching practices, their practices were not aligned with their beliefs found in interviews similar to findings of Mellado (1998) and Uzuntiryaki et al. (2010). They behaved like their previous teachers and they used teacher centered approaches in the classroom. Researchers found that most first-year teachers adopted beliefs which were consistent with teacher centered teaching about science and mathematic content. Teachers' actions in the classroom were sometimes related to teacher centered or student centered approach. Less than 20% of beginning teachers had student centered or teacher centered beliefs about students' actions. Most teachers' beliefs about students' actions were related to wobbling teaching style which means 50% of beliefs related to student-centered teaching and 50% of beliefs related to teacher-centered teaching style.

BouJaoude (2000) used metaphors and open-ended questions to assess pre-service science teachers' beliefs before the education programme which was designed for changing teachers' beliefs. Researcher found that, before the education programme started, 75% of pre-service teachers had a transmission view of teaching, which includes: 'transmitting knowledge to students', 'thinking students as blank slates' and 'seeing students as passive learners'. Only 1% of pre-service teachers had a constructivist view of teaching before the programme started; however, number of teachers who believe in constructivist view of teaching increased after the programme. Moreover, it was found that biology teachers had more transfer/transmitter conception of teaching than physics and chemistry teachers during the education programme.

The study which was conducted by Beck et al. (2000) showed that teachers' beliefs about constructivism affected their intention to implement constructivism. Constructivist Learning Environment Survey subcomponents: 'personal relevance;' 'scientific uncertainty;' 'critical voice;' 'shared control;' and 'student negotiation' which were developed by Taylor, Fraser and White (1994) was administered to 500 teachers in the Ohio in this study. Researchers used an open-ended questionnaire to elicit teachers' salient beliefs. They found that some beliefs affected teaching of subcomponents of Constructivist Learning Environment Survey. For example, teachers believed that teaching of these subcomponents could motivate students, involve students in learning, increase students' interest, help students understand the limitations and changing aspect of science, give students responsibility, encourage group works, improve communication and improve students' higher order thinking skills.

A case study which was conducted by Levitt (2001) with 16 elementary teachers showed that many of the participants believed that the teaching and learning of science should be student centered. Five patterns supporting teachers' beliefs related to student centered teaching and learning were found: (1) hands-on activities should contribute meaningful learning; (2) students should be active in learning science; (3) science learning should be personally meaningful to students; (4) science education should improve students' positive attitudes toward science; and (5) teachers' role such as facilitator, model and encourager should be changed according to classroom environment. In addition, consistency between educational reforms and teachers' beliefs about teaching and learning were examined in this study. It was found that some of the teachers' beliefs were aligned with educational reforms but there were still some gaps between teachers' beliefs and the principles of reform.

Haney et al. (2002) examined the relationship between six elementary teachers' personal agency beliefs about teaching science and their ability to effectively implement science instruction. Two belief systems which are capability and context, proposed by Ford (1992), which teachers had were studied. They used two instruments which are 'Context Beliefs about Teaching Science' (Lumpe et al., 2000) and 'Science Teacher Efficacy Beliefs' (Riggs & Enochs, 1990) in addition to interview with participants. They found that few teachers had positive capability and context beliefs. These participants tended to design lessons according to incorporated inquiry, described planning, prior knowledge and experiences of students, equality issues, available and appropriate resources, daily life examples and collaborative approaches.

Haney and McArthur (2002) investigated four pre-service science teachers' beliefs about constructivist teaching practices and consistency between their beliefs and instructional practices. They administered teachers to 'Classroom Learning Environment Survey' (Taylor et al., 1994) to choose four of them. They chose four participants who get lowest grade, highest grade and greatest grade from the survey for interview and classroom observation. They interviewed with them to explore their beliefs after the questionnaire was completed and classroom observation. They classified teachers' beliefs as being 'core beliefs;' and 'peripheral beliefs'. Core beliefs also were categorized as 'constructivist core beliefs;' 'conflict core beliefs;' and 'emerging core beliefs'. Core beliefs were defined as beliefs that were both stated and enacted by teachers; whereas peripheral beliefs were defined as beliefs that were stated, but were not enacted. Case teachers' beliefs about the role of teachers were as follows: one of them saw her teaching role as a supplier of the information contrary to constructivists' view; another indicated that the teachers' role in the learning process was that of a motivator and other two pre-service teachers thought themselves as a tour guide and resource person respectively. In addition, core beliefs which the participants have differed from each other. However, all the teachers had the same constructivist core belief, which is student negotiation. All of the teachers gave importance to communication among students (Haney & McArthur, 2002).

McGinnis et al. (2002) designed an instrument to assess pre-service teachers' attitudes and beliefs about science and mathematic. The questionnaire was prepared for Maryland Collaborative for Teacher Preparation (MCTP) programme. They compared MCTP and non-MCTP pre-service teachers' beliefs and attitudes about mathematic and science and observed the change in MCTP teachers' beliefs and attitudes during the programme. They found significant difference between MCTP and non-MCTP pre-service teachers' beliefs and attitudes about mathematic and science. In addition, they found that MCTP pre-service teachers' attitudes and beliefs improved during a 2,5 year period reform based courses; however non-MCTP pre-service teachers' attitudes and beliefs did not improve like MCTP pre-service teachers' attitudes and beliefs.

According to the study of Richmond and Anderson (2003) with three secondary pre-service science teachers, their beliefs affected their instructional practices. For example, one of the pre-service teachers saw scientific knowledge as a set of facts, definitions and algorithms. Therefore, he wanted students to read and recite definitions in his lesson. In addition, researchers found that there is an inconsistency between pre-service teachers' practice in the classroom and their plans about teaching. Researchers suggested that pre-service teachers must use effective teaching strategies which engage students in application and inquiry (Richmond & Anderson, 2003). Similarly, the study which was conducted by Yerrick and Hoving (2003) to investigate pre-service science teachers' beliefs about science teaching and learning showed that pre-service science teachers conducted their lesson by lecturing, asking only a few questions to students and thinking science knowledge as fixed and actual. Moreover, many of the participants did not value inquiry science processes (Yerrick & Hoving, 2003).

Bryan (2003) investigated one pre-service teacher's beliefs about science teaching and learning. Two data sources observations and interviews were used in this study. It was found that the participant of this study believed that science was valuable because of its connectedness to everything. She also believed the necessity of experiments and hands-on activities in science teaching. However, she viewed science concepts as truths and believed that students should know these truths. She considered science as a body of knowledge consisting of facts. Furthermore, classroom management and discipline were important for her. She was a strict teacher and did not give students permission to talk with each other in the classroom. However, she facilitated group works by giving students permission to walk around the seats. As a consequence, researcher found two types of beliefs which correspond to the actions of the participant. Firstly, she believed the teacher-centered talk, transition of content knowledge, teacher directed instructional methods and giving students a few opportunities in activities. On the other hand, she believed the importance of hands-on activities. Therefore, she emphasized the interactions among students, use of open-ended questions and students' explanations in the lessons.

Tuzun (2008) created a 'Beliefs About Teaching (BAT) Scale' to investigate pre-service teachers' beliefs about their abilities to use reform-based and traditional instructional methods, use assessment and classroom management techniques, and teach science content. BAT was administered to 166 pre-service teachers in three different universities in the USA. Researcher found that pre-service teachers' confidence level in their content knowledge, use of different instructional methods, management strategies and assessment strategies was positively related to number of science courses which were taken. Researcher also found an interesting result that pre-service teachers were more confident in teaching biology concepts than teaching physics and chemistry concepts.

Boiadjieva, Tafrova-Grigorova, Hollenbeck, and Kirova (2009) examined Bulgarian secondary science teachers' pedagogical philosophies by using interview techniques. They asked participants to questions about teachers' role in the classroom, how teachers and students learn best, characteristics of good learner and teachers' strengths in teaching. They found that participants believed that students learned by doing best. In addition, they believed that the best learning occurs when students engage in hands-on activities, listen and read. According to participants, students should be self-motivated and good listeners. They also indicated that making students to attain problem solving skills, and using individual and multiple learning styles were crucial in teaching. Researchers concluded that most participants had constructivist and inquiry beliefs according to conducted interviews.

Oskay, Erdem, and Yılmaz (2009) investigated the relationship between pre-service teachers' beliefs about teaching and their pedagogical content knowledge. In addition, they investigated whether there was a difference among pre-service teachers' beliefs in terms of gender. Two questionnaires were administered to 99 pre-service chemistry teachers. They found that many of the participants believed the use of some methods which were based on student participation. Especially, they believed that they were able to implement inquiry method. In addition, they thought that they were able to evaluate students' success by using summative tests and projects. Other important results which were found in this study were as follows: There was insignificant relationship between male and female teachers according to their beliefs about teaching, and there was insignificant correlation between pre-service teachers' beliefs about teaching and their pedagogical content knowledge.

Chai, Teo, and Lee (2010) investigated the relationship among 718 pre-service teachers' learning beliefs, epistemological beliefs and pedagogical beliefs. They tried to model teachers' beliefs by comparing and matching them with each other. Researchers found that pre-service teachers who believed in 'innate ability' also believed in 'traditional teaching'. In addition, pre-service teachers who believed in 'learning effort and process' also believed in 'constructivist teaching'. The constructs 'certainty of knowledge' and 'authority/expert knowledge' did not significantly affect 'constructivist teaching' negatively. They did not also affect significantly 'traditionalist teaching' positively in their study.

As a conclusion, teachers' actions in the classroom are affected by their beliefs about teaching and learning (Nespor, 1987; Pajares, 1992). There is a relationship between their beliefs and their practice in the classroom (Bryan, 2003; Beck et al., 2000; Haney et al., 1996; Haney et al., 2002; Haney & McArthur, 2002; Hashweh, 1996; Mellado, 1998; Olafson & Schraw, 2006; Porlán & Martín, 2004; Richmond & Anderson, 2003; Simmons et al., 1999; Tsai, 2002; Uzuntiryaki et al., 2010; Yerrick & Hoving, 2003). For example, although some teachers believed in transmitting knowledge to students and they practiced their lessons according to their traditional beliefs (BouJaoude, 2000; Porlán & Martín, 2004; Simmons et al., 1999; Tsai, 2002; Yerrick & Hoving, 2003), some teachers believed in student centered learning (Boiadjieva et al., 2009; Levitt, 2001).

Moreover, teachers' beliefs can be classified to understand their instructional practice better (Olafson & Schraw, 2006; Porlán & Martín, 2004; Simmons et al., 1999; Tsai, 2002; Uzuntiryaki et al., 2010). For example, according to Tsai (2002), teaching beliefs could be classified as 'traditional;' 'process;' and 'constructivist'. While constructivist teachers believed in construction of knowledge, use of daily examples in their lessons, and active participation of students, traditional teachers believed in transmission of knowledge (Tsai, 2002).

Moreover, teachers' beliefs about constructivism can influence their instructional practices in the classroom (Beck et al., 2000; Haney & McArthur, 2002; Uzuntiryaki et al., 2010). For example, teachers who have constructivist beliefs were more successful than empristic teachers in overcoming the alternative conception of students (Hashweh, 1996). However, teachers attained more positive beliefs about constructivist teaching after attending education programmes (Boujedeva, 2000).

There can relationship between pre-service teachers' beliefs about teaching and their pedagogical beliefs and knowledge. For example, there was an insignificant correlation between pre-service teachers' beliefs about teaching and their knowledge of pedagogical content knowledge (Oskay et al., 2009). On the other hand, pre-service teachers who believed in 'innate ability' also believed in traditional teaching and pre-service teachers who believed in 'learning effort' and 'process' also believed in constructivist teaching (Chai et al., 2010). There was also positive relationship between pre-service teachers' confidence level in their content knowledge, use of different instructional methods, management strategies and assessment strategies, and number of science courses taken (Tuzun, 2008).

Finally, teachers can have different beliefs about teaching. They sometimes believed in teacher-centered instruction and sometimes believed in student centered instruction (Bryan, 2003; Simmons et al., 1999). In addition, there can be an inconsistency between what teachers believe about teaching and what teachers do in the classroom (Levitt, 2001; Mellado, 1998; Simmons et al., 1999; Uzuntiryaki et al., 2010).

3.2 Belief and Curriculum/Education Reforms

One of the aims of the THSPC is to train individuals who internalize physics with their life (MoNE, 2007). To reach this aim, it encourages teachers to teach physics according to expected roles from teachers in it. However, some teachers cannot use prepared curricula insistently (Kelly, 2009). The practice of curriculum is seriously affected by teachers' decisions and judgments. Therefore, the prepared curriculum does not reach its goals (Kelly, 2009).

According to Ogborn (2002), the success and failure of curriculum innovations depend on teachers' feeling of ownership of curriculum. He also states that teachers should be the developers of the curriculum to reach success in curriculum innovations. However, their beliefs and values can affect the implementation of curriculum (Ogborn, 2002). For example, according to Anderson (1996), one of the barriers for teachers who resist the implementation of constructivist curriculum reform project is their beliefs and values. If teachers believe in theory development in their lessons, they cannot use the suggested curriculum materials such as experimenting. They create their own learning environment and continue to behave according to their beliefs (Ogborn, 2002).

In addition, according to Grossman and Stodolsky (1995), beliefs, norms and practices of teachers affect their implementation of reform efforts. Teachers have big roles in shaping their new goals and implementing their new practices. Changes in educational standards create dilemmas for teachers (Anderson & Helms, 2001). Therefore, there is a need for significant changes in teachers' values and beliefs. They must be encouraged to confront their beliefs and values to better implement the standards of reforms (Anderson & Helms, 2001). I reviewed some studies to understand the interaction between teachers' beliefs and the curriculum or educational reforms better in this section.

Yerrick, Parke, and Nugent (1997) investigated eight teachers' beliefs and their interpretations of two week summer institute which was designed to change their treatment of assessment methods and scientific knowledge. Pre and post interviews were conducted to collect data. It was found that teachers perceived teaching science as a transmission of factual list of abstract ideas. Researchers proposed that participants might think that students understood the scientific concept immediately and completely in this manner. Participants saw their students as recipients of factual knowledge. In addition, many participants delivered knowledge as fixed packages to students. Their decisions of how and what to teach were little affected by students' ideas. Independent leaning was not achieved because their intended curriculum did not coincide with students' interests. After the two week programme, participants began to emphasize student dialog more. Students became more active in selection of topic and construction of classroom activities. Student centered questions were more used and participants were aware of importance of using inquiry.

Kindberg (1999) studied with one science and one language art teacher to explore whether curriculum theory and instructional practices of teachers were in accordance. Semi structured interviews were conducted with these two teachers. One of the questions used in the interview was about teachers' beliefs on student learning. The science teacher believed that modifying the lesson to address individual needs and using hands on activities were necessary in learning. In addition, the participant believed that integrating the curriculum with daily-life of students was an important issue. After the observation of teachers, researcher found that the science teacher's practice was consistent with his beliefs. The participant talked about the examples in daily life, gave importance to group works and encouraged students to use their previous learning in the classroom.

Another study which was related to relationship between curriculum and teachers' instructional practices was conducted by Saez and Carretore (2002). Teachers' role became 'facilitators' of learning after the curriculum changes in Spain. Teachers tried to find different ways for developing lesson plans and making curriculum adaptations. However, contrary to findings of Kindberg (1999), researchers found that teachers did not follow the expectations of the curriculum. Teachers believed that teaching 'integrated science' to students seemed impossible because of not having enough knowledge about other disciplines. Another important thing to cause teachers to leave the expectations of curriculum was that they thought themselves as physicists, biologists, and chemists instead of thinking their role as a 'teacher of something'. In addition, researchers thought that learning theories teachers had and teaching strategies they employed were not well aligned with each other. There was an inconsistency between what teachers planned and what they practiced. Although teachers were open to innovations in the curriculum, their concern was difficulty of changing their teaching practices in the class.

Osborne, Duschl, and Fairbrother (2002) investigated 20 teachers' implementation about new science curriculum and determined teachers' difficulties about curriculum implementation. After the interviews and classroom observations, researchers found that teachers did not really understand the different nature of the course which was designed by considering expectations of curriculum. For example, one of the participants was not used to teaching with discussion; therefore, the participant interrupted students' speech too often. In addition, one of the participants believed that note taking was important in lessons and spent much of the time having students to take note.

Drake and Sherin (2006) investigated two mathematic teachers' implementation of reform based curriculum (Children's Math Worlds) as well as their adaptation to curriculum. Implementing reform based curriculum changed teachers' teaching style and their views about teaching and learning. Researchers examined teachers' narratives and beliefs to understand their implementation of curriculum. Researchers found that teachers' teaching styles were closely related to their previous experiences and their beliefs in their identities affected their responses to curriculum efforts. In addition, teachers' efficacy level when they adapt the curriculum was affected by their conceptions and interpretations about previous experiences in adulthood years. Teachers' learning from their family members also had an affect on their adaptations to curriculum.

Roehrig et al. (2007) investigated the effect of 27 high school chemistry teachers' beliefs and knowledge on the implementation of new high school inquiry-based chemistry curriculum. Data were collected both qualitatively and quantitatively. Teachers Beliefs Interview (TBI) which was designed by Luft, Roehrig, Brooks, and Austin (2003) was used to understand how teachers view teaching and students' learning and which beliefs affect the curriculum implementation. Like other researchers (Olafson & Schraw, 2006; Porlán & Martín, 2004; Tsai, 2002; Uzuntiryaki et al., 2010), Roehrig et al. (2007) classified teachers according to their beliefs. Teachers were classified as 'traditional;' 'mechanistic;' and 'inquiry'. Traditional teachers did not use engagement activities, did not give students chance to discuss their findings after activities, used individual worksheet activities instead of group exploration activities and transmitted information to students. Second group teachers who were mechanistic asked students little questions, ignored discussions after activities and did not use any cooperative learning activities. Inquiry teachers' lessons had all the components of proposed curriculum. Effective questioning skills, consistent cooperative learning activities, and discussion after activities were observed in inquiry teachers' lessons. Researchers found that teachers' beliefs seriously affected curriculum implementation.

Jones and Eick (2007) investigated two middle school science teachers' implementation of guided inquiry in the classroom after school reforms were enacted. Researchers thought that reform was complex to implement. Therefore, they thought that supporting teachers' pedagogy was needed to make them inquiry oriented teachers. School reform changed some teachers' behaviors positively in the classroom. For example, one of the participants only followed his textbook in his teaching and taught subjects as step by step before this reform; however, his beliefs were changed after the reform enacted. The participant began to see curriculum as more thematic and used more questioning strategies and discussions in the classroom. Although the participant taught topics which were more familiar and more comfortable for him before, prepared kits for inquiry lessons guided his teaching practices and prevented him to jump to other topics. At the end of this study, both teachers had positive beliefs about the curriculum.

Smith and Southerleand (2007) investigated two elementary teachers' responses to a school reform to change their consideration about science and science teaching. The interaction between teachers' beliefs and reform tools which include national standards, curriculum and testing was also explored in the context of science teaching in this study. One of the participants was unfamiliar with National Standards. Although the participant was aware of the importance of using inquiry in the classroom, she believed in more teacher-directed discussion, driving lessons according to textbooks and cookbook activities. Her actual practice in the classroom was different from her ideas about inquiry. In addition, she believed the effectiveness of her current teaching practice. On the contrary, other participant believed the inquiry process. Her practice in the classroom was accordance with her ideas about inquiry. In addition, the curriculum influenced practices of both participants.

Coenders, Terlouw, and Dijkstra (2008) investigated seven chemistry teachers' beliefs about chemistry curriculum, their roles, their contributions to curriculum development and their professional development. According to interview results, participants believed in giving assignments and exercises to students from simple to complex. They thought that assignments should help students construct knowledge networks. They also believed that some concepts could be removed from curriculum and some basic concepts had to be hold in the curriculum to reach an ideal curriculum. Participants did not interact with students too much due to insufficient class time in the classroom. They thought current curriculum as much overloaded. In addition, some participants saw their roles as guide-coach. Some believed in making students enthusiastic in the classroom. They thought that they needed supports in such areas: content, cooperative learning assignments, and evaluation of learning results. Finally, they thought that current curriculum was outdated. They expected some changes in the curriculum.

Barak and Shakman (2008) investigated 11 experienced physics teachers' beliefs and practices about reform-based instruction. Researcher chose 22 strategies to learn teachers' opinions about the effectiveness of these strategies in instruction. In the interview, teachers indicated how often they used these strategies. The most used strategies which were chosen by teachers were: 'teaching various problem solving strategies', 'guiding students to confirm their solutions to a problem' and 'presenting data in multiple forms'. However, many of the teachers perceived problem solving as computation of standard problems. They gave little importance to some teaching strategies such as learning with team work and asking students to formulate their own questions. In addition, few teachers mentioned the development of students' thinking skills as a major objective of physics.

As a conclusion, teachers' practice in the classroom is affected by teachers' beliefs about curriculum or education reforms (Anderson, 1996; Anderson & Helms, 2001; Barak & Shakman, 2008; Coenders et al., 2008; Drake & Sherin, 2006; Grossman & Stodolsky, 1995; Jones & Eick, 2007; Kelly, 2009; Ogborn, 2002; Roehrig et al., 2007; Saez & Carretore, 2002; Smith & Southerleand, 2007; Yerrick et al., 1997). Educational reforms or curricula cannot be implemented as described due to teachers' beliefs (Anderson, 1996; Coenders et al., 2008; Ogborn, 2002; Roehrig et al., 2007). There can be an inconsistency between teachers' practice in the classroom and educational reforms (Osborne et al., 2002; Saez & Carretore, 2002; Smith & Southerleand, 2007). However, teachers' beliefs about teaching and learning can be changed after training programs or educational reforms (Jones & Eick, 2007; Saez & Carretore, 2002; Yerrick et al., 1997). Moreover, teachers can face some difficulties in the implementation of educational reforms due to some factors (Coenders et al., 2008; Drake & Sherin, 2006; Osborne et al., 2002).

3.3 Belief and Skills

I divided this section into three parts. These were 'belief and problem solving skills;' 'belief and science-technology-society issues;' and 'belief and information, communication and technology'. The following section explains the relationship between belief and problem solving skills.

3.3.1 Belief and problem solving skills

Some skills are explicitly stated in the THSPC for students to attain such as scientific process, creative thinking, critical thinking, and higher order thinking under the problem solving skills (MoNE, 2007). Teachers are required to help students attain these skills. According to the THSPC, students who have these skills will be more successful in encountered problems in their daily life. In addition, training productive and creative individuals who have problem solving skills is one of the main goals of the THSPC (MoNE, 2007). Similarly, NRC (1996) in the USA advocates that "business community needs entry-level workers with the ability to learn, reason, think creatively, make decisions, and solve problems" (p .12). In addition to these benefits of attainment of the problem solving skills, Delisle (1997) thinks that students learn by themselves, involve in active learning, and develop their creative, critical and reasoning skills in problem solving. In addition, conducting lessons by considering problem solving motivate and encourage students to involve in learning (Delisle, 1997).

Haladyna (1997) states that problem solving includes a set of mental steps which lead students to reach an answer. It includes combination of physical and mental steps and requires some higher-order thinking skills such as creative and critical thinking (Haladyna, 1997). For example, some steps were defined by Gagne (1966) to solve problems effectively as follows: (1) statement of the problem, (2) defining the problem, distinguishing essential features, (3) searching for and formulating hypotheses, and (4) verifying the solution.

Another problem solving strategy which was developed by Beichner (2002) to solve physics problems was the Goal strategy. This strategy was easy to recall and could assist novice problem solvers by providing some procedures (Beichner, 2002). Goal strategy includes some steps; gathering information about the problem, organizing an approach to the problem, analyzing the problem and learning from your efforts. Positive effects of this strategy on student ability to solve problems were also found (Beichner, 2002). In addition, the THSPC orders some steps for problem solving; (1) identifying the problem and making plan to solve the problem, (2) carrying out an experiment and collecting data to solve the problem, and (3) processing and interpreting data (MoNE, 2007). To develop students' problem solving skills, the THSPC gives importance to hands-on activities and experiments which include physical and mental steps (MoNE, 2007).

Dede and Yaman (2006) stated that students who attained problem solving skills would be successful in overcoming the difficulties they face in their daily life. Therefore, problem solving skills should be considered at all levels of education and teachers have some responsibilities to help students attain these skills (Dede & Yaman, 2006). For example, teachers are responsible for developing good problems before coming to class, guiding students when they solve the problem and evaluating students' performance at the end of the process (Delisle, 1997). I reviewed some of the studies which were related to problem solving skills in the literature to understand better the importance of problem solving in education and the relationship between teachers' beliefs and the problem solving skills in this section.

Gök and Sılay (2008) investigated the effect of cooperative problem solving strategies on students' physics achievement, strategy level and problem solving abilities. Cooperative problem solving strategies were used in experimental group. Researchers found that using problem solving strategies in cooperative groups positively affected students' attitude toward physics and students' physics achievement. In addition, teaching with problem solving by constructing cooperative groups provided group members to share their knowledge, discuss their findings with peers and teachers, realize their weak points and correct their misunderstandings (Gök & Sılay, 2008).

According to Demirtaş and Dönmez (2008), teachers' perceptions about problem solving skills can affect students' success in problem solving. They administered Problem Solving Survey (Heppner & Petersen, 1982) to 455 secondary school teachers in Turkey. It was found that teachers had a moderate level of problem solving skills. Researchers argued that teachers should improve their problem solving skills, had a good level of problem solving skills and taught these skills to their students.

Ünsal and Moğol (2006) investigated pre-service physics teachers' perceptions and difficulties about problem solving by using interviews and questionnaire. Researchers found that participants did not have enough prior knowledge, practice, and motivation to solve the problems. In addition, 81 percent of them indicated that they did not adopt problem solving as an instructional method. Almost all of the participants thought that problem solving helped them improve and arouse their thinking skills. In addition, they believed that problem solving method would improve their science achievement and contributed to development of their observation, analysis, thinking and creativity skills.

Ogunleye (2009) investigated problem solving difficulties of 210 students and 16 teachers in physics course. It was found that the most important factor which affected students' problem solving skills was laboratory experiences. Researcher suggested teachers use more laboratory activities although preparing new experiments brought some burdens for teachers. Another factor which affected students' success in problem solving was teachers' poor teaching and encouragement.

Luft (1999) investigated 13 upper elementary level in-service teachers' salient beliefs about problem solving demonstration classroom after the SSCS (search, solve, create and share) problem solving instruction. Researcher interviewed with teachers, observed them throughout the in-service programme, and observed their implementation of SSCS problem solving in teachers' classroom to elicit their beliefs about problem solving demonstration classroom. Similar to study of Ünsal and Moğol (2006) and Ogunleye (2009), Luft (1999) identified some difficulties which teachers faced in problem solving. Teachers believed that they did not have enough time to plan SSCS problem solving lessons. Class hours and materials were not enough to implement SSCS problem solving lessons. In addition, some teachers hesitated to use SSCS problem solving because they did not believe their competence in their instructional philosophy and science background. After the in-service programme, teachers had strong beliefs which were related to student-centered instruction. They believed that SSCS problem solving lessons provided students an opportunity to engage actively in learning, learn nature of science and become a member of cooperative team.

Zohar, Degani, and Vaaknin (2001) conducted a study which was related to teachers' beliefs about low achieving students and higher order thinking instruction. Interview technique was used to elicit beliefs of 40 teachers from different two types of schools which are junior high school and combination of junior high school and high school. After the analyses of interviews, teachers' responses about necessity of attaining higher order thinking skills for low and high achievers were classified into three categories. Three groups of teachers who were (1) consistent, (2) inconsistent, and (3) sometimes consistent and sometimes inconsistent in their ideas were found. Although many of the participants believed the benefits of thinking-based learning for students, they saw it as confusing and difficult for low achievers. In addition, many of the teachers believed that learning with problem based learning caused frustration among low achievers because they were not able to solve problems. Many of the teachers used same questions for low and high achievers without differentiating them from each other. They believed the inappropriateness of attaining higher order thinking skills for low achievers.

Wallace and Kang (2004) investigated six high school science teachers' beliefs about successful science learning, purposes of laboratory and inquiry implementation after the summer workshop about inquiry. One of the participants believed that when students were able to understand a scientific problem, use appropriate tools and techniques and engage in discourse, successful science learning would occur. In addition, he believed that the purpose of laboratory experiment in science learning was to develop students' problem solving skills. Another two participants believed that thinking and problem solving were needed for successful science learning. They believed that enhancing autonomous thinking and problem solving were the purpose of inquiry based instruction. Another participant believed that successful science learning occurred with creative and independent scientific thinking.

Kang and Wallace (2004) studied with three science case teachers to investigate their epistemological beliefs about the laboratory activities, the reason of why they use laboratory activities, and relationship between their epistemological beliefs and teaching actions. One of the participants believed that science included factual knowledge and problem solving. He believed that problem solving in laboratory provided students to reach multiple methods and answers. In addition, he believed that problem solving process caused students to be a scientist. Only difference between scientist and students were the depth of the knowledge at the end of the process. He believed that students could use their own intuitions and create their own ways to reach a solution in problem solving.

Yerushalmi, Henderson, Heller, Heller, and Kuo (2007) investigated six physics professors' beliefs and values about problem solving skills in teaching of introductory physics course. Three professors believed the linear decision making process in problem solving which included problem solving steps such as firstly determining relevant physics principles and concepts, then applying scientific techniques and finally evaluating answer. Two professors believed exploration process. One professor believed a mixture of the exploration and linear decision making process in problem solving. For example, professors who believed the exploration process thought that students' decisions might be incorrect. They believed that students could choose a correct decision within incorrect possibilities. Another question which researchers investigated was about students' learning in the context of problem solving. Participants believed that students could be provided with appropriate knowledge when they worked with problems. Researchers also found some beliefs related to problem solving as follows: students learn problem solving by engaging in problem solving activity, reflectivity (selfregulation) is prerequisite for problem solving, and solving problems with expert thinking such as including too many steps to reach a solution can frighten students.

To sum up, using problem solving strategies had a positive effect on students' achievement (Gök & Sılay, 2008) and development of some skills (Kang & Wallace, 2004; Luft, 1999; Ünsal & Moğol, 2006; Wallace & Kang, 2004). However, teachers' problem solving abilities (Ogunleye, 2009) and their perceptions (Demirtaş & Dönmez, 2008; Luft, 1999; Zohar et al., 2001) can affect the effective use of problem solving strategies. In addition, teachers can face some problems in helping students attain problem solving skills (Luft, 1999; Ogunleye, 2009; Ünsal & Moğol, 2006). For example, not having enough time and materials prevent using problem solving strategies effectively in the classroom (Luft, 1999). In addition, believing different problem solving strategies influenced how they are used (Yerushalmi et al., 2007).

3.3.2 Belief and science, technology and society issues

Relating physics lessons with technology, society, and environment is another emphasis in the THSPC. For example, real-life context based approach and physics-technology-society-environment objectives are complementary parts of each other. It is expected from students to link between abstract physics concepts and life by attaining physics-technology-society-environment objectives. These objectives were developed by adapting them to science-technology-society-environment objectives (MoNE, 2007).

According to Carroll (1999), science, technology and society (STS) practices in teaching engage students in inquiry, discovery or research based approaches with real world applications. For example, students in technology courses which are integrated with STS practices can make waterwheel, camera, and elevator (Brusic, 1992). Students have a chance of seeing and experimenting the science-technology-society relationship throughout STS implementation (Brusic, 1992). STS makes science instruction current and a part of real world (Yager, 1996). Due to these benefits of STS practices, many of the state programme frameworks in the USA emphasize on science and technology issues (Kumar &

Berlin, 1998). They value the interrelationship among science, society, technology and environment.

STS means “dealing with students in their own environment and with their own frames of reference” (Yager, 1996, p.10). Students can enter their own technology and application world with STS practices. They make their own connections to living in this world (Kumar & Berlin, 1998). In addition, Mansour (2009) states that STS is an interdisciplinary field which integrates modern technology and science with modern culture, values and institutions. Similarly, Cutcliffe (1990) reflects that STS is an interdisciplinary field and it shapes the directions of scientific research, and technological innovations. Cultural, economic and political values, society and institutions are affected by science and technology issues (Cutcliffe, 1990).

Heath (1992) ordered some advantages of STS instruction as follows: (1) it begins with attracting students’ interest, (2) it forces students to be an informed judger in science and technology issues, (3) it develops students’ decision making skills, and (4) it fosters science, technology and social literacy. Heath (1992) also suggested some teaching and learning approaches such as simulations, collaborative and cooperative learning, debates, independent projects, small group discussions, case studies, surveys, oral presentations and written reports for effective STS instruction.

Mansour (2009, 2010) argues that the success of STS practices depends on teachers’ beliefs, values and abilities. For example, inconsistency between teachers’ thinking about educational reforms and standards of educational reforms which are related to STS practices can affect the implementation of the reforms effectively (Mansour, 2009; Rubba, 1991). Therefore, science teachers’ beliefs and values must be compatible with STS practices before appropriate STS practices are developed (Rubba, 1991). Teachers must have opportunities to examine their beliefs and values, confront the inconsistencies in their beliefs about STS action and construct more appropriate beliefs with the help of model teachers and knowledgeable science educator (Rubba, 1991). Without ongoing support from other educators and involvement of others, it is very difficult to accomplish effective STS instruction (Heath, 1992).

In addition, Brusic (1992) states that teachers' role cannot be ignored in STS courses. According to Brusic (1992), teachers' role is directing students to new sources of information, asking probing questions, encouraging students to notice the connection among science, technology and society. The studies related to STS practices to understand better teachers' beliefs about STS practices and the difficulties teachers faced in STS implementation were reviewed in this section.

Rye and Dana (1997) investigated a research assistant's teaching beliefs and practices in STS instruction. As data collection method, the participant was interviewed and observed. He believed the active participation of students in lessons. In addition, he thought that knowing previous experiences and prior knowledge of students, and being open to students' ideas were needed to foster active participation of students. To achieve effective instruction, he believed relating topics to daily life experiences of students and having students with appropriate level in prior knowledge about the topics. Researchers also found that the participant believed that undergraduate education could not teach him how to teach.

Lumpe et al. (1998) investigated science teachers' beliefs about STS implementation. Two instruments an open-ended questionnaire which was administered to 14 teachers to elicit their salient beliefs and a questionnaire which was administered to 232 teachers to assess their behavioral intention toward STS implementation were used. Some of the teachers' identified salient beliefs were as follows: STS implementation provides students meaningful applications of real life, improves students' decision making skills, increases student interest, provides students direct experiences for the use of everyday materials, and helps students learn science concepts. In addition, participants believed that implementing STS in the classroom took much time, lead to covering less content in the classroom, changed the way of teaching, and lead to controversial issues in the classroom. Researchers also found that participants had a positive attitude toward using STS in the classroom. Another important result was that teachers who have fewer years of experience possessed more behavioral intention to implement STS in the classroom (Lumpe et al., 1998).

In addition to these findings, Lumpe et al. (1998) suggested some ways to make STS instruction more affective. For example, more importance should be given to teachers' salient beliefs about STS to foster positive beliefs about STS teaching in in-service training programmes. Determining salient beliefs of teacher before in-service training programmes could make training more effective. Discussing STS issues in programmes and reaching a consensus about STS implementation could build more positive beliefs about STS instruction for teachers. Observing and trying to implement STS activities in the classrooms could help teachers develop positive self-efficacy toward the implementation of STS.

In addition, Pedersen and Totden (2001) examined 32 science teachers' beliefs and perceptions about controversial social and technological issues by delivering a questionnaire. One of the dimensions of the questionnaire was related to teachers' personal beliefs. They found that over 80% of participants believed that discussing social issues in the classroom was valuable. More than 55% of participants believed that social issues were as important as math and science courses. In addition, 95% of participants followed their textbooks and they believed that textbooks were deficient in the area of social issues. They also believed that in-service and pre-service education could not give adequate support to them for mentioning social issues in their classrooms.

Tsai (2001) studied with one science teacher to explore her views about STS instruction and what she attained after the actual practice of STS instruction. The participant believed that STS instruction was an appropriate way to implement constructivism in the class. She thought that STS instruction provided students more opportunities for group work and discussion. According to the participant, students' decision making abilities, process skills, scientific knowledge and citizenship behaviors were developed by means of STS instruction. In addition, she believed that society and politics had an effect on the development of science. For example, students in Taiwan did not like discussion because their cultures did not encourage people to express their ideas and did not value their ideas. However, her students became more willingness to group work and discussion after the STS implementation in the classroom.

Bakar, Bal, and Akcay (2006) examined 66 pre-service science teachers' beliefs about science and technology and implication of science and technology on society. Views on Science Technology and Society (VOSTS) questionnaire which was prepared by Aikenhead, Fleming, and Ryan (1987) was used to collect data about pre-service teachers' beliefs. Six questions were chosen from the VOSTS questionnaire. Two groups which were control receiving traditional instruction and experimental receiving STS teaching and learning methods were used to find the effect of STS teaching on pre-service teachers' beliefs. Pretest results of this study showed that pre-service teachers in two groups believed that science and technology could not help people when they made moral and ethical decisions. However, pre-service teachers' beliefs in experimental group were changed after STS teaching. In addition, after the treatment many of the pre-service teachers in experimental group believed that science and technology helped solving many of the social problems, provide knowledge to understand everyday problems, and bring more pollution problems.

Mansour (2010) explored Egyptian science teachers' beliefs about the integration of STS issues into curriculum and the factors affecting their judgments about the integration of STS issues. Data was collected through administering questionnaire to 250 participants and interviewing with 12 of them. According to results of this study, participants believed that science would be nonsense if it did not cover the needs of society. Many of the participants believed that STS topics should be related to students' experiences in life. Some factors influencing the implementation of STS issues negatively in the classroom, for example, exams, attitude of families, inadequate lesson hours, a great number of students in the classroom, previous experiences of teachers, and lacking of materials were also found in this study. Researcher argued that STS practices could not be successful in the classrooms unless curriculum developers thought teachers' beliefs about STS issues.

To sum up, teachers' beliefs about the implementation of STS issues in the classroom affect what they teach and how they teach (Lumpe et al., 1998; Mansour, 2009, 2010; Rye & Dana, 1997; Tsai, 2001). In addition, some factors, for example, limited class hours could affect the implementation of STS issues negatively in the classroom (Lumpe et al., 1998; Mansour, 2010). Science teachers considered that mentioning social issues in the classroom are valuable (Pedersen & Totden, 2001). In addition, there was a positive effect of STS instruction on the change of teachers' beliefs about STS issues (Bakar et al., 2006, Tsai, 2001). However, there could be sometimes inconsistency between teachers' beliefs about STS instruction and their actions in the classroom (Mansour, 2009; Rubba, 1991).

3.3.3 Belief and information, communication and technology

In addition to problem solving skills and physics-technology-society-environment objectives, the THSPC emphasizes the attainment of information and communication skills by students. It is required from teachers to help students attain some skills such as; investigating, finding and choosing suitable information, developing relevant information, presenting information most effectively by using technology, developing communication skills, and developing basic computer skills (MoNE, 2007). According to the THSPC, students who have information and communication skills will be successful in reaching information by using technology and will be able to interpret and present this reached information (MoNE, 2007).

In addition, according to summary report prepared by British Educational Communication and Technology Agency (BECTA, 2003), using Information Communication Technology (ICT) in science teaching has some key benefits. For example, science teaching can be more interesting, authentic, and relevant with using ICT in teaching. Using ICT can encourage communication and collaboration in the classroom, and save time for observation, discussion and analysis (BECTA, 2003).

Using ICT also can support students' meaningful knowledge construction (Yoon et al., 2005). It provides students to see authentic and real world context. It encourages collaboration and communication with peers and experts. It involves students cognitively in higher order thinking skills. Teachers and students have more opportunities to give feedback, reflection and revision each other by using ICT (Yoon et al., 2005).

In addition, according to Osborne and Hennesy (2003), teacher's role and curriculum contents are in the transition stage in 21th century. New curricula want teachers to adopt and adapt different pedagogic practices. For example, new technologies such as computers lead to some pedagogic changes in the science education due to their widespread access in schools (Osborne & Hennesy, 2003). In addition, these new technologies are reshaping education curricula (Osborne & Hennesy, 2003; Tondeur, Braak, & Valcke, 2007).

However, teachers are resistant to use ICT in their classrooms. Few teachers use ICT in their lessons although they have enough equipment (Cuban, Kirkpatrick, & Peck, 2001). Teachers' decisions are important factors to use technology in classroom. When teachers face new technologies, a value judgment which was based on their current knowledge, beliefs and attitudes is made (Zhao & Frank, 2003). The studies related to ICT to understand better teachers' beliefs and perceptions about use of ICT and their competency in using ICT were reviewed in this section.

Niederhauser and Stoddart (2001) examined relationships between teachers' instructional perspectives and their use of technology in instruction. Researchers used a questionnaire to collect data from 1093 elementary teachers. Two types of instructional software which were skill-based software which encouraged traditional teaching and open-ended software which encouraged constructivist teaching were offered to teachers. Teachers' pedagogical perspectives and beliefs affected their software selection. A few teachers chose student-centered open-ended software. In addition, there was a relationship between teachers' perspectives about the instructional uses of computers and the types of selected software. For example, teachers who chose open-ended software had a strong learner-centered approach. In contrast, teachers who chose skill-based software had a strong computer-directed approach.

According to Yerrick and Hoving (2003), one of the factors which effected teachers' use of technology was teachers' beliefs. They studied with two schools in their project which was 'Tech Tolls'. Data was collected with observation, interviews and survey. Cotton High School teachers believed that technology could be used for inquiry, collecting data, and investigating problems. On the contrary, Tarsville teachers viewed technology as searching information on the net or using presentations on the overhead projectors. Furthermore, attitude of Tarsville teachers were different from Cotton High School teachers in terms of valuing project goals. Although project goals were associated with inquiry learning, they believed that the project was intended to assist their existing traditional technology use.

Pedersen and Liu (2003) conducted a case study to examine 15 middle school science teachers' beliefs about key issues in the implementation of a computer based program Alien Rescue which was designed to support student centered learning. Participants saw themselves as a facilitator in classroom in the implementation of Alien Rescue, but their facilitation involved providing students too much direction and structure. They believed in grading after activities and collaboration in activities. In addition, they believed that using student centered activities motivated students intrinsically. However, they thought that student centered activities took much time in concept learning. Moreover, participants thought that students' families could support the student centered learning activities in the classroom. However, some teachers were worried about families' thoughts because they could think that their students played instead of studying.

Zacharia (2003) investigated 13 pre-service physics teachers' beliefs about using interactive computer based simulations (ICBS), laboratory inquiry based experiment (LIBE) and combination of ICBS and LIBE in the classroom in terms of considering their advantages and disadvantages. Theory of reasoned action was used to identify teachers' beliefs about using IBCS, LIBE and combination of IBCS and LIBE. For example, participants believed that ICBS created active learning environment, gave students an opportunity to manipulate variables, reduced anxiety, and could be used at home. However, they saw it as disadvantageous because it did not allow cooperative work, reflect reality and mostly focused on technical issues. Researcher claimed that teachers' beliefs affected their attitudes, and in turn these attitudes affected their behavioral intention. In addition, participants had a positive attitude toward using IBCS, LIBE and combination of both according to result of this study.

Yoon et al. (2005) studied with six teachers to understand their views and beliefs about the role of ICT. Researchers investigated how teachers design and implement engaging learning experiences with ICT. Pre-lesson and post-lesson interviews were conducted with teachers to determine their views and beliefs about the role of ICT. According to interviews, participants thought that guiding students to discovery was important while students were using ICT. In addition, they believed that using ICT which was integrated with classroom discussion, collaboration, scaffolding and encouraging multiple perspectives in the classroom increased the effectiveness of the lesson.

Andersson (2006) focused on 21 newly qualified teachers' use of information and communication technology. Interviews and observations were used as data sources. According to interviews, two thirds of the participants stated that they used ICT in their teaching. For example, they used the internet for sending e-mails and sharing information with their pupils, and to improve their knowledge by searching information on the net. In addition, they used computers to teach pupils how to write on the word processing program and how to find different information on the net.

Jimoyiannis and Kommis (2007) examined 1165 primary and secondary education teachers' attitudes and beliefs about ICT. After training programme which was 'Teachers' Training on ICT in Education', a questionnaire was delivered to teachers to determine their beliefs and perceptions about ICT. It was found that many of the participants had positive attitude toward ICT training programme and were willing to adopt ICT as a teaching and learning tool. Three discrete groups of teachers were found after the analyses of participants' responses to the questionnaire. First group had strongly positive attitude toward ICT in education. Second group had generally negative attitude. Third group had neutral beliefs about ICT. In addition, teachers' beliefs about ICT integration into educational practice were examined in this study. Majority of the participants believed that ICT could be used in instruction and learning of every subject matter. According to them, using ICT could contribute positively to teaching and learning, involve students in active learning, and help students think critically. In addition, many of the participants believed that ICT was necessary for education curricula.

Over the 50% of participants believed that they would be successful in using ICT, organizing and managing students' learning task in their instruction. Finally, many of the participants considered ICT as necessary for modern society.

Tondeur et al. (2007) investigated 570 primary school teachers' ICT competencies which were proposed by Flemish government. Teachers' views about three types of competency areas which were 'technical ICT competencies', 'social and ethical ICT competencies', and 'ICT competencies in learning process' were examined by administering a questionnaire. It was found that participants gave more attention to development of students' technical ICT competencies such as using the elementary functions of computer, and applying operating systems as compared with other competency areas. In addition, researchers claimed that although teachers were aware of the importance of social and ethical ICT competencies, they did not give enough importance to use of ICT in learning process. They argued that teachers' actions in the classroom and the national curriculum were inconsistent.

Similar study to Tondeur et al. (2007) was conducted by Markauskaite (2007) about competency of teachers on ICT. Markauskaite (2007) examined 122 first-year postgraduate trainee teachers' beliefs related to their capabilities in ICT at the beginning of pre-service training. Participants participated in a two-year Master of Teaching degree at the University of Sydney. It was found that trainee teachers believed that they were quite confident with their basic ICT skills such as operating a computer, using basic software application, managing files and communicating via network. However, they were least confident with their capabilities to create web pages and use planning and decision support tools.

Siorenta and Jimoyiannis (2008) investigated 53 physics teachers' beliefs about laboratory and ICT. They classified teachers as 'traditional;' 'nontraditional;' and 'undecided' by considering their responses which were obtained from the questionnaire. They found that over the 75% of physics teachers believed that problem solving by using paper and pencil was indispensable to learn physics, and textbooks were important to understand physics. In addition, many of the participants believed the positive contributions of ICT on students' understanding of physics but they did not know how to use ICT to organize students' work and learning activities. They did not believe the reducing effect of ICT on the role of teacher.

Chai (2010) investigated seven teachers' epistemic and pedagogical beliefs in the context of ICT supported reforms in Singapore. Selected participants of this study participated in in-service training programme which was related to integration of ICT to teaching. According to results of semi-structured interview with participants, some participants believed the attainment of knowledge and some believed the construction of knowledge. However, many of the participants believed the transmission of knowledge to students. Researcher argued that changing the context in which teachers act was needed to achieve the reform efforts related to ICT.

Finally, Ertmer (2005) reviewed the literature to indicate the relationship between teachers' pedagogical beliefs and their technology practice. Teachers saw technology use similar to other teaching methods or thought technology as a different tool (Ertmer, 2005). Teachers' beliefs played a critical role in how technology was implemented and adopted. He argued that little research was carried about the relationship between use of technology and teachers' beliefs. According to Ertmer (2005), additional research are needed to explore the relationship between teachers' beliefs and technology practices in detail.

As a conclusion, teachers' beliefs about using technology can affect their intention to use technology (Zacharia, 2003). For example, teachers' pedagogical perspectives and beliefs can affect their selection of software in teaching (Niederhauser & Stoddart, 2001). In addition, there can be some inconsistencies in teachers' beliefs about ICT. For example, according to the study of Yoon et al. (2005) many of the teachers had positive beliefs about ICT; however, according to study of the Chai (2010), many of the teachers believed the transmission of knowledge instead of using ICT supported activities.

Other interesting result was that teachers who work in different schools had different beliefs about the use of technology (Yerrick & Hoving, 2003). In addition, according to Pedersen and Liu (2003), teachers can face some difficulties in the use of technology.

Finally, teachers generally used technology for basic operations (Andersson, 2006; Markauskaite, 2007; Tondeur et al., 2007). Teachers did not have enough knowledge about how to use technology and they believed in use of problem solving and textbook more (Siorenta & Jimoyiannis, 2008).

3.4 Belief and Previous Teaching/Learning Experiences

According to Pajares (1992), beliefs are highly personal and affected by individuals' experiences. Nespor (1987) states that individuals' actions are influenced by experiences held in the episodic structure. These experiences affect teachers' judgments in the classroom (Pajares, 1992). For example, Levin and He (2008) investigated 94 pre-service teachers' sources of beliefs about some themes such as teachers' roles and responsibilities, qualities of good teachers, general classroom environment and assessment. They found that many sources of beliefs came from pre-service teachers' family background, K-12 educational experiences, and teacher education programme. Some studies (e.g., Briscoe, 1991; Bryan & Abell, 1999; Eick & Reed, 2002) also investigated how teachers' previous experiences affect their teaching.

According to study of Briscoe (1991), teachers began to believe the effectiveness of new techniques and new curriculum materials on students' learning after professional development programmes. However, their previous experiences and beliefs about teaching affected their instructional practices. According to one participant, teachers were constructing their own interpretation about teaching strategies and implementing their lessons according to their beliefs and prior knowledge about teaching and learning. For example, he believed that students should be rewarded after they were successful or working hard. However, his belief caused some problems in his implementation of cooperative learning. He believed that giving all students in the cooperative group grade 'A' was not fair only if two students in the group studied. In addition, he did not overcome managing small group activities because of his lack of pedagogical knowledge. Therefore, he little contacted with his students in small group activities.

Bryan and Abell (1999) conducted a case study with one pre-service science teacher to investigate her beliefs about science teaching and learning. One of the factors affecting her belief was her past experiences. For example, involving in hands on activities in physical science in early years made her an active participant. In contrast, her most science learning experiences were textbook driven. Therefore, her beliefs about how children learn science and how she wanted to teach science were influenced by her both positive and negative experiences. The participant believed that learning by doing was inevitable for science teaching, and teacher-centered approaches and text book driven courses were not affective in science learning. However, although she stressed the importance of hands on science and use of manipulative in teaching science in interviews, mismatch between expression of her teaching science and her behavior in classroom was found.

Eick and Reed (2002) studied with 12 secondary pre-service science teachers to investigate how their personal histories affect their structured inquiry implementation. Two case pre-service teachers were analyzed in detail. One of the participants handled implementing structured inquiry in her lessons. Previous negative experiences of her in traditional history class did not affect her teaching. Her role model was her biology teacher in high school and affected her ideas seriously about learning. Therefore, she imitated some characteristics of her teacher such as performing many hands-on activities. In addition, because she was not able to learn when she did not make connections among concepts in university years, she believed that science learning occurred when she observed and performed hands-on work. Another participant was not successful in implementing structured inquiry. She learned science by reading books and working problems. In addition, she sometimes did not understand what was actually done in laboratory in spite of liking laboratory experiments. Although she knew how to implement structured inquiry, her previous experiences negatively affected her actions in the classroom.

3.5 Studies Related to Turkish High School Physics Curricula in Turkey

In this part, I reviewed the studies related to Turkish High School Physics Curricula. Some of the reviewed studies (Balta & Eryılmaz, 2011; Baybars & Kocakülah, 2010; Ergin et al., 2011) were related to current Turkish High School Physics Curricula and some of them (Akay, 2009; Marulcu & Doğan, 2010;

Özdemir et al., 2011) were related to Turkish High School Physics Curricula which were implemented before 2008.

Marulcu and Doğan (2010) investigated 70 physics teachers' and 1392 students' views about the physics curriculum which was implemented before 2008 and physics course books which were used before 2008. They used a questionnaire and the screening conference during data collection. They found that many of the participants thought that lesson hours were limited for teaching physics according to the curriculum. In addition, they thought that course books and physics curriculum were up-dated. They also mentioned that course books could not meet students' expectations for university entrance exam.

The study which was conducted by Akay (2009) explored whether physics curriculum had expected properties in terms of total quality. The curriculum used in this study was implemented before 2008. The researcher administered an open-ended questionnaire to 34 physics teachers and 16 school managers in his study. He found that the objectives in the curriculum were not attainable by students due to some reasons. For example, participants indicated that physical and technological facilities in the schools were not sufficient to teach physics effectively.

Özdemir et al. (2011) evaluated the arrangements in the physics curriculum which was implemented in 2005. They explored 80 pre-service physics teachers' views about the arrangements in the physics curriculum. They found that participants thought that the physics curriculum in 2005 did not bring innovations in terms of objectives, teaching and learning approaches, content and measurement and evaluation. They indicated that changes in the curriculum were only related to subject orders in it.

Ergin et al. (2011) investigated physics teachers' views on physics curriculum which was put into practice in 2008-2009 education-year. They administered a questionnaire to 41 physics teachers. The questionnaire aimed to measure teachers' views about objectives in the curriculum, content of the curriculum, teaching and learning activities and measurement and evaluation activities in the curriculum. They found that physics teachers had generally positive views about objectives in the curriculum, and content of the curriculum. However, teachers had partially positive views about suggested teaching and learning methods and measurement and evaluation activities in the curriculum. For example, many of the participants thought that lesson hours were not enough to implement curriculum by considering suggested teaching and learning methods and measurement and evaluation activities.

Baybars and Kocakülah (2010) examined 44 physics teachers' views about Grade 9 physics curriculum which was put into practice in 2008-2009 education-year. They administered a questionnaire to in-service teachers to collect data. They found that many participants thought that the approaches in the curriculum were clearly defined. In addition, many of the participants did not believe the applicability of the suggested instructional methods in the curriculum. They indicated that physical facilities of the school were not appropriate and lessons hours were limited to implement physics curriculum.

Balta and Eryılmaz (2011) investigated physics teachers' views about changes in the present physics curriculum and in-service needs related to topics added to physics curriculum. They used a questionnaire to explore 104 physics teachers' views. However, they used 100 questionnaires in data analysis. They found that physics teachers' views about changes in the physics curriculum were positive and they thought that they did not need to in-service training programs for the newly added concepts into the curriculum too much.

3.6 Summary of the Literature Review

I reviewed the literature to understand relationship among belief and teaching practice, belief and curriculum/educational reforms, belief and problem solving skills, belief and science, technology and society issues, belief and information and communication skills, and belief and previous experiences of teachers before beginning to collect data. In addition, I reviewed the studies related to Turkish High School Physics Curricula in Turkey. Summary of the literature review was given as follows:

- Teachers' beliefs about teaching and learning can affect their instructional practice in the classroom (Beck et al., 2000; Bryan, 2003; Czerniak & Lumpe, 1996; Haney et al., 1996; Haney et al., 2002; Haney & McArthur, 2002; Hashweh, 1996; Levitt, 2001; Mellado, 1998;

Nespor, 1987; Olafson & Schraw, 2006; Pajares, 1992; Porlán & Martín, 2004; Richmond &Anderson, 2003; Simmons et al., 1999; Tsai, 2002; Uzuntiryaki et al., 2010; Yerrick & Hoving, 2003).

- Teachers' instructional practices sometimes are not well aligned with stated beliefs (Bryan & Abell, 1999; Levitt, 2001; Mansour, 2009; Mellado, 1998; Richmond & Anderson, 2003; Rubba, 1991; Simmons et al., 1999; Smith & Southerleand, 2007; Uzuntiryaki et al., 2010; Tondeur et al., 2007).
- There were some categorization for teachers' teaching beliefs as core and peripheral (Haney & McArthur, 2002); realist, contextualist and relativist (Olafson & Schraw, 2006); traditional, technical and alternative (Porlán & Martín, 2004); traditional, mechanistic and inquiry (Roehrig et al., 2007); traditional, nontraditional and undecided (Siorenta & Jimoyiannis, 2008); traditional, process and constructivist (Tsai, 2002); weak, moderate and strong conceptions of constructivism (Uzuntiryaki et al., 2010); consistent, inconsistent, and sometimes consistent and sometimes inconsistent (Zohar et al., 2001).
- Teachers' beliefs influence the implementation of curriculum/education reforms (Anderson, 1996; Anderson & Helms, 2001; Barak & Shakman, 2008; Coenders et al., 2008; Drake & Sherin, 2006; Grossman & Stodolsky, 1995; Haney et al., 1996; Jones & Eick, 2007; Kindberg, 1999; Ogborn, 2002; Osborne at al., 2002; Roehrig et al., 2007; Saez & Carretore, 2002; Smith & Southerleand, 2007; Yerrick et al. 1997).
- Teachers' beliefs about constructivism (Beck et al., 2000; Haney & McArthur, 2002; Uzuntiryaki et al., 2010), teachers beliefs' about problem solving (Kang & Wallace, 2004; Luft, 1999; Yerushalmi et al., 2007; Wallace & Kang, 2004), teachers' beliefs about STS implementation (Brusic, 1992; Lumpe et al., 1998; Mansour, 2009, 2010; Rubba, 1991; Rye & Dana, 1997; Tsai, 2001), teachers' beliefs about information and communication technologies (Jimoyiannis & Komis, 2007; Pedersen & Liu, 2003; Siorenta & Jimoyiannis, 2008;

Yerrick & Hoving, 1999; Zacharia, 2003; Zhao & Frank, 2003) can affect their instructional practices.

- Education programmes had a positive influence on the change of teachers' beliefs (BouJaoude, 2000; Jones & Eick, 2007; Luft, 1999; McGinnis et al., 2002; Yerrick et al., 1997).
- Teachers' previous experiences which shape their current beliefs can influence their instructional practice (Briscoe, 1991; Bryan & Abell, 1999; Drake & Sherin, 2006; Eick & Reed, 2002; Mellado, 1998) and teachers can bring some beliefs about teaching from school years, curriculum and their families (Levin & He, 2008).
- Some studies (e.g., Balta & Eryılmaz, 2011; Baybars & Kocakülah, 2010; Ergin et al., 2011) related to THSPC which was put into practice 2008-2009 education-year, and some studies (e.g., Akay, 2009; Marulcu & Doğan, 2010; Özdemir et al., 2011) related to the THSPC which was implemented before 2008 were conducted.
- Physics teachers' views about the changes in current THSPC were generally positive (Balta & Eryılmaz, 2011; Ergin et al., 2011). However, physics teachers had some difficulties in teaching physics according to the current THSPC (Baybars & Kocakülah, 2010; Ergin et al., 2011). For example, limited lesson hours (Baybars & Kocakülah, 2010; Ergin et al., 2011) and inadequacy of physical facilities (Baybars & Kocakülah, 2010) were the obstacles to teach physics according to the current THSPC.
- Similar findings were also found for the THSPC which was implemented before 2008. For example, physics teachers thought that limited lesson hours (Marulcu & Doğan, 2010), inadequacy of physical and technological facilities (Akay, 2009) affected the implementation of the THSPC negatively.

CHAPTER 4

METHODOLOGY

In this chapter, firstly, I summarized the research design. Then, I described the selection of cases and their background information. Next, I presented data collection sources and data analysis. Finally, I discussed validity, reliability and ethical issues.

4.1 Research Design

I used qualitative research design to investigate four in-service physics teachers' beliefs related to the THSPC in this study. This study included interview with participants, classroom observations, and administration of an open-ended questionnaire to participants.

According to Pajeres (1992), the most effective way to understand teachers' beliefs is interviewing with individuals and observing their actions. Fishbein and Ajzen (2010) also support his ideas and suggest researchers use open-ended questionnaire or interview to identify teachers' beliefs.

I tried to elicit beliefs of the teachers participating in this study by considering the theory of planned behavior which was developed by Ajzen in 1985. Because the identification of the beliefs in my study was mainly based on the theory developed by Ajzen (1985), this study was basic or generic qualitative study. However, to answer the research questions in this study, there was a need to have an in-depth understanding of teachers' beliefs related to the THSPC. In this regard, the research design of my study included the characteristics of case study. Case study was combined with basic or generic qualitative study in this study.

There are many types of case study design in the literature. It is important to choose the best type of case study before starting data collection. For example, types of case studies can be classified in terms of size and intent. A case can be one individual, several individuals, a group, an entire program, and an activity (Cresswell, 2007).

Moreover, the intent of the case can be changed according to the purpose of the study. Three types of case studies can be conducted in terms of intent: 'the single instrumental case study;' 'the intrinsic case study;' and 'the collective or multiple case studies' (Stake, 1995). The focus of the single instrumental case study is on an issue or concern (Cresswell, 2007). Researcher selects one case to explain this issue or concern. In the intrinsic case study, researcher focuses on the case itself as the case has unique and unusual situation. For example, evaluating a program or studying with a student having some learning difficulties can be an example of intrinsic case study. The final one collective or multiple case study focuses on one issue or concern similar to the single instrumental case study; however, researcher selects more than one case to investigate the issue or concern. This provides researcher to replicate cases with each other (Cresswell, 2007). Therefore, researcher can reach more valid results (Cresswell, 2007; Merriam, 1998; Yin, 2003).

For example, using multiple case designs in educational studies enhances the external validity or generalizability of findings (Merriam, 1998). However, using single cases makes generalizability difficult. Therefore, multiple case study designs can be preferred for replication aims. Same procedures can be replicated for each case to generalize cases with each other (Yin, 2003). For example, according to Yin (2003), it is important to be careful in the selection of cases to predict similar results for literal replication and to predict constructing results with predictable reasons for theoretical replication.

Due to these benefits of multiple case study design, I selected four physics teachers as cases in this study. Finally, according to Yin (2003), there are four types of multiple case study designs. These are holistic single case study, embedded single case study, holistic multiple case study and embedded multiple case study designs. My study was holistic multiple case study design because I 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.

4.2 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 “information-rich cases” is a critical issue before starting data collection (Merriam, 1998). Therefore, I interviewed with seven physics teachers who worked in the Eastern Anatolia region of Turkey before selecting case teachers among them. However, firstly, I conducted interviews with school principals about the purpose of this study and how to collect data. Then, I showed the principals the permission letter (see Appendix D) which was taken from the Provincial Directorate of National Education. After taking their permission to conduct this study, I talked with teachers about the purpose of this study and data collection. I asked them how much they helped me in the data collection.

For example, when I began to talk about the data collection, two teachers did not want to be observed in their lessons during one semester. They allowed me to observe their lessons only four or six times during one semester. Therefore, I did not study with them. In addition, one of the teachers worked as a physics teacher and vice principle of the school. I considered that I could not collect rich information from him due to his workload. Therefore, I did not select him either. I chose four remaining teachers who, I believed, could provide rich information. Therefore, I selected cases purposefully to reach more data.

In addition, Merriam (1998) states that case selection depends on some criteria. I considered that school types could cause teachers to have different beliefs because the students in different schools had different achievement level. For example, students were directed to different high school types to be educated after the exams, which were applied during their primary school education in Turkey. By assuming that teachers who work in different types of schools could have different beliefs, I selected two teachers who worked in Anatolian High Schools which had generally low-achieving students, and one case teacher who worked in Anatolian Teacher High School and one case teacher who worked in Science High School which had generally high-achieving students. In addition, as I mentioned before, literal and theoretical replications are important in the selection of cases. For this purpose, I chose teachers from different types of schools.

The second criterion in the selection of cases was whether participating teachers in this study teach physics according to the THSPC. All of them indicated that they tried to teach physics according to the THSPC before I began to collect data. However, they indicated that they sometimes did not teach physics according to the THSPC due to some factors.

In addition, each school had only one physics teacher. Therefore, same teacher entered all physics lessons in each school. For example, one physics teacher had to enter all grades which were 9, 10, 11 and 12. However, I observed teachers in the lessons of Grade 9. Grade 9 THSPC was put into practice in 2008. Therefore, teachers had two years of teaching experience in the implementation of the THSPC. I considered observing teachers in the lessons of Grade 9 as an advantage on the assumption of teachers' more familiarity to Grade 9 THSPC when compared with Grade 10 and Grade 11 THSPC. I believed that I could reach more valid results by observing them in Grade 9. In addition, I chose the units 'nature of physics' and 'energy' because these units included many of the skill objectives in the THSPC which were expected from teachers to help students attain.

I referred to teachers throughout this thesis with pseudonyms. The following is a presentation of a detailed account of background information about each participant.

4.2.1 Case 1 – Sinan

Sinan was 27 years old. He was in the first year of teaching profession when the data collection of this study began. He has been working in Anatolian High School since September 2010. He graduated from the department of secondary science and mathematic education as a physics teacher in 2009. He has been a master of physics student in the field of general physics since 2009. He did not attend any in-service training programmes or seminars related to physics education or the THSPC. Moreover, during his teacher training years, none of the courses informed him about the THSPC.

4.2.2 Case 2 – Fatih

Fatih was 35 years old. Like Sinan, Fatih was in the first year of teaching profession when the data collection of this study began. He has been working in Anatolian High School since January 2010. He graduated from the department of physics in 1998. He had a non-thesis master degree in physics education. However, he has never worked as a physics teacher until January 2010. In addition to his current position, he was also the physics teacher of another, vocational school in the city center. The Anatolian High School which he is working now had some discipline problems according to Fatih. Therefore, this school was very infamous in the city due to some discipline problems. He, similar to Sinan, did not attend any in-service training programmes or seminars related to physics education and/or the THSPC. Fatih became anxious, when I talked about the data collection procedure. He indicated that nobody observed his lessons before. Therefore, to reduce his anxiety, I observed his teaching practice in a different classroom before the actual classroom observations for data collection began.

4.2.3 Case 3 – Tarık

Tarık was 33 years old. He graduated from the department of secondary science and mathematics education in 2001. He has been working as a science and physics teacher for nine years. He had four years of teaching experience in primary schools and five years of teaching experience in high schools. He always worked as a teacher in the Eastern Anatolia region of Turkey. He has been a physics teacher of Science High School in the city center since September 2010. He attended some seminars. For example, he attended the regional workshop of TÜBİTAK. In addition, he had a certificate of computer. However, he did not attend any in-service training programmes related to physics education or the THSPC. I began to study with Tarık two weeks late because he took permission from school administration for two weeks at the beginning of the semester.

4.2.4 Case 4 – Altan

The last case teacher of this study was Altan. He was 29 years old. He was graduated from the department of secondary science and mathematic education in

2006. He has worked as a physics teacher for six years in private institutions which offer private preparatory courses (dershane) and public schools. He worked as a physics teacher in private institutions offering private preparatory courses during two years before graduating the university. He has been a physics teacher of Anatolian Teacher High School since January 2010. He was, at the time of data collection, a graduate student studying towards MS degree in the field of general physics. Like other participants, he did not attend any in-service training programmes or seminars related to physics education or the THSPC. Altan indicated that he was familiar with classroom observations. His classroom practices were observed by some trainee teachers when they worked as a teacher in private institutions which offer private preparatory courses. Therefore, he indicated that he would not be anxious in the classroom observations.

4.3 Data Collection

According to Yin (1993), several techniques such as collection of documents and archival records, interviews, observations and physical artifacts can be used in data collection in case studies. Throughout the data collection, I interviewed with participants, observed their instructional practices in the classroom, and administered an open-ended questionnaire to them. In addition, I recorded interviews and participants' instructional practices. I described data collection sources in detail in the following sections.

4.3.1 Interviews

According to Robson (2002), interviews are used particularly in survey and grounded theory studies as a primary instrument, but they are also used in case studies to complement participant observation. The primary data source in this study was the semi-structured interviews. They were conducted with participants several times during the fall semester of 2010-2011 education-year. I used four interview protocols in this study. While many of the interview questions to identify beliefs were based on the suggestions made by Fishbein and Ajzen (2010), some questions were prepared by me to help me answer research questions of this study.

In August 2010, I piloted interview questions with a physics teacher working in a public school in Ankara. Based on the feedback from this pilot, I reviewed the interview questions and restructured them. For example, I changed expression of some interview questions which were not understood by a teacher. I changed order of some interview questions. Additionally, at the beginning, I had two interviews. However, I increased the number of interviews to four because they took much time. At the end, four interviews were deemed appropriate. Below, I presented a detailed description for each of the interviews.

Interview 1 and Interview 2 (see Appendix A) included questions related to strengths of teaching physics according to the THSPC, weaknesses of the THSPC, how to teach physics according to the THSPC and the factors that make teaching physics according to the THSPC easy and difficult. Interview 3 and Interview 4 (see Appendix B) consisted of questions about strengths of attainment of problem solving skills, physics-technology-society-environment objectives and information and communication skills as perceived by the teachers, factors which affect the attainment of these skills, and what teachers do to help students attain these skills.

I interviewed with participants in their free time. For example, I interviewed with them after their lessons finished in the schools. All the interviews were conducted in a relaxed environment. Each session for interview with teachers last approximately 30 to 60 minutes.

Furthermore, I used the following abbreviations for the interview session with each teacher. For example, I used the abbreviation 'Sis1' for the interview session 1 with Sinan, 'Fis1' for the interview session 1 with Fatih, 'Tis1' for the interview session 1 with Tarık, and 'Ais1' for the interview session 1 with Altan. The first letter of these abbreviations means 'the name of the teacher participated in this study', the second two letters means 'interview session' and the number at the end of these abbreviations indicates 'the number of the interview session'. For example, Sis3 means 'interview session 3 with Sinan'.

4.3.2 Open-ended questionnaire

The second data source was an open-ended questionnaire (see Appendix C) prepared by me in order to elicit teachers' beliefs about skill objectives in 'nature of physics' and 'energy' units. Open-ended questionnaire was composed of two parts. The first part asked teachers about the necessity of the skill objectives to be attained by students. Second part asked the teachers whether it was possible for students to attain those skill objectives in the teaching and learning process. In the questionnaire, teachers are firstly required to indicate, next to skill objectives, their agreement or disagreement on the necessity of the attainment of the skill objectives, and then to explain their reasons why they agree or disagree. Then they are required to indicate, next to skill objectives, their agreement or disagreement on the possibility of the attainment of skill objectives. For each item, they also indicated how they would help students attain those skill objectives, if they agreed on the possibility of the attainment of them. In addition, they explained their reasons why they disagree on the possibility of the attainment of them.

4.3.3 Video-recorded classroom observations

The third data source for this study included observations of the case teachers' instructional practices during the fall semester of 2010-2011 education-year. I observed their practices on the 'nature of physics' and 'energy' units. I observed each teacher from the start of these units until they were completed.

Observations were made as non-participant fashion as Fraenkel and Wallen (2005) described. I did not interact with students and teachers in the classroom. I sat on the desk at the end of the classroom. I recorded teachers' instructional practice in the classroom by using video-camera. I took students' and teachers' permission to use video-camera before recording.

Similar to abbreviations used in the interviews, I used the abbreviation 'Tow1' for the observation of Tarık in Week 1, 'Fow1' for the observation of Fatih in Week 1, 'Sow1' for the observation of Sinan in Week 1, and 'Aow1' for the observation of Altan in Week 1. The first letter of these abbreviations means 'the name of the teacher participated in this study', the second two letters means 'observation week' and the number at the end of these abbreviations indicates 'the number of the observation week'. For example, Sow3 means 'observation of Sinan in Week 3'. The abbreviations of observation weeks for each participant and lecture hours expended by participants for each week were given in Table 4.1.

Table 4.1 Abbreviations of observation weeks for each teacher and lecture hours expended by each teacher for each week

	Teachers							
	Sinan		Fatih		Tarık		Altan	
Weeks	Nature of Physics	Energy	Nature of Physics	Energy	Nature of Physics	Energy	Nature of Physics	Energy
Week1	Sow1		Fow1		Tow1		Aow1	
	1+1		1+1		1+1		1+1	
Week2	Sow2		Fow2			Tow2	Aow2	
	1+1		1+1			1	1	
Week3	Sow3		Fow3			Tow3	Aow3	
	1+1		1+1			1	1+1	
Week4	Sow4	Sow4	Fow4			Tow4	Aow4	
	1	1	1+1			1+0,5	1+1	
Week5		Sow5		Fow5		Tow5	Aow5	
		1+1		1+1		0,5	1	
Week6		Sow6		Fow6		Tow6	Aow6	Aow6
		1+1		1+1		1	1+0,5	0,5
Week7		Sow7		Fow7				Aow7
		1+1		1				1+1
Week8		Sow8		Fow8				Aow8
		1+1		1+1				1+1
Week9		Sow9		Fow9				Aow9
		1+1		1+1				1+1
Week10		Sow10		Fow10				Aow10
		1+1		1				1
Week11		Sow11						Aow11
		1+1						1
Week12		Sow12						Aow12
		1+1						1+1
Week13								Aow13
								1
Total	7	17	8	10	2	5	9,5	11,5

I observed only one class for each teacher, and followed collecting data by observing the same classes during the entire data collection process. In so doing, I intended to investigate if the teachers' beliefs revealed during the interviews and open-ended questionnaires were reflected in their actions by focusing on how they attempted to help their students attain those skill objectives related to the 'nature of physics' and 'energy' units.

To sum up, I used three data sources interviews, video-recorded classroom observations and an open-ended questionnaire to be able to answer research questions in this study. Table 4.2 summarizes the link between data sources and research questions.

Table 4.2 Link between data sources and research questions

Research Questions	Data Sources
1. What do physics teachers believe to be strengths of teaching physics according to the THSPC?	Interview 1 Interview 2 Interview 3 Interview 4 Open-ended questionnaire
2. What do physics teachers believe to be weaknesses of the THSPC?	Interview 1
3. What beliefs do physics teachers have about how to teach physics according to the THSPC?	Interview 2 Interview 3 Interview 4 Open-ended questionnaire
4. To what extent are physics teachers' beliefs about how to teach physics according to the THSPC reflected in their instructional practices?	Video-recorded classroom observations
5. What beliefs do physics teachers have about the attainment of skill objectives in the THSPC?	Open-ended questionnaire
6. To what extent are physics teachers' beliefs about the attainment of skill objectives in the THSPC reflected in their instructional practices?	Video-recorded classroom observations
7. What are the factors that physics teachers believe to be affecting their instructional practices in teaching physics according to the THSPC?	Interview 1 Interview 2 Interview 3 Interview 4 Open-ended questionnaire

4.4 Data Analysis

Qualitative data analysis, according to Miles and Huberman (1994), consists of three components: data reduction, data display, and conclusion drawing and verification. I started my data analysis immediately after collecting my data. First of all, I transcribed all the interviews (transcript of the interviews with one of the participants were given in Appendix E) and some of the talks in the video recordings into documents. Then, I used coding strategy for data reduction. I constructed categories and codes after analyzing the transcripts of interviews and teachers' responses to the open-ended questionnaire by focusing on research questions. I coded physics teachers' beliefs related to strengths of teaching physics according to the THSPC, weaknesses of the THSPC, about how to teach physics according to the THSPC, and factors that they believed to affect teaching physics according to the THSPC. In addition to these codes, I coded skill objectives which were wanted from teachers to help students attain in 'nature of physics' and 'energy' units.

Miles and Huberman (1994), for drawing conclusions and verification, proposed some tactics such as 'clustering', 'counting', 'checking for representatives' and 'triangulation'. In this regard, I clustered codes under the categories. In addition, I obtained the occurrence frequencies of the attempts made by teachers to help students attain the skill objectives from the video-recordings of each case teacher's instructional practices. I calculated the occurrence frequencies of beliefs related to the THSPC indicated by each teacher by analyzing the interview transcripts. Finally, I triangulated some of the findings obtained from interviews, open-ended questionnaire and video-recordings with each other.

4.4.1 Data coding and coding categories

According to Merriam (1998), data coding is necessary in qualitative studies to organize and manage data. She defined coding as "nothing more than assigning some sort of short hand designation to various aspects of your data so that you can easily retrieve specific pieces of the data … [which] can be single words, letters, numbers, phrases, or combination of these" (p.164). On the other hand, category names can come from the researcher, the participant and the literature. However, naming categories from literature can cause some problems because of the nature of research question (Merriam, 1998). Due to this reason, I constructed the codes by considering my research questions.

In addition to these categories and codes, I constructed some categories and codes according to transcripts of the interviews and teacher responses to open-ended questionnaire. In coding, I adhered to the following conventions; beliefs related to strengths of teaching physics according to the THSPC were always coded with ‘S’ as the initial letter, and beliefs related to weaknesses of the THSPC with ‘W’ as the initial letter. I coded the factors that teachers believe to make teaching physics according to the THSPC easy with ‘FE’ as the initial letters, and the factors which teachers believe to make teaching physics according to the THSPC difficult with ‘FD’ as the initial letters. I coded teachers’ beliefs about how to teach physics according to the THSPC with ‘T’ as the initial letter.

I asked teachers questions which were related to strengths of teaching according to the THSPC to answer Research Question 1 in the interviews. They also indicated some strengths of teaching physics by considering skill objectives in the open-ended questionnaire. Table 4.3 includes teachers’ beliefs related to strengths of teaching physics according to the THSPC and the codes of each belief.

Table 4.3 Beliefs related to strengths of teaching physics according to the THSPC and the related codes

Category I. Beliefs related to strengths of teaching physics according to the THSPC		**Code**
THSPC helps students	develop study habits	SDS
	use their skills	SUT
	have a permanent knowledge	SPK
	have a general knowledge about physics	SGK
	become interested in physics lessons	SIP
	feel more self-confident	SFS
	become more conscious individuals	SBC
	relate physics to their daily life	SRP
	overcome the problems encountered in their life	SOP
	participate in discussions or activities	SPD

In interview, I also asked teachers about the weaknesses of the THPSC to answer Research Question 2. Teachers' beliefs related to weaknesses of the THSPC and the codes of each belief were given in Table 4.4.

Table 4.4 Beliefs related to weaknesses of the THSPC and the related codes

Category I. Beliefs related to weaknesses of the THSPC		Code
THSPC	does not mention how to attain objectives in detail	WMH
	includes unsuitable orders of topic	WUO
	includes difficult topics for students' level	WDT
	expects from teachers to explain topics superficially	WTS

I asked teachers questions related to how they teach physics according to the THSPC in interviews to answer Research Question 3. They also indicated some teaching techniques for helping students attain some skill objectives in the open-ended questionnaire. Teachers' beliefs about how to teach physics according to the THSPC and the codes of each belief were given in Table 4.5.

Table 4.5 Beliefs about how to teach physics according to the THSPC and the related codes

Category I. Beliefs about how to teach physics according to the THSPC		Code
Physics can be taught according to THSPC by	giving students research homework	TGS
	creating a discussion environment*	TCD
	giving examples from daily life	TGE
	carrying out hands-on activities	TCO
	using information and communication technologies	TUI

*'creating a discussion environment' actually means nothing more than a simple question and answer session

In video-recordings of teachers' instructional practices, I sought for these teaching techniques. I calculated the occurrence frequencies of each teaching technique indicated by the teachers in the interviews by analyzing video-recordings of participants to answer Research Question 4. Although teachers, in interviews, used the term "discussion environment" as a technique that they would use in teaching physics according to the THSPC, their conception of discussion, as observed from their instructional practices, was nothing more than a simple question and answer session. A simple session merely involves a teacher asking a question(s) and students giving answers to these question(s) without much questioning, either by students or the teacher, the credibility of the answers and interaction among class members. In this regard, I coded such question-and-answer sessions in video-recordings as ‘creating a discussion environment’.

In addition, I asked teachers the factors that affect their teaching physics according to the THSPC in the interviews to answer Research Question 7. The beliefs related to factors that make their teaching physics according to the THSPC easy and the codes of each belief were given in Table 4.6.

Table 4.6 Beliefs related to factors that make teaching physics according to the THSPC easy and the related codes

It is easy to teach physics according to THSPC due to	**Category I. Beliefs related to students**	**Code**
	students’ interest in physics lessons	FESIP
	students’ sufficient readiness level	FESSR
	students’ interest in using information and communication technologies	FESIUI
	Category II. Beliefs related to teachers	
	teacher’s opportunity to give more examples about daily life	FETOG
	being young teacher	FEBYT
	Category III. Beliefs related to course book	
	feasible activities/experiments in the course book	FEFAE
	interesting pictures and examples in the course book	FEIPE
	Category IV. Beliefs related to physical and technological facilities	
	widespread use of technology	FEWUI

Teachers also indicated some factors affecting their teaching physics according to the THSPC negatively in the interviews and open-ended questionnaire. The beliefs related to factors that make their teaching physics according to the THSPC difficult and the codes of each belief were given in Table 4.7.

Table 4.7 Beliefs related to factors that make teaching physics according to the THSPC difficult and the related codes

	Category I. Beliefs related to students	**Code**
It is difficult to teach physics according to THSPC due to	students' low economic status	FDSLE
	discipline problems among students in the classroom	FDDPS
	students' desire to learn with teacher centered learning approaches	FDSDT
	students' lack of interest in activities	FDSLI
	students' insufficient readiness level	FDSIR
	Category II. Beliefs related to teachers	
	considering the necessity of teaching some topics in the curriculum in detail	FDCNT
	teacher's insufficient pedagogic formation	FDTIF
	Category III. Beliefs related to family, school administration and university entrance exam	
	university entrance exam	FDUEA
	families' insufficient knowledge about curriculum	FDFIK
	school administration's insufficient knowledge about curriculum	FDSAI
	Category IV. Beliefs related to lesson hours and physical and technological facilities	
	inadequacy of laboratory environment	FDILE
	inadequacy of lesson hours	FDILH
	lack of information and communication technologies	FDLIC
	a great number of students in classrooms	FDGNS
	insufficient number of programs in the media about physics and technology	FDINP

Additionally, I used the categorization of the THSPC. It consists of two main categories for the student learning outcomes: 'knowledge objectives;' and 'skill objectives'. Under the skill objectives, there are four categories: 'problem solving skills;' 'physics-technology-society-environment objectives;' 'information and communication skills;' and 'attitude and values' (MoNE, 2007). In this study, I only focused on 'problems solving skills;' 'information and communication skills;' and 'physics-technology-society-environment objectives' related to the 'nature of physics' and 'energy' units in the THSPC. I used these skill objectives as the codes (see Table 4.8) for managing data to answer Research Question 6.

Table 4.8 Skill objectives expected from teachers to help students attain in the 'nature of physics', and 'energy' units and the related codes

Category I. Problem solving skills	**Code**
Distinguishing scientific knowledge, and view and values from each other	PSS1
Formulating a testable hypothesis for an identified problem	PSS2
Determining appropriate measurement tool to measure variables	PSS3
Recognizing appropriate experimental equipment or tools and using them safely	PSS4
Making experimental setups to test the formulated hypothesis	PSS5
Performing adequate number of measurements to reduce measurement errors	PSS6
Analyzing data collected in experiments and observations by using tables, graphs, statistical methods or mathematical calculations	PSS7
Using calculator, calculation sheet, graphing software etc. when performing numerical calculations in the process of analysis and modeling	PSS8
Expressing findings obtained after the analysis of data as models such as mathematical equations	PSS9
Realizing the probable sources of error during problem solving	PSS10
Category II. Physics-technology-society-environment objectives	
Defining physics and comprehending it as one of the basic sciences helping to understand the events in the universe	PSTEO1
Comprehending testable, questionable, falsifiable and evidence-based structure of physics	PSTEO2
Realizing that knowledge in physics increases in an accelerated way	PSTEO3
Realizing that scientific knowledge in physics is not always absolutely true; it is valid under certain conditions and limitations	PSTEO4
Explaining the role of evidences, theories and/or paradigms (ideas agreed upon by consensus by scientists) in change of scientific knowledge in physics	PSTEO5
Realizing that the change of scientific knowledge in physics is generally continuous, but it sometimes occurs as a paradigm shift	PSTEO6
Realizing that existing scientific knowledge, when a new evidence arises, is limited, corrected or renewed by testing	PSTEO7
Realizing key physics concepts (change, interaction, force, field, conservation, measurement, probability, scale, equilibrium, matter-energy relationships, space-time structure, resonance, entropy etc…)	PSTEO8
Relating physics to other sciences in terms of scientific and technological applications	PSTEO9
Examining the historical development of interaction between physics and technology	PSTEO10

Table 4.8 (continued)

Determining and explaining with examples the contribution of a technological innovation to development of scientific knowledge in physics	PSTEO11
Determining and explaining with examples the contribution of scientific knowledge in physics to development of technology	PSTEO12
Comprehending the importance of relationship between physics and technology in solving problems in daily life	PSTEO13
Explaining the working principle and/or function of technological tools used in daily life by using scientific knowledge	PSTEO14
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)	PSTEO15
Understanding that precautions can be taken against negative effects of technology, these effects can be reduced and eliminated again with technological and physical innovations	PSTEO16
Participating in contemporary discussions based on physics and technology that can affect the future of individual, society and environment	PSTEO17
Comparing the benefits of technology in terms of its balancing effect on economic, environmental and social costs	PSTEO18
Observing how physics and technology is used by society while deciding in environmental problems	PSTEO19
Offering a solution by considering needs of individual, society and environment to social problems by using physics and technology for better life	PSTEO20
Knowing necessary basic principles for safe use of equipment and devices	PSTEO21
Category III. Information and communication skills	
Using different sources of information	ICS1
Controlling whether the sources of information is reliable and valid	ICS2
Using multiple search criteria	ICS3
Searching, finding and choosing the information appropriate for one's aim	ICS4
Synthesizing information and obtaining new information	ICS5
Preparing presentations with correct outputs and appropriate for one's aims	ICS6
Using different formats such as text, number, picture, graph, diagram or table as much as possible while preparing presentation	ICS7
Making an effective presentation by using appropriate technological media and devices (internet, computer, projection device, overhead projector, slide, etc.)	ICS8
Using appropriate terminologies in their communications (written, verbal and visual) related to physics	ICS9
Expressing complex information in a clear, understandable and concise way	ICS10

Above categories and codes, as mentioned before, emerged from the student outcomes of the THSPC. However, as per Research Question 6, these were used to code teachers' attempts during their instructional practices to help students attain these outcomes. Hence, I need to exemplify here how I coded teachers' attempts. For example, for PSS2 (formulating a testable hypothesis for an identified problem), I specifically expected from teachers to create an opportunity for students to be able to hypothesize, as part of a problem solving or modeling activity. Then and only then, I considered teacher as making an attempt to help students attain this skill. However, when a teacher explains what a hypothesis is or that a hypothesis is a step in scientific process I did not consider that action as an attempt for the attainment of PSS2. As can be seen, if a teacher created an opportunity for students to perform the skills stated in the skill objectives, I counted as an attempt.

4.5 Validity and Reliability

Validity and reliability have to be considered in qualitative studies. Some issues such as constructing reliable and valid interview, analyzing the content of documents properly and drawing conclusions which are related to data can be considered in qualitative studies (Meriam, 1998). For example, four criteria were stated by Yin (2003) to judge the quality of case study research designs. These are construct validity, internal validity, external validity and reliability.

Yin (2003) defined construct validity as an "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 source of evidences, establishing chain of evidence and having key informants review draft case study report (Yin, 2003). First of all, I used multiple sources such as interview, classroom observation, and an open-ended questionnaire to collect data. Secondly, I always considered my research questions and revised them during the data collection. When evidences which were collected in data collection were not related to my research questions and did not help me reach conclusions, I tried to add extra questions into the interviews. Finally, I wanted my supervisor to examine the drafts of the case study reports and one participant to examine his case study report to increase the construct validity of the study.

Meriam (1998) suggested some strategies such as triangulation, member checks, long term observation, and peer examination to enhance internal validity in qualitative studies. I triangulated my data results by using multiple sources for the confirmation of my findings. I request one case teacher of this study to examine some parts of my data results to enhance the internal validity of this study. In addition, I observed all of the lessons of participants during one semester to increase internal validity. During the data collection, all results were sent to my supervisor to interpret data results properly.

External validity is the extent to which results of the study is generalizable to other situations (Meriam, 1998). Replication strategy (Yin, 2003) was used to generalize the results of this study. Yin (2003) proposed that “a theory must be tested by replicating the findings in a second or even a third neighborhood, where the theory has specified that the same results should occur” (p. 37). Therefore, I 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 same result. Therefore, I followed the same procedure in the data collection for each participant to increase the reliability. Robson (2002) also suggested another alternative way to increase the reliability. Keeping a full record of activities such as interviews and field notes and details of coding and data analysis increase the reliability of study. Therefore, I recorded all the interviews, and classroom observations in addition to details of coding and data analysis. In addition, I transcribed all interviews and some of the talks of teachers and students in the classroom into documents.

Moreover, I calculated the inter-rater reliability coefficient. I requested one research assistant at the university in which I worked to analyze some parts of my data. He accepted to read interview transcript of one of the participants and watch two-hours of video-recordings of each participant. As I mentioned before, I calculated the occurrence frequencies of each code in interview transcripts and video-recordings. I compared my results on the occurrence frequencies of each code with the results of the second observer.

One of the ways to calculate the inter-rater reliability is as follows: (Total number of agreements) / (Total number of observations) x 100 (Marques & McCall, 2005). I used this calculation to estimate the inter-rater reliability.

Firstly, I explained second observer how to analyze the data. I wanted him to calculate the occurrence frequencies of each code in Tables 4.5 and 4.8 by observing two-hours of video-recordings of each participant and calculate the occurrence frequencies of each code in Tables 4.3, 4.4, 4.5, 4.6 and 4.7 by reading interview transcript of one participant. Before selecting which video-recordings to be watched and interview transcript to be read by the second observer, I randomly select the video-recordings and interview transcript. After random selection, the second observer watched the video-recordings ‘Sow7’, ‘Fow4’, ‘Tow4’ and ‘Aow6’ and read the interview transcript of Case 4 – Altan.

As given in Tables 4.5 and 4.8, there were totally 46 codes for the second observer to calculate the occurrence frequencies of each code for the video-recordings. As he watched video-recordings of four participants, there were 184 observations. We agreed on 161 observations. According to formula to calculate the inter-rater reliability (Total number of agreements) / (Total number of observations) x 100, I found the inter-rater reliability as 88% for the video-recordings. There were totally 42 codes, as can be seen in Tables 4.3, 4.4, 4.5, 4.6 and 4.7 for the second observer to calculate the occurrence frequencies of each code in the interview transcript of Case Teacher 4 – Altan. We agreed on 34 observations. According to formula to calculate the inter-rater reliability, I found the inter-rater reliability as 81% for the interview transcript of Case 4 – Altan. The values above the 80% for the inter-rater reliability are in acceptable level (Marques & McCall, 2005). Therefore, the values found in this study are in acceptable level for the inter-rater reliability.

4.6 Ethical Issues

Fraenkel and Wallen (2005) warned researchers about three critical ethical issues in education research. These are protecting participants from harm, ensuring confidentially of research data and undeceiving participants. I tried to be careful in data collection process by considering these issues. First of all, I took permission from the Provincial Directorate of National Education in the city where this study was conducted. Then, I talked about the principles of schools, and teachers about the purpose and procedure of this study. I chose volunteer teachers. After their acceptance to this study was taken, each participant talked his/her students about the purpose of this study. In addition, I explained the purpose of this study to students before beginning observations. Instead of indicating participants' names, I used pseudonyms in this study to ensure confidentiality.

In addition, I only observed teachers' practice in the classroom by sitting on one of the chairs at the end of the class. I did not talk with students and interact with them during video-recordings. I did not help teachers organize the lesson and activities. I did not interact with students while they are performing some activities. I tried to be honest in the data collection and data analysis process. I informed teachers about the results of this study. In addition, I did not ask discoursing questions to teachers in interviews. I conducted interviews by considering teachers' free times.

CHAPTER 5

RESULTS

In this chapter, firstly, I presented teachers' beliefs related to strengths of teaching physics according to the THSPC. Then, I presented teachers' beliefs related to weaknesses of the THSPC. Next, I presented teachers' beliefs about how to teach physics according to the THSPC. After that, I presented the extent of reflection of teachers' beliefs about how to teach physics according to the THSPC in their instructional practices. Then, I presented teachers' beliefs about the attainment of skill objectives and the extent of reflection of these beliefs in their instructional practices. Finally, I presented the factors that teachers believe to affect their teaching physics according to the THSPC.

5.1 Beliefs Related to Strengths of Teaching Physics According to the THSPC

In order to answer Research Question 1, I asked teachers what they believe to be strengths of teaching physics according to the THSPC in the interview. Based on teachers' responses, I calculated the occurrence frequencies of strengths of teaching physics according to the THSPC that teachers indicated. Table 5.1 presents the beliefs related to strengths of teaching physics according to the THSPC and how many times each teacher expressed these beliefs in the interview.

As can be seen in Table 5.1, the beliefs related to strengths of teaching physics according to the THPSC indicated by most teachers were 'SRP', 'SIP', 'SPK'. Three teachers Sinan, Fatih and Altan believed that the THSPC helped students relate physics to their daily life, become interested in physics lessons and have a permanent knowledge.

Table 5.1 Beliefs and occurrence frequencies of these beliefs related to the strengths of teaching physics according to the THSPC

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
THSPC helps students	relate physics to their daily life	SRP	8	2		1	11
	become interested in physics lessons	SIP	2	3		4	9
	participate in discussions or activities	SPD	2	4			6
	have a permanent knowledge	SPK	3	1		1	5
	have a general knowledge about physics	SGK			4		4
	develop study habits	SDS	3				3
	use their skills	SUT	2				2

For example, the following excerpt from the interview with Sinan illustrates his beliefs that "THSPC helps students relate physics to their daily life" and "THSPC helps students participate in discussions or activities":

> Sinan: "This program [referring to THSPC] draws the attention of students more while we are giving examples from physics-technology-society-environment relationship. For example, when we 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. They want to talk about their readings and the videos they watched which are related to their daily life. They can talk about them." (Sis1)

Pajares (1992) indicated that teaching experiences of individuals affected formation of beliefs. For example, when I watched video-recordings of Sinan, I realized that his answers to interview questions could be a manifestation of his teaching experiences. Sinan believed that the THSPC helped students participate in discussions due to its relation with technology, society and environment. I observed that students were more willing to participate in discussions in the classroom, while he was talking about the physics and technology relationship. The following excerpt from the video-recordings of Sinan exemplifies this situation:

> Sinan: “You are filling in the blanks.” [He wanted students to perform one activity in their course book. He wanted students to find some energy transformations in daily life. Students wrote their findings on their course book]
>
> Student: “Teacher! Could I give an example?” [Students could not begin to perform the activity because they wanted to mention their ideas wishfully in the classroom. Although Sinan warned them to perform the activity, one of the students in the classroom said his idea.]
>
> Sinan: “No. It is not the time.”
>
> Student: “Teacher!” [He also wanted to express his ideas. However, Sinan only gave permission to only one student, out of five students to say his idea]. (Sow6)

Like Sinan, Fatih believed that the THSPC helped students become interested in physics and have a permanent knowledge. In addition, he believed that students could participate in discussions and relate physics to daily life by means of the THSPC. The following excerpt from the interview with Fatih illustrates his beliefs related to strengths of teaching physics according to the THSPC:

> Fatih: “Before this curriculum, we mentioned formulas and rules. We solved questions by using these formulas and rules. Students did not understand or a few students understood them. Now, physics lessons are enjoyable due to its emphasis on daily life. Majority of students try to participate in discussion in physics lessons and they like physics lessons. Students are more willing to participate in discussions in lessons. It is more related to daily life, therefore, understanding physics become easy and students do not forget what they have learned.” (Fis1)

Similar to Sinan and Fatih, Altan believed that the THSPC helped students become interested in physics lessons, relate physics to their daily life and have a permanent knowledge. The following excerpt from the interview with Altan illustrates his beliefs related to strengths of teaching physics according to the THSPC:

> Altan: “Now, there are some strengths of physics curriculum as follows: it emphases on visuals and using laboratory. But there are some problems. For example, students do not have same opportunities in Turkey. There is no appropriate laboratory environment…”
>
> Interviewer: “I want to ask the question again. Are there any strengths of teaching physics according to the THSPC?”
>
> Altan: “Students will become more interested in physics lessons if the curriculum is implemented. Students do not forget what they learned because physics curriculum

emphasizes on visuals. In addition, it relates physics to daily life. It emphasizes on practice instead of emphasizing on abstract concepts. Due to emphasis on practice, it draws attention of students more. Students become interested in physics lessons." (Ais1)

Different from other teachers, Tarık stated that the fact that Grade 9 Physics Curriculum included a majority of physics topics. In this regard, he believed, students could have general knowledge about physics. The following excerpt from the interview with Tarık illustrates his belief:

Tarık: "Mentioning many topics in the Grade 9. Students can be aware of almost all of the physics topics especially in Grade 9. I think that it is an advantage for students."

Interviewer: "What do you mean with being aware of many of the physics topics?"

Tarık: "Therefore, we can inform students about physics world. For example, think that students will choose courses after 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 which were related to waves and electric…" (Tis1)

Tarık also indicated this strength in the classroom. The following excerpt from the video-recordings of Tarık illustrates this situation:

Tarık: "This unit [referring to 'nature of physics' unit] includes verbal explanations. There is what physics includes. In fact, I want to say again; I like the topics of Grade 9 High School Physics Curriculum. For example, you [students] will prepare projects as a student of Science High School. However, when we wanted students to prepare projects in Grade 9, they did not know anything about physics. They know some topics, but they never heard some topics. In this situation, how do they prepare projects?" (Tow1)

To sum up, three teachers Sinan, Fatih and Altan had generally similar beliefs related to strengths of teaching physics according to the THSPC. For example, they believed that the THSPC helped students relate physics to their daily life, become interested in physics lessons and have a permanent knowledge. Differently, Tarık believed that the THSPC helped students have a general knowledge about physics.

In order to understand better teachers' beliefs related to strengths of teaching physics according to the THSPC, I also asked teachers about what they believe to be strengths of teaching physics by considering real-life context-based approach, integrating knowledge and skill objectives, and considering problem solving skills (PSS), physics-technology-society-environment-objectives (PTSEO) and information and communication skills (ICS). The following sections present the findings related to these questions.

5.1.1 Beliefs related to strengths of teaching physics by considering real-life context-based approach

I asked teachers what they believe to be strengths of teaching physics by considering real-life context-based approach in the interview. According to teachers' responses, I calculated the occurrence frequencies of strengths of teaching physics by considering real-life context-based approach that teachers indicated. Table 5.2 presents the beliefs related to strengths of teaching physics by considering real-life context-based approach and how many times each teacher expressed these beliefs in the interview.

Table 5.2 Beliefs and occurrence frequencies of these beliefs related to strengths of teaching physics by considering real-life context-based approach

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
Teaching physics by considering real-life context-based approach helps students	become interested in physics lessons	SIP		7	1	7	15
	use their skills	SUT				13	13
	relate physics to their daily life	SRP	1		2	6	9
	participate in discussions or activities	SPD				9	9
	have a permanent knowledge	SPK	2	2		1	5
	become more conscious individuals	SBC	1		1		2
	overcome the problems encountered in their life	SOP			1		1

As can be seen in Table 5.2, the beliefs related to strengths of teaching physics by considering real-life context-based approach indicated by most teachers were ‘SIP’, ‘SRP’, ‘SPK’. Three teachers believed that the THSPC helped students relate physics to their daily life, become interested in physics lessons and have a permanent knowledge. For example, the following excerpt from the interview with Sinan illustrates his belief that “THSPC helps students have a permanent knowledge”:

> Sinan: “It [referring to teaching physics by considering real-life context-based approach] provides students to have a permanent knowledge. They understand physics concept better. Students can learn better. They can think concretely.” (Sis2)

Like Sinan, Fatih believed that teaching physics by considering real-life context-based approach helped students have a permanent knowledge. The following excerpt from the interview with Fatih exemplifies his belief:

> Fatih: “Unless you give concrete examples from daily life, students think where they [students] will use this knowledge. For example, when I talked about the nuclear centrals, I talked about the examples which were related to nuclear centrals in Germany. I talked about the central which will be built in Sinop. When we talk about these examples, students understand better and learn easier…” (Fis2)

In addition, Sinan believed that teaching physics by considering real-life context-based approach provided students to become more conscious individuals. The following excerpt from the interview with Sinan illustrates this belief:

> Sinan: “In addition, 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.” (Sis2)

Fatih believed that students became interested in physics lessons when he taught physics by considering real-life context-based approach. This belief could be formed due to his teaching experiences. I observed that students were interested in physics lessons, when he was talking about nuclear centrals. The following excerpt from the video-recordings of Fatih illustrates this situation:

> Fatih: “Let’s discuss the advantages of disadvantages of nuclear centrals.”

Student 1: "There are some disadvantages of …" [Fatih interrupted a student's speech because he wanted to discuss advantages of nuclear centrals first].

Fatih: "First, let's talk about advantages."

Student 2: "Teacher! It produces electric."

Student 3: "Electric."

Fatih: "Friends! It produces huge amount of electric by using little amount of energy."

Student 3: "Hımmm"

Fatih: "With consuming less fuel, for example, it produces huge amount of energy by using one or two kilograms of uranium."

Student 4: "More work with little cost."

Fatih: "It can produce huge amount of energy."

Student 4: "Wow!" (Fow8)

Altan believed that teaching physics by considering real-life context-based approach helped students participate in discussions or activities. The following excerpt from the interview with Altan exemplifies his belief:

> Altan: "Due to not mentioning the physics rules at the beginning of the lessons, students can relate it to their daily life. Because you did not mention the rules and formulas, …they can relate them to their experiences in daily life. They try to participate in discussions by showing it as an example" (Ais2)

Consequently, different from the beliefs related to strengths of teaching physics according to the THSPC, two beliefs were found in this section. These were "Teaching physics by considering real-life context-based approach helps students become more conscious individuals" and "Teaching physics by considering real-life context-based approach helps students overcome the problems encountered in their life"

5.1.2 Beliefs related to strengths of teaching physics by integrating knowledge and skill objectives

Similar to previous section, I calculated the occurrence frequencies of strengths of teaching physics by integrating knowledge and skill objectives that teachers indicated in the interview. Table 5.3 presents the beliefs related to strengths of teaching physics by integrating knowledge and skill objectives and how many times each teacher expressed these beliefs in the interview.

Table 5.3 Beliefs and occurrence frequencies of these beliefs related to strengths of teaching physics by integrating knowledge and skill objectives

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
Teaching physics by integrating knowledge and skill objectives helps students	have a permanent knowledge	SPK	2	2	1	2	7
	become interested in physics lessons	SIP				3	3
	use their skills	SUT		1			1

According to Table 5.3, all participants believed that teaching physics by integrating knowledge and skill objectives provided students to have a permanent knowledge. In addition, Altan believed that it helped students become interested in physics lessons. Fatih believed that it helped students use their skills. The following excerpt from the interview with Sinan illustrates his belief that "Teaching physics by integrating knowledge and skill objectives helps students have a permanent knowledge":

> Sinan: "Teaching knowledge with activities provides students to have permanent knowledge. Therefore I think preparation of knowledge and skill objectives together as positive. Students do not forget what they learned." (Sis2)

Like Sinan, Altan believed that teaching physics by integrating knowledge and skill objectives helped students have a permanent knowledge. The following excerpt from the interview with Altan exemplifies his belief:

> Altan: "…when practical knowledge is given to students in addition to theoretical knowledge, 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…" (Ais2)

As a conclusion, all participants believed that teaching physics by integrating knowledge and skill objectives helped students have a permanent knowledge about physics.

5.1.3 Beliefs related to strengths of teaching physics by considering PSS

I asked teachers strengths of teaching physics by considering PSS in the interview. Based on their responses, I calculated the occurrence frequencies of strengths of teaching physics by considering PSS that teachers indicated. Table 5.4 presents the beliefs related to strengths of teaching physics by considering PSS and how many times each teacher expressed these beliefs in the interview.

Table 5.4 Beliefs and occurrence frequencies of these beliefs related to strengths of teaching physics by considering PSS

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
Teaching physics by considering PSS helps students	use their skills	SUT	12			4	16
	overcome the problems in their life	SOP		2	1		3
	become interested in physics lessons	SIP	1			1	2
	develop study habits	SDS	1				1
	participate in discussions or activities	SPD	1				1
	have a permanent knowledge	SPK	1				1
	feel more self-confidence	SFS			1		1

As shown in Table 5.4, Sinan believed that teaching physics by considering PSS helped students use their skills. The following excerpt from the interview with Sinan exemplifies his belief:

> Sinan: "First of all, when we perform activities, students recognize themselves better. They study as team. We try to create a discussion environment in problem solving. Therefore, students become more interested. They are carrying out experiments and they develop their psychomotor skills. For example, when they collect data, they investigate whether the source of knowledge is reliable and learn how to research. In addition, they learn how to test hypothesis. They express their findings with mathematical terms. They develop their numerical skills."
>
> Interviewer: "What do you mean with numerical skills?"

> Sinan: "For example, they can interpret graphs. They can use mathematic to interpret graph. They perform mathematical calculations on the graph." (Sis3)

Sinan also indicated this same belief "Teaching physics by considering PSS helps students use their skills" in the open-ended questionnaire. For example, he stated that helping students attain 'PSS4' which is "recognizing appropriate experimental equipment or tools and using them safely" developed their psychomotor skills. The following excerpt from the open-ended questionnaire illustrates the necessity of attainment of 'PSS4' by students:

> "Using equipment in problem solving provides students to practice. While they are using equipment, they develop their psychomotor skills. In addition, they will not be unfamiliar to equipment in following years."

Like Sinan, Altan believed that teaching physics by considering PSS helped students use their skills. In the interview, he indicated that teaching physics by considering PSS helped students use their questioning skills. The following excerpt from the interview with Altan illustrates his belief:

> Altan: "Questioning skills. He/she does not look at the events without questioning. Why it is like this? For example, we were mentioning past. For example, you ask students: there is a gravity force, it is toward down, that is, centre of the world; why the plant moves towards the opposite direction of the gravity force. For example, students are curious about them because they see them in daily life." (Ais3)

Altan indicated this same belief "Teaching physics by considering PSS helps students use their skills" in the open-ended questionnaire. For example, he stated that helping students attain 'PSS6' which is "performing adequate number of measurements to reduce measurement errors" provided students to use their skills. The following excerpt from the open-ended questionnaire illustrates the necessity of attainment of 'PSS6' by students:

> "It provides students to use their skills related to measurement."

Fatih indicated that students who had PSS would be more successful in overcoming the problems in their life. The following excerpt from the interview with Fatih exemplifies his belief:

> Fatih: “Students will learn how to solve problems which are encountered in daily life. They will become a person who can solve problems instead of becoming a person who has many problems. For example, when I face some problems, I get help from school administration. However, if we have PSS, we can solve our problems without getting help.” (Fis3)

Similarly, he indicated that students could solve the problems encountered in their life by attaining problem solving skill ‘PSS2’ which is “formulating a testable hypothesis for an identified problem” in the open-ended questionnaire. The following excerpt from the open-ended questionnaire illustrates the necessity of attainment of ‘PSS2’ by students:

> “Students can find reasonable and applicable solutions to overcome the problems in daily life.”

Tarık stated that students who attained PSS looked at the events in nature as scientist. Like Fatih, he believed that helping students attain PSS helped them overcome the problems in their life. The following excerpt from the interview with Tarık illustrates his belief:

> Tarık: “When students attain PSS, they look at the events in nature as scientist. They develop their PSS.”
>
> Interviewer: “How do they look at the events in the nature as scientists?”
>
> Tarık: “For example, when they face some problems in their life, they think like scientist. They try to become productive individuals. They try to find solution ways to problems [referring to problems in daily life] by investigating.”

Similarly, Tarık stated this belief in the open-ended questionnaire. He believed that helping students attain ‘PSS2’ which is “formulating a testable hypothesis for an identified problem” helped them overcome the problems in their life. The following excerpt from the open-ended questionnaire exemplifies the necessity of attainment of ‘PSS2’ by students:

> “Students learn how to solve the problems in life.”

In addition, Tarık indicated different belief which is “Teaching physics by considering PSS helped students feel more self-confidence”. The following excerpt from the interview with Tarık illustrates his belief:

Tarık: "When students attain PSS, their self-confidence increases. Their teachers and society appreciate them due to their achievement..." (Tis3)

Tarık stated the same belief in the open-ended questionnaire. The following excerpt from the open-ended questionnaire exemplifies his belief and the necessity of attainment of 'PSS4' which is "recognizing appropriate experimental equipment or tools and using them safely" by students:

"Students feel more self-confidence when they begin to perform experiments because they do by themselves. Therefore, they develop their PSS."

As a consequence, most teachers believed that teaching physics by considering PSS helped students use their skills, overcome the problem in their life and become interested in physics lessons.

5.1.4 Beliefs related to strengths of teaching physics by considering PTSEO

I asked teachers strengths of teaching physics by considering PTSEO in the interview. According to their responses, I calculated the occurrence frequencies of strengths of teaching physics by considering PTSEO that teachers indicated. Table 5.5 presents the beliefs related to strengths of teaching physics by considering PTSEO and how many times each teacher expressed these beliefs in the interview.

Table 5.5 Beliefs and occurrence frequencies of these beliefs related to strengths of teaching physics by considering PTSEO

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
Teaching physics by considering PTSEO helps students	become interested in physics lessons	SIP	1	1	4	6	12
	relate physics to their daily life	SRP	1	2	2	4	9
	become more conscious individuals	SBC	5	1			6
	use their skills	SUT	1			1	2
	participate in discussions or activities	SPD				1	1

As indicated in Table 5.5, the beliefs related to strengths of teaching physics by considering PTSEO indicated by all teachers were ‘SIP’, and ‘SRP’. They believed that teaching physics by considering PTSEO helped students relate physics to their daily life, and become interested in physics lessons. For example, the following excerpt from the interview with Sinan illustrates his belief that “Teaching physics by considering PTSEO helps students become interested in physics lessons”:

> Sinan: “First of all, students’ interest increases. For example, they realize that physics is developing continuously. They realize that developments in physics influence developments in technology. On the other hand, they realize that developments in technology influence developments in physics. When students learn them, their attitude toward physics also changes.” (Sis3)

Like Sinan, Tarık believed that teaching physics by considering PTSEO helped students become interested in physics lessons. The following excerpt from the interview with Tarık exemplifies his belief:

> Tarık: “For example, when we give examples from physics and technology, students become more interested. They ask me questions. For example, when I talk about the waves, they ask me that where will we use waves in our daily life. I have been talking about mobile phones. We mention that mobile phones are working according to principles of electromagnetic waves. We talk about current issues which are related to physics and technology. Therefore, students’ interest increases.” (Tis3)

In the open-ended questionnaire, Tarık also indicated that helping students attain ‘PTSEO10’ which is “examining the historical development of interaction between physics and technology” helped them become interested in physics lessons. The following excerpt from the open-ended questionnaire which was administered to Tarık illustrates the necessity of attainment of ‘PTSEO10’ by students:

> “When student investigates historical development, he/she realizes how science develops. Therefore, his interest increases.”

In addition, Sinan believed that teaching physics by considering PTSEO helped students become more conscious individuals. The following excerpt from the interview with Sinan illustrates his belief:

> Sinan: "...when students learn them, their attitude toward physics also changes. Then, they begin to consider how I [students] can be beneficial for the society. They reflect their learning in their life. For example, they use the electric economically in their home. They realize that electric energy is not produced easily."
>
> Interviewer: "Are there any other strengths?"
>
> Sinan: "When they understand physics, they begin to understand technology. For example, when they buy technological products, they consider their affect on environment. When they buy vacuum cleaner, they think how much this vacuum cleaner consumes power. They begin to think them." (Sis3)

In addition, in the open-ended questionnaire, he indicated that helping students attain 'PTSEO18' which is "comparing the benefits of technology in terms of its balancing effect on economic, environmental and social costs" helped students become more conscious individuals. The following excerpt from the open-ended questionnaire illustrates the necessity of attainment of 'PTSEO18' by students:

> "It helps students buy technologic products by considering its negative effects on environment. Therefore, there is a need to attain."

Like Sinan, Fatih believed that teaching physics by considering PTSEO helped students become more conscious individuals. The following excerpt from the interview with Fatih exemplifies his belief:

> Fatih: "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 to environmental problems and try to protect their environment. For example, when students think how to increase their quality of life, they encounter with physics and technology. People think how to consume water less, are aware of the use of A class of home appliances to save up electricity, and buy cars which consume less oil. Students will be aware of these technological tools that facilitate their life." (Fis3)

In addition, he stated this belief, when he explained the necessity of attainment of 'PTSEO16' which is "understanding that precautions can be taken against negative effects of technology, these effects can be reduced and eliminated again with technological and physical innovations" in the open-ended questionnaire. The following excerpt from the open-ended questionnaire illustrates the necessity of attainment of 'PTSEO16' by students:

> "He/she knows how to use technology without damaging his/her environment. For example, he buys a car which consumes less oil and damage environment less."

Consequently, all teachers believed that teaching physics by considering PTSEO helped students become interested in physics lessons and relate physics to their daily life.

5.1.5 Beliefs related to strengths of teaching physics by considering ICS

I asked teachers strengths of teaching physics by considering ICS in the interview. Based on their responses, I calculated the occurrence frequencies of strengths of teaching physics by considering ICS that teachers indicated. Table 5.6 presents the beliefs related to strengths of teaching physics by considering ICS and how many times each teacher expressed these beliefs in the interview.

Table 5.6 Beliefs and occurrence frequencies of these beliefs related to strengths of teaching physics by considering ICS

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
Teaching physics by considering ICS helps students	use their skills	SUT	9	4	3	7	23
	become interested in physics lessons	SIP		1		3	4
	have a permanent knowledge	SPK				3	3
	feel more self-confidence	SFS	1				1

As given in Table 5.6, all participants believed that teaching physics by considering ICS helped students use their skills. For example, the following excerpt from the interview with Sinan illustrates this belief:

> Sinan: "First of all, student 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 as books and internet. In addition, we assign students research homework, they investigate information from internet. They can learn how to use computer and computer programs. For example, they may use some programs such as MS PowerPoint or MS Word. They can choose information according to their aims while preparing poster. They can use appropriate pictures or texts in the preparation. They develop their imagination skills. They organize the texts and pictures in the poster." (Sis4)

Additionally, in the open-ended questionnaire, Sinan indicated that helping students attain 'ICS2' which is "controlling whether the sources of information is reliable and valid" encouraged them to develop their questioning skills. The following excerpt from the open-ended questionnaire illustrates the necessity of attainment of 'ICS2' by students:

> "Due to this skill, students should have questioning skills. They do not memorize information."

Like Sinan, Fatih believed that helping students attain ICS helped them use their skills. For example, he indicated that helping students attain 'ICS10' which is "expressing complex information in a clear, understandable and concise way" encouraged students to develop their communication skills in the open-ended questionnaire. The following excerpt from the open-ended questionnaire illustrates the necessity of attainment of 'ICS10' by students:

> "It is needed for students to express themselves more effectively and explain his ideas."

In addition, similar to Sinan and Fatih, Altan believed that teaching physics by considering ICS helped students use their skills. For example, the following excerpt from the open-ended questionnaire illustrates the necessity of helping students attain 'ICS4' which is "investigating, finding and choosing the information appropriate to his/her aim":

> "Students learn how to find information"

To sum up, Fatih and Altan believed that teaching physics by considering ICS helped students become interested in physics lessons, Altan believed that teaching physics by considering ICS helped students have a permanent knowledge, and Sinan believed that teaching physics by considering ICS helped students feel self-confidence more.

5.1.6 Summary of the results about the beliefs related to strengths of teaching physics according to the THSPC

I asked teachers strengths of teaching physics by considering real-life context-based approach, integrating knowledge and skill objectives, and considering PSS, PTSEO and ICS to get complete answer for Research Question 1 in addition to asking them strengths of teaching physics according to the THSPC in the interviews. I presented the beliefs related to strengths in Sections 5.1, 5.1.1, 5.1.2, 5.1.3, 5.1.4 and 5.1.5. In this section, on the other hand, I presented overall beliefs related to strengths of teaching physics according to the THSPC and overall occurrence frequencies of these beliefs in Table 5.7.

According to Table 5.7, the beliefs related to strengths of teaching physics according to the THPSC indicated by most teachers were 'SUT', 'SIP', 'SRP', 'SPK', 'SPD' and 'SBC'. 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 permanent knowledge. Sinan, Fatih and Altan believed that the THSPC helped students participate in discussions or activities, and Sinan, Fatih and Tarık believed that the THSPC helped students become more conscious individuals.

In addition to these beliefs indicated by most teachers, teachers had some different beliefs related to teaching physics according to the THSPC. For example, Sinan believed that the THSPC helped students develop study habits. Tarık believed that the THSPC helped students have a general knowledge about physics. Fatih and Tarık believed that the THSPC helped students overcome the problems encountered in their life. Sinan and Tarık believed that the THSPC helped students feel more self-confidence.

Table 5.7 Overall beliefs and overall occurrence frequencies of these beliefs related to strengths of teaching physics according to the THSPC

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
THSPC helps students	use their skills	SUT	24	5	3	25	57
	become interested in physics lessons	SIP	4	12	5	24	45
	relate physics to their daily life	SRP	10	4	4	11	29
	have a permanent knowledge	SPK	8	5	1	7	21
	participate in discussions or activities	SPD	3	4		10	17
	become more conscious individuals	SBC	6	1	1		8
	develop study habits	SDS	4				4
	have a general knowledge about physics	SGK			4		4
	overcome the problems encountered in their life	SOP		2	2		4
	feel more self-confidence	SFS	1		1		2

5.2 Beliefs Related to Weaknesses of the THSPC

Research Question 2 concerned about teachers' belief related to weaknesses of the THSPC. In the interview, related to this research question, I asked participants what they believe to be weaknesses of the THSPC. Based on teachers' responses, I calculated the occurrence frequencies of weaknesses of the THSPC that teachers indicated. Table 5.8 shows the beliefs related to weaknesses of the THSPC and how many times each teacher expressed these beliefs in the interview.

According to Table 5.8, most of the weaknesses of the THSPC that participants believed were related to the topics in the THSPC. For example, Tarık and Altan believed that orders of topic in the curriculum were not appropriate. For example, the following excerpt from the interview with Tarık illustrates this belief:

> Tarık: "I do not like orders of topic especially in the Grade 11. For example, it is needed to teach circular motion before teaching energy."
>
> Interviewer: "Why?"

Tarık: "Because, we mention the energy of planets in force and motion unit in Grade 11. However, students do not know circular motion. I think that students should know some concepts of circular motion in Grade 11. I mentioned some of the concepts such as angular velocity. Therefore, students understood better the motion of planets. I think that all of the topics which are related to mechanics should be finished before students pass the Grade 12. In addition, I think that we cannot separate topics of optics and topics of wave from each other. For example, in the Grade 10, we mention reflection of waves; however, which rules students will use while explaining the reflection. Topics which are related to optics are mentioned in Grade 12. Students do not know the reflection in Grade 10. Therefore, I think that there are some problems in the orders of the topics." (Tis1)

Table 5.8 Beliefs and occurrence frequencies of these beliefs related to weaknesses of the THSPC

			Teachers				Total
Beliefs		Code	Sinan	Fatih	Tarık	Altan	freq.
THSPC	includes unsuitable orders of topic	WUO			2	3	5
	does not mention how to attain objectives in detail	WMH	1			3	4
	expects from teachers to explain topics superficially	WTS		1		2	3
	includes difficult topics for students' level	WDT		2			2

Like Tarık, Altan believed that orders of topic in the THSPC were not appropriate. The following excerpt from the interview with Altan illustrates his belief:

Altan: "… not mentioning buoyancy force in the explanation of matter and properties or not mentioning pressure is weakness."
Interviewer: "Why?"
Altan: "Now, for example, when the buoyancy force is not taught, there are some deficiencies in the 'matter and properties unit'. Students cannot understand completely 'matter and properties unit'.

In addition, Fatih and Altan believed that the THSPC expected from teachers to explain topics superficially. They believed that it was a weakness of the

THSPC. The following excerpt from the interview with Altan exemplifies this belief:

> Altan: "… students learn 'work' and 'energy'; however, they do not learn them in detail. After one year passed, they will forget 'work' and 'energy' because they do not repeat topics. Students will have to learn these topics again in Grade 11. If the concepts of 'energy' unit or others were learned only in Grade 11, learning would occur better."
>
> Interviewer: "Will not students forget, when the concepts in 'energy' unit are taught entirely in one grade?"
>
> Altan: "This really affects our teaching negatively. We cannot teach in detail. After two years passed, students forget… (Ais1)

As a conclusion, teachers had different beliefs related to weaknesses of the THSPC. For example, Tarık and Altan believed that the THSPC included unsuitable order of topics, Fatih and Altan believed that the THSPC expected from teachers to explain topics superficially. Sinan and Altan believed that the THSPC did not mention how to attain objectives in detail; Fatih believed that the THSPC included difficult topics for students' level.

5.3 Beliefs about How to Teach Physics According to the THSPC

Research Question 3 was concerned with teachers' beliefs about how to teach physics according to the THSPC. Data for this question were collected through the interviews and an open-ended questionnaire. In the interviews, I asked teachers how they teach physics by considering, in general sense, the real-life context-based approach, PSS, PTSEO and ICS. Also, in the open-ended questionnaire, I specifically asked teachers, if and only if they agreed that a particular skill objective can be attained by the students in a classroom environment, to describe how that particular skill objective would be attained.

5.3.1 Beliefs about how to teach physics by considering real-life context-based approach

I asked teachers about how to teach physics by considering real-life context-based approach in the interview. Based on teachers' responses, I calculated the occurrence frequencies of teaching techniques that teachers indicated. Table 5.9

presents the beliefs related to how to teach physics by considering real-life context-based approach and how many times each teacher expressed these beliefs in the interview.

Table 5.9 Beliefs and occurrence frequencies of these beliefs related to how to teach physics by considering real-life context-based approach

Beliefs		Code	Teachers Sinan	 Fatih	 Tarık	 Altan	Total freq.
Physics can be taught by considering real-life context-based approach by	giving examples from daily life	TGE	2	6	1	1	10
	creating a discussion environment	TCD		1	1	4	6

As indicated in Table 5.9, all teachers believed that physics could be taught by considering real-life context-based approach by giving examples from daily life. The following excerpt from the interview with Sinan illustrates this belief:

> Sinan: "Now, we try to mention the experiences of students more. While helping students remember the events which they face in their daily life, we try to relate them to physics. We wish go to laboratory. However, we cannot. We talk about the examples which are related to daily life. We try to perform some activities."
>
> Interviewer: "Do you choose activities from daily life?"
>
> Sinan: "We choose them from course book. For example, we demonstrate visuals which are related to daily life in the course book in the classroom. We associate these visuals with life." (Sis2)

Like Sinan, Fatih believed that he could teach physics by considering real-life context-based approach by giving examples from daily life. The following excerpt from the interview with Fatih illustrates his belief:

> Fatih: "For example, I teach the transformation of heat. I ask students that can you [students] touch the wooden spoon when your mother forgets it in the kettle. When we give examples like this, students become more interested. In the transformation of heat, I ask students that how the heater heats your room, and how the sun heats us. In addition, I ask that do you [students] do work when you move your bag along a straight road. We try to give examples which are related to students' experiences."

Similarly, Tarık believed that physics could be taught by considering real-life context-based approach by giving examples from daily life. The following excerpt from the interview with Tarık exemplifies his belief:

> Tarık: "Now, physics takes its power from technology. While teaching physics, we mention electrical installations in the school, X-ray films in hospitals, cars, bus and planes. They facilitate our life and they are operating according principles of physics. For example, one of the important tools which facilitates our life is mobile phone. It is operating according to principle of wave physics. We try to mention all of them. Therefore, we do not begin our teaching immediately without explaining them."
>
> Interviewer: "Do you use this method before beginning to lesson?"
>
> Tarık: "Yes, in addition, I ask students questions to increase students' interest…" (Tis2)

Like other teachers, Altan believed that he could teach physics by considering real-life context-based approach by giving examples from daily life. The following excerpt from the interview with Altan exemplifies his belief:

> Altan: "Before beginning to lesson, we talk about examples which are related to daily life. We asked that how it [referring to events in daily life] occurred. Student interprets. Then, there is something in physics, it [referring to events in daily life] is explained like this. Students say that if you explained it before, we have already known it. Due to this reason, student does not forget it. He/she becomes interested in lesson and comment a lot. After they learned some physics rules, they realize whether their interpretation is true. I teach like this." (Ais2)

In addition, Fatih, Tarık and Altan believed that physics could be taught by considering real-life context-based approach by creating a discussion environment. The following excerpt from the interview with Fatih illustrates his belief:

> Fatih: "I remember that I talked about the fossil fuels in the classroom. I said that they were exhausted after 50 years. Wars will begin. They attract students' attention. We have also discussed hydroelectric centrals and solar energy. I have talked about the working principle of cars. We try to give examples from daily life." (Fis2)

To sump up, all teachers believed that physics could be taught by considering real-life context-based approach by giving examples from daily life. There teachers believed that they could teach physics by considering real-life context-based approach by creating a discussion environment.

5.3.2 Beliefs about how to teach physics by considering PSS

In addition to asking teachers about how to teach physics by considering real-life context-based approach, I asked them how to teach physics by considering PSS in the interview. However, Tarık and Altan indicated that they did not teach physics by considering PSS. Sinan and Fatih indicated some teaching techniques to teach physics by considering PSS in the interview. I calculated the occurrence frequencies of teaching techniques that they indicated. Table 5.10 presents the beliefs related to how to teach physics by considering PSS and how many times each teacher expressed these beliefs in the interview.

Table 5.10 Beliefs and occurrence frequencies of these beliefs related to how to teach physics by considering PSS

Beliefs		Code	Teachers		Total
			Sinan	Fatih	freq.
Physics can be taught by considering PSS by	creating a discussion environment	TCD	2	3	5
	carrying out hands-on activities	TCO	1	2	3
	giving examples from daily life	TGE		2	2
	giving students research homework	TGS	1		1

Sinan believed that he helped his students attain PSS by performing some activities, creating a discussion environment, and giving students research homework. The following excerpt from the interview with Sinan illustrates his belief which is “Physics can be taught by considering PSS by creating a discussion environment”:

> Sinan: “… I asked students questions from the course book. For example, there were two pictures in the course book. I asked which crane was more powerful and lifted objects higher. I wanted students to guess. In addition, there were pictures which were related to energy sources. I asked students the efficiency of these energy sources. I tried to collect students’ ideas.” (Sis3)

Investigation of how Sinan would teach PSS also included collecting data with an open-ended questionnaire. Sinan indicated in the open-ended questionnaire that he could help students attain ‘PSS2’, ‘PSS3’, ‘PSS7’ and ‘PSS10’ among 10 PSS. He indicated that he could help students attain ‘PSS2’ and ‘PSS10’ by creating a discussion environment, and ‘PSS3’ and ‘PSS7’ by carrying out hands-on activities. He thought that he could not help students attain ‘PSS1’, ‘PSS4’, ‘PSS5’, ‘PSS6’, ‘PSS8’ and ‘PSS9’ due to some factors, which would be discussed later in next sections. For example, he believed that he could help students attain ‘PSS2’ which is “formulating a testable hypothesis for an identified problem”. The following excerpt from the open-ended questionnaire illustrates how he wanted to teach this skill:

> “I can help students attain this skill by discussing what is needed for hypothesizing and how is hypothesized”

Fatih believed that he could help students attain PSS by performing some hands-on activities, giving examples from daily life, and creating a discussion environment in the classroom. The following excerpt from the interview with Fatih illustrates his beliefs about how to teach physics by considering PSS:

> Fatih: “We try to choose easy examples from daily life. We talk about them in the classroom. We use accessible materials in the classroom. For example, we pour water into the perforated bottle. We try to mention the examples in the daily life. For example, we determine a problem. I ask students that how we can solve it. They suggest their solution ways. We encourage them to discuss them. Everybody in the classroom says their ideas. We try to guide them to solve the problem.” (Fis3)

Fatih indicated that he could help students attain ‘PSS1’, ‘PSS3’, ‘PSS6’ and ‘PSS10’ in the open-ended questionnaire. He thought that he could help students attain ‘PSS1’ by creating discussion environment, and ‘PSS3’, ‘PSS6’ and ‘PSS10’ by performing hands-on activities. He believed that he could not help students attain ‘PSS2’, ‘PSS4’, ‘PSS5’, ‘PSS7’, ‘PSS8’, and ‘PSS9’. The following excerpt from the open-ended questionnaire illustrates how he wanted to help students attain ‘PSS1’ which is “distinguishing scientific knowledge, and view and values from each other”:

> “We can discuss which knowledge are scientific and which knowledge are not scientific in the classroom.”

Although Tarık and Altan indicated that they could not teach physics by considering PSS, they believed that they could help students attain some PSS in the open-ended questionnaire. For example, Tarık indicated that he could help students attain ‘PSS1’ by creating a discussion environment. He thought that he could not help students attain ‘PSS2’, ‘PSS3’, ‘PSS4’, ‘PSS5’, ‘PSS6’, ‘PSS7’, ‘PSS8’, ‘PSS9’ and ‘PSS10’. For example, he believed that he could help students attain ‘PSS1’ which is “distinguishing scientific knowledge, and view and values from each other” by creating a discussion environment. The following excerpt from the open-ended questionnaire exemplifies how he wanted to teach this skill:

> “We can discuss the questions which are ‘what are the differences between scientific knowledge?’ and ‘are every information scientific?’ in the classroom.”

Altan indicated that he could help students attain ‘PSS1’, ‘PSS2’, and ‘PSS7’ in the open-ended questionnaire. He believed that he could help students attain ‘PSS1’ by creating a discussion environment, and ‘PSS2’ and ‘PSS7’ by giving students research homework. He believed that he could not help students attain ‘PSS3’, ‘PSS4’, ‘PSS5’, ‘PSS6’, ‘PSS8’, ‘PSS9’ and ‘PSS10’. The following excerpt from the open-ended questionnaire illustrates how he wanted to teach ‘PSS2’ which is “formulating a testable hypothesis for an identified problem”:

> “It can be required from students to hypothesize about one problem by giving them homework”

Consequently, Sinan believed that he could teach physics by considering PSS by creating a discussion environment, carrying out hands-on activities and giving students research homework. Fatih believed that he could teach physics by considering PSS by creating a discussion environment, carrying out hands-on activities and giving examples from daily life.

Although Tarık and Altan indicated that they could not teach physic by considering PSS in the interview, they indicated how they would teach physics by considering some of PSS in the open-ended questionnaire. For example, Tarık and Altan believed that they could help students attain ‘PSS1’ by creating a discussion environment and Altan believed that he could help students attain ‘PSS2’ and ‘PSS7’ by giving them research homework.

5.3.3 Beliefs about how to teach physics by considering PTSEO

Like in the previous section, the data for analysis of beliefs about how to teach physics by considering PTSEO were obtained from the interview. Teachers indicated some teaching techniques that they would use in their instruction for the purpose of helping students attain PTSEO. I calculated the occurrence frequencies of teaching techniques that teachers indicated. Table 5.11 presents the beliefs related to how to teach physics by considering PTSEO and how many times each teacher expressed these beliefs in the interview.

Table 5.11 Beliefs and occurrence frequencies of these beliefs related to how to teach physics by considering PTSEO

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
Physics can be taught by considering PTSEO by	creating a discussion environment	TCD	3	1	1	1	6
	giving examples from daily life	TGE	1		2	1	4
	carrying out hands-on activities	TCO	1				1
	giving students research homework	TGS		1			1
	using information and communication technologies	TUI			1		1

As can be seen in Table 5.11, all teachers believed that they could teach physics by considering PTSEO by means of creating a discussion environment. The following excerpt from the interview with Sinan illustrates this belief:

> Sinan: “There were some activities in our course book. For example, we discussed the renewable and non-renewable energy sources. We discussed why wind energy was renewable.” (Sis3)

Investigation of how Sinan would teach PSTEO also included collecting data with an open-ended questionnaire. Sinan, in his answers to this questionnaire, indicated that students could attain 18 of the 21 PTSEO in the classroom. He thought that he could help students attain 12 of these by creating a discussion environment, four by giving examples from daily life and two by both giving examples from daily life and creating a discussion environment. He believed that he could not help students attain only ‘PTSEO4’, ‘PTSEO19’, and ‘PTSEO21’. Sinan’s following response explains how he wanted to help attain students ‘PTSEO15’ which is “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)”:

> “In the classroom environment, students can attain this skill by discussing the examples in the course book and their research homework.”

Like Sinan, Fatih believed that a discussion environment is useful for helping students attain PTSEO. The following excerpt from the interview with Fatih illustrates his belief:

> Fatih: “We generally discuss physics and technology relationship in the classroom. I ask students questions and try to answer their questions.” (Fis3)

In the open-ended questionnaire, Fatih indicated that he could help students attain 17 of 21 PTSEO. He believed that he could attain 10 of these by creating a discussion environment and seven of these by giving examples from daily life. He indicated that he could not help students attain ‘PTSEO2’, ‘PTSEO8’, ‘PTSEO14’ and ‘PTSEO21’. The following excerpt from the open-ended questionnaire illustrates how he wanted to help students attain ‘PTSEO12’ which is “determining and explaining with examples the contribution of scientific knowledge in physics to development of technology”:

> “Working principle of some devices can be discussed by considering physics rules.”

Similar to Sinan and Fatih, Tarık believed that he could help students attain PTSEO by creating a discussion environment. The following excerpt from the interview with Tarık illustrates his belief:

> Tarık: “We give examples from our environment.”
>
> Interviewer: “How?”

> Tarık: “We create a discussion environment in the classroom. We ask students questions.” (Tis3)

Differently, Tarık also believed that he could teach physics by considering PTSEO by using information and communication technologies. The following excerpt from the interview with Tarık illustrates his belief:

> Tarık: “We try to demonstrate students some animations. For example, when we ask students how the energy is produced [meaning to say that he asked students production of energy, when they watched animation], they talk about their ideas.” (Tis3)

Tarık indicated that he could help students attain 19 of 21 PTSEO in the open-ended questionnaire. He believed that he could not help students attain only ‘PTSEO7’, and ‘PTSEO14’. He believed that he could help students attain 10 of these by creating a discussion environment, four of these by giving students research homework, one of these by giving examples from daily life and two of these by both creating discussion environment and using information and communication technologies. Tarık’s following response explains how he wanted to help students attain ‘PTSEO12’ which is “determining and explaining with examples the contribution of scientific knowledge in physics to development of technology”:

> “For this, the working principle of some products such as cell phone, and cars around our environment can be discussed”

Like other teachers, Altan believed that he could teach physics by considering PTSEO by creating a discussion environment. The following excerpt from the interview with Altan exemplifies his belief:

> Altan: “First of all, I have talked about the examples which are related to physics in the environment. It takes approximately 10 to 15 minutes. I try to draw attention of students with that way. I try to provide students to realize it by observing…”
> Interviewer: “You teach by giving examples from daily life at the beginning of the lessons, aren’t you? However, while doing this, do you ask students questions?”
> Altan: “I sometimes ask students their ideas. If I only speak, it is meaningless. Students do not speak due to their respect to me in this situation. However, when you ask students their ideas, students say their ideas.” (Ais3)

Altan indicated that he could help students attain 18 of 21 PTSEO in the open-ended questionnaire. He thought that he could help students attain 14 of these by creating a discussion environment and three of these by giving examples from daily life. He did not write anything for one of the objectives in the open-ended questionnaire. He believed that he could not help students attain only ‘PTSEO3’, ‘PTSEO14’, and ‘PTSEO21’. The following excerpt from the open-ended questionnaire illustrates how he wanted to help students attain ‘PTSEO2’ which is “comprehending testable, questionable, falsifiable and evidence-based structure of physics”:

> “I can help students attain it [PTSEO2] by giving examples in the classroom environment. For example, which changes emerge with quantum physics when the Newton’s physics is used can be discussed.”

To sum up, all teachers believed that physics could be taught by considering PTSEO by creating a discussion environment. Three teachers believed that physics could be taught by considering PTSEO by giving examples from daily life. In addition, Sinan believed that physics could be taught by considering PTSEO by carrying out hands-on activities; Fatih believed that physics could be taught by considering PTSEO by giving students research homework; and Tarık believed that physics could be taught by considering PTSEO by using information and communication technologies.

5.3.4 Beliefs about how to teach physics by considering ICS

The final question related to how to teach physics in the interview was about ICS. Teachers indicated some teaching techniques to teach physics by considering ICS. I calculated the occurrence frequencies of teaching techniques that teachers indicated. The beliefs related to how to teach physics by considering ICS and how many times each teacher expressed these beliefs in the interview were given in Table 5.12.

Table 5.12 Beliefs and occurrence frequencies of these beliefs related to how to teach physics by considering ICS

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
Physics can be taught by considering ICS by	creating a discussion environment	TCD	1	2	2	1	6
	giving students research homework	TGS	2			2	4
	using information and communication technologies	TUI			2		2
	carrying out hands-on activities	TCO	1				1

According to Table 5.12, all teachers believed that physics could be taught by considering ICS by creating a discussion environment. The following excerpt from the interview with Fatih exemplifies this belief:

> Fatih: “I do not claim that I can help students attain all ICS. I try to encourage students to participate in discussions. I try to create a discussion environment when I can keep order in the classroom.” (Fis4)

Fatih’s acceptance that he cannot not help students attain all ICS was supported by his responses to open-ended questionnaire, in which he indicated that he could help students attain only ‘ICS6’ and ‘ICS9’; and he could do this by only creating a discussion environment. He believed that he could not help students attain other eight of 10 ICS in the open-ended questionnaire. The following excerpt from the open-ended questionnaire illustrates how he wanted to help students attain ‘ICS9’ which is “using appropriate terminologies in their communications (written, verbal and visual) related to physics”:

> “When we ask students questions, they use this skill [ICS9]. For example, when we define ‘work’, we discuss it and demonstrate students how work is done.”

Like Fatih, Altan believed that he could help students attain ICS by creating a discussion environment. The following excerpt from the interview with Altan illustrates his belief:

> Altan: "First of all, we create a discussion environment in the classroom. Everybody try to say their ideas, however, we sometimes cannot do it. There can be some problems in curriculum. When there is a discussion in the classroom, students cannot accept ideas of other students or they can reject ideas of others. In this situation [meaning to say that students say their ideas], we can create a discussion environment." (Ais4)

In the open-ended questionnaire, Altan indicated that he could help students attain 'ICS1', 'ICS4', 'ICS6', 'ICS9' and 'ICS10'. He indicated that he could help students attain 'ICS1' and 'ICS4' by giving students research homework, and 'ICS6' by both giving students research homework, creating a discussion environment. However, he did not write anything about how to help students attain 'ICS9' and 'ICS10' in the open-ended questionnaire. He believed that he could not help students attain other ICS. The following excerpt from the open-ended questionnaire exemplifies how he wanted to help students attain 'ICS6' which is "preparing presentations with correct outputs and appropriate for one's aims":

> "Whether the correctness of the results and whether they are presented according to desired aim can be discussed by giving homework"

Like Altan, Sinan believed that he could help students attain ICS by giving them research homework. The following excerpt from the interview with Sinan illustrates his belief:

> Sinan: "We cannot teach students computer programs. However, we assign research homework. They try to investigate them by using internet. In addition, I encourage them to investigate their homework from some books or journals. In addition, while we are performing activities, we separate students into groups. They discuss their findings with each other. We ask questions to students and create a discussion environment." (Sis4)

Sinan indicated that he could help students attain 'ICS2', 'ICS7', and 'ICS9' in the open-ended questionnaire. He believed that he could help students attain 'ICS2' and 'ICS9' by creating a discussion environment, and 'ICS7' by giving students research homework. He believed that he could not help students attain the remaining seven ICS. The following excerpt from the open-ended questionnaire illustrates how he wanted to help students attain 'ICS7' which is "using different formats such as text, number, picture, graph, diagram or table as much as possible while preparing presentation":

> "Research homework can be given to students as wanted in the course book and curriculum. Students can attain this skill by preparing posters."

Tarık indicated that he could help students attain seven of ICS in the open-ended questionnaire. He indicated that he could help students attain 'ICS5', 'ICS6' and 'ICS7' by giving students research homework, 'ICS8' by using information and communication technologies, and 'ICS10' by creating a discussion environment. He did not write anything about how to help students attain 'ICS2' and 'ICS9' in the open-ended questionnaire. He believed that he could not help students attain 'ICS1', 'ICS3' and 'ICS4'. The following excerpt from the open-ended questionnaire exemplifies how he wanted to help students attain 'ICS6' which is "preparing presentations with correct outputs and appropriate for one's aims":

> "We can want students to prepare their term paper as a power point presentation. It is wanted from students who completed their term paper to present them in the classroom."

As a conclusion, all teachers believed that they could teach physics by considering ICS by creating a discussion environment. Differently, Tarık believed that he could use information and communication technologies, and Sinan believed that he could perform hands-on activities to teach physics by considering ICS.

5.3.5 Summary of the results related to the beliefs about how to teach physics according to the THSPC

I asked teachers how to teach physics by considering real-life context-based approach, PSS, PTSEO and ICS to be able to answer Research Question 3 in interviews. I presented teachers' beliefs about how to teach physics by considering real-life context-based approach, PSS, PTSEO and ICS in Sections 5.3.1, 5.3.2, 5.3.3, and 5.3.4. In this section, on the other hand, I presented overall beliefs related to how to teach physics according to the THSPC and overall occurrence frequencies of these beliefs in Table 5.13.

Table 5.13 Overall beliefs and overall occurrence frequencies of these beliefs related to how to teach physics according to the THSPC

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
Physics can be taught according to THSPC by	creating a discussion environment	TCD	6	7	4	6	23
	giving examples from daily life	TGE	3	8	3	2	16
	giving students research homework	TGS	3	1		2	6
	carrying out hands-on activities	TCO	3	2			5
	using information and communication technologies	TUI			3		3

As can be seen in Table 5.13, the beliefs 'TCD' and 'TGE' were indicated by all teachers. They believed that they could teach physics according to the THSPC by creating a discussion environment and giving examples from daily life. Additionally, Sinan and Fatih believed that they could teach physics according to the THSPC by carrying out hands-on activities. Another teaching technique which Sinan, Fatih and Tarık believed to teach physics according to the THSPC was giving students research homework. Differently, Tarık believed that he could teach physics according to the THSPC by using information and communication technologies.

5.4 Extent of Reflection of Teachers' Beliefs about How to Teach Physics in Their Instructional Practices

For the purpose of answering Research Question 4, I calculated the occurrence frequencies of teaching techniques that physics teachers used to teach physics according to the THSPC in their instructional practices. However, since it was extremely difficult, if not impossible, to identify that a teaching technique was used by a teacher for considering real-life context-based approach, PSS, PTSEO or ICS. For example, when a teacher gave a daily life example during his instruction, one could not easily decide whether that example was given as a result of real-life context-based approach consideration or for helping student attain one of PTSEO. In this regard, instead of calculating the occurrence frequencies of teaching techniques used by teachers in the classroom for different considerations, I calculated the occurrence frequencies of each teaching technique that participants indicated in the interviews and open-ended questionnaire by observing their instructional practices (see Tables 5.14, 5.15, 5.16, and 5.17).

As shown in Table 5.14, Sinan gave 56 daily life examples and created 65 discussion environments. Compared to these seemingly high numbers, he gave students five research homework and carried out two hands-on activities. The following excerpts from the video-recordings of Sinan exemplify his instructional practices by considering real-life context-based approach, PSS, PTSEO and ICS.

Sinan believed that he could teach physics by considering real-life context-based approach by giving examples from daily life. This belief could be reflected in instruction of Sinan. For example, he taught students ‘measurement error’ by giving an example related to daily life. The following excerpt from the video-recordings of Sinan illustrates this situation:

> Sinan: “For example, we go to grocer. If he/she is leery, he/she tries to deceive people by measuring wrong. For example, let’s have a balance like this.” [He draw the sketch of balance on the blackboard.] “For example, you want to buy five kilograms of rice. The grocer put five kilograms in this pan. However, it is not actually five kilograms, it is four kilograms. He/she tries to deceive you. He/she measures one kilogram missing. The measurement error in this situation is one kilogram.” (Sow3)

He believed that he could teach physics by considering PSS by creating a discussion environment. This belief was reflected in instructional practice of him. He asked students questions and discussed some of the steps of scientific method in the classroom. However, it was very difficult to claim that he could help students hypothesize by using this technique when the following excerpt from the video-recordings of Sinan was examined:

Table 5.14 Occurrence frequencies of teaching techniques that Sinan used in his instructional practice

Teaching techniques	Code	Observation Weeks 1	2	3	4	5	6	7	8	9	10	11	12	Total freq.
giving students research homework	TGS	–	–	–	–	–	–	2	–	–	1	2	–	5
giving examples from daily life	TGE	10	1	3	–	3	12	5	12	8	2	–	–	56
carrying out hands-on activities	TCO	–	–	–	–	–	1	1	–	–	–	–	–	2
creating a discussion environment	TCD	8	6	7	2	3	8	4	9	3	3	8	4	65

Table 5.15 Occurrence frequencies of teaching techniques that Fatih used in his instructional practice

Teaching techniques	Code	Observation Weeks 1	2	3	4	5	6	7	8	9	10	Total freq.
giving students research homework	TGS	1	–	1	–	–	1	–	–	–	–	3
giving examples from daily life	TGE	4	6	5	11	4	15	7	19	6	–	77
carrying out hands-on activities	TCO	–	–	2	–	–	–	–	1	–	–	3
creating a discussion environment	TCD	7	6	5	6	7	10	5	21	4	–	71

Table 5.16 Occurrence frequencies of teaching techniques that Tarık used in his instructional practice

Teaching techniques	Code	Observation Weeks						Total
		1	2	3	4	5	6	freq.
giving examples from daily life	TGE	19	15	2	4	3	3	46
using information and communication technologies	TUI	6	5	–	–	–	–	11
creating a discussion environment	TCD	15	8	2	2	1	2	30

Table 5.17 Occurrence frequencies of teaching techniques that Altan used in his instructional practice

Teaching techniques	Code	Observation Weeks													Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	freq.
giving students research homework	TGS	–	–	–	–	–	–	–	–	–	–	–	–	–	0
giving examples from daily life	TGE	5	1	3	3	3	–	1	1	2	1	3	8	2	33
creating a discussion environment	TCD	4	3	6	1	4	2	–	–	–	2	4	3	3	32

Sinan: "Friends, we collect data after observation. Then what do we do? We present a temporary solution according to collected data. Is it Ok? What is this? First of all, we say this as hypothesis. Let's write. Are you ready?"

Students: "Yes"

Sinan: "Yes, Friends! Now we have collected data after the observations, haven't we?"

Students: "Yes."

Sinan: "What do we do now? Friends! We hypothesize. Do you know what is hypothesis? Hypothesis is a temporary proposed solution according to data. We said that if there was a problem, there had to be hypothesis. It is a temporary solution. Is it Ok? Friends! Do you understand it?" (Sow2)

In addition, he performed an activity in the course book related to transformation of potential energy to kinetic energy in seventh week of my observation (Sow7). This activity, in the course book, was prepared to help students attain some of PSS. However, he was not able to help students attain any of PSS in this activity. Students observed the motion of marble which was dropped from rest at the top of the hill of poster board. Students bent poster board to resemble it to roller coaster to observe the motion of marble. While students were performing this activity, Sinan could not guide students to attain some skills.

The belief, that a discussion environment is a means for attaining PTSEO, was reflected in Sinan's instructional practice. For example, he, for 'PSTEO15' which is "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)" created a discussion environment, which can be seen from the following excerpt:

Sinan: "Why do we use nuclear centrals? Friends!"

Student 1: "For nuclear bomb."

Sinan: "For example, America threw nuclear bomb to Japan. One of the cities was destroyed. This bomb has huge energy. Is it Ok?"

Student 2: "Teacher! Plants do not grow in there."

Student 3: "Teacher! New-born were deformed due to this nuclear bomb."

Sinan: "It has huge effects."

Student 3: "Nuclear centrals affected also the black sea region…" (Sow1)

Sinan acted according to his belief which was about how to teach physics by considering ICS. For example, Sinan gave students research homework to help students attain 'ICS7' which is "using different formats such as text, number, picture, graph, diagram or table as much as possible while preparing presentation". He wanted students to investigate what kind of precautions can be taken to decrease the energy lost in buildings and why the front of vehicles is pointed (Sow7). However, he warned students about how to conduct their research. The following excerpt from the video-recordings of Sinan illustrates this situation:

> Sinan: "In page 66, there is research homework." [He gave students homework from the course book.] "It is wanted you to explore what kind of precautions can be taken to decrease the energy lost in buildings and which technological equipment were used. Investigate it for next lesson. For next lesson." [Students wanted to say their ideas immediately. However, he did not listen their ideas. He wanted them to investigate the research homework for next week.]
>
> Student 1: "Using styrofoam."
>
> Sinan: "For next lesson. Friends! Investigate it. I do not want you to bring print output. Write them."
>
> Student 2: "Can we write summary of our readings?"
>
> Sinan: "It is not story. You will write your findings." (Sow7)
>
> Sinan: "Friends! You are investigating why the front of vehicles is pointed. Is it Ok? You can investigate it from internet, library and books. You will prepare a poster according to your findings which are obtained from your readings in the articles and books. Friends! It will not be big. It will be like a poster on the wall. Do not prepare big posters. Is it understood? Prepare it as in the course book. You will prepare by sticking on visual materials on the poster and explaining why the front of vehicles is pointed. We will hang your posters on the wall." (Sow7)

Fatih gave students three research homework and carried out three hands-on activities as can be seen in Table 5.15. Moreover, he gave 77 examples from daily life and created 71 discussion environments during 10 weeks of observation. The following excerpts from the video-recordings of Fatih illustrate his teaching by considering real-life context-based approach, PSS, and PTSEO.

He believed that he could teach physics by considering real-life context-based approach by creating a discussion environment. This belief could be reflected in his teaching. For example, he discussed disadvantages of using fossil fuels in the classroom. The following excerpt from the video-recordings of Fatih examplifies his teaching:

> Fatih: "Which kind of energy source is used in the cars now?"
>
> Student 1: "Benzine"
>
> Fatih: "Benzine and diesel, petroleum products. We try to diminish the use of them. What is done? Cars which work with electricity are produced."
>
> Student 2: "Teacher! With solar energy."
>
> Fatih: "The cars which work with solar energy are also produced."
>
> Student 3: "Water."
>
> Fatih: "Ok! The cars which work different kinds of fuels are tried to be produced. For example, think! If all the cars consume oils, what will we do in 2030, 2040 and 2050." (Fow8)

The belief of Fatih about how to teach physics by considering PSS was reflected in his teaching. I observed that when he helped students attain 'PSS1' which is "distinguishing scientific knowledge, and view and values from each other", he created a discussion environment and asked questions to students. The following excerpt from the video-recordings of Fatih illustrates his instruction:

> Fatih: "I want one student who will read the reading part." [He wanted one of the students in the classroom to read a reading part in the course book.]
>
> Student 1: "Can I read? Teacher!"
>
> Fatih: "Yes."
>
> Student 1: "…. What is the difference between scientific knowledge and personal view? Are you curious about these questions? Let's try to explain this with one example. You know that objects which are dropped from rest in the air falls in the ground…." [She read this reading part. Then, Fatih asked students questions.]
>
> Fatih: "…which one is scientific view and which one is personal view?"
>
> Student 2: "Teacher! Can I say?"
>
> Fatih: "Yes!"
>
> Student 2: "First one is scientific and other is personal."
>
> Fatih: "In the first situation, he/she hypothesizes. He tried to construct theory. He said that there was gravitational force among masses and therefore it fall down toward ground." (Fow2)

In addition, although he believed that he could not help students formulate a testable hypothesis for an identified problem in the open-ended questionnaire, he performed an activity related to hypothesizing. He made a demonstration using a plastic water bottle with holes on the side. The following excerpt from the video-recordings of Fatih illustrates his instruction:

> Fatih: "Now, when we open, what happens?" [He created three holes on a plastic water bottle, and then covered them with tape]
>
> Student 1: "Water flows more at the bottom of the bottle."
>
> Fatih: "Forget it. First, I will open at the top." [He warned students to be calm. He wanted to open the holes by starting from the top of the bottle]
>
> Student 2: "Water flows less…" (Fow3)

He believed that he could teach physics by considering PTSEO by creating a discussion environment. He acted according to his belief to help students attain 'PTSEO12' which is "determining and explaining with examples the contribution of scientific knowledge in physics to development of technology". The following excerpt from the video-recordings of Fatih illustrates how he helped students attain this objective:

> Student 1: "…What is the relationship between technology and science?" [Fatih allowed one of the students in the classroom to read a reading part in the course book. She asked the question to her friends at the end of the reading part].
>
> Fatih: "Yes. Friends! What is the relationship?"
>
> Student 2: "Technology improves with science"
>
> Fatih: "Yes it is true. They are dependent on each other. To improve technology we need science. For example, how is Hubble telescope built without development in scientific knowledge? To construct Hubble telescope, we need scientific knowledge. To develop science, it is necessary to use technology. For example, we need to build a laboratory like in the CERN." (Fow4)

As can be seen in Table 5.16, Tarık gave 46 examples from daily life and created 30 discussion environments. In addition, he used information and communication technologies in his teaching 11 times in six weeks. The following excerpts from the video-recordings of Tarık illustrate his teaching by considering real-life context-based approach, and PTSEO.

The instructional practice of Tarık could be manifestation of his belief which is physics can be taught by considering real-life context-based approach by giving examples from daily life. I observed that he tried to give examples from daily life in mentioning branches of physics. The following excerpt from the video-recordings of Tarık illustrates his instruction:

> Tarık: "For example, we can use cell phone as a result of modern physics. Why? How is the connection between base station and cell phone? Wave only comes, there is no cable. However, there are many disadvantages. For example, we are exposed to radiation, there are many damages of technology. For example, you have an operation in your kidney. What do you do? [He asked students; however, he answered this question without waiting students' responses] Kidney stone is decayed with laser gun." (Tow1)

His belief about how to teach physics by considering PTSEO was reflected in his teaching. For example, he used animations in the 'nature of physics' unit. He sometimes stopped to play animations on the media player. Then, he tried to discuss some points with students. The following excerpt from the video-recordings of Tarık illustrates how he helped students attain 'PSTEO12' which is "determining and explaining with examples the contribution of scientific knowledge in physics to development of technology":

> Tarık: "[Having played the animation, Tarık started explaining relationship between physics and technology to students]. When we say technology, physics comes to my mind. When we look at our environment now, technological tools such as television, computers are certainly related to physics. All of them work with electricity. You will learn later, all of them include resistant, capacitor, and circuit…" (Tow1)

Altan stated that he would give students research homework in the interview; however, he did not give students research homework, when actually it was possible to give such homework. In addition, he gave 33 examples from daily life and created 32 discussion environments as given in Table 5.17. The following excerpts from the video-recordings of Altan illustrate his teaching by considering real-life context-based approach, and PTSEO.

Altan's belief about how to teach physics by considering real-life context-based approach could be reflected in his instruction. I observed that Altan gave examples from daily life in teaching of heat and temperature. He discussed thermal expansion with students. The following excerpt from the video-recordings of Altan illustrates his instruction:

> Altan: "…for example, is it appropriate to build electric wire in winter? It is appropriate to build them in winter. Why? They contract in winter. If we build them in summer, they expand."
>
> Student: "Why?"
>
> Altan: "In summer, they expanded. You stretch wires. In winter, what happens? They contract. When they contract, they break out. If they are built in summer, they have to be loosened..." (Aow12)

He believed that he could help students attain PTSEO by creating a discussion environment. I observed that Altan helped students attain 'PTSEO2' which is "comprehending testable, questionable, falsifiable and evidence-based structure of physics" as he believed. He discussed whether there was a certainty in the science in the classroom. The following excerpt from the video-recordings of Altan illustrates his teaching:

> Student 1: "Scientist found many thermometers. There is no need to find new ones."
>
> Altan: "Why?"
>
> Student 1: "Teacher! Why are there Celsius and Fahrenheit?"
>
> Altan: "Friends! Is there a certainty in the science?"
>
> Student 2: "I think that there is not."
>
> Student 3: "No!"
>
> Altan: "Hence, for example, Newton physics has been known as true for many a long year. However, with the quantum physics, we realize that Newton physics cannot explain many physical events…" (Aow13)

According to these findings, Sinan and Fatih who are in the first year of teaching profession gave examples from daily life and created a discussion environment in the 'nature of physics' and 'energy' units more than the teachers Tarık and Altan. In addition, they sometimes gave students research homework and carried out some activities.

Additionally, participants generally acted according to their beliefs to help students attain some skills. However, they were sometimes unsuccessful in helping students attain some skills in spite of acting according these beliefs. For example, Sinan believed that he could help students attain PSS by performing activities. Therefore, he acted as he believed to help students attain some PSS. He performed an activity in the classroom. This activity was taken from the course book and related to hypothesizing. However, he could not help students attain the skill hypothesizing.

5.5 Beliefs about the Attainment of Skill Objectives and the Extent of Reflection of These Beliefs in Teachers' Instructional Practices

In this section, I presented the answer to Research Questions 5 and 6, which were concerned about teachers' beliefs about the attainment of skill objectives and the extent of reflection of these beliefs in teachers' instructional practices. For revealing their beliefs about the attainment of these skills, I asked teachers, in the open-ended questionnaire, if students should attain skill objectives related to the 'nature of physics' and 'energy' units. I also asked them if students could attain skill objectives in the classroom. I calculated the occurrence frequencies of teachers' attempts to help students attain PSS, PTSEO and ICS by observing their instructional practices. In the following sub-sections, I presented the results related to PSS, PTSEO and ICS in separate sections.

5.5.1 Beliefs about the attainment of PSS and the extent of reflection of these beliefs in teachers' instructional practices

Teachers indicated whether they agreed the necessity and possibility of attainment of PSS in the open-ended questionnaire. In addition, I calculated the occurrence frequencies of teachers' attempts to help students attain PSS. Table 5.18 presents teachers' beliefs about the attainment of PSS and how many times each teacher attempted to help students attain PSS.

As can be seen in Table 5.18, Sinan believed, as revealed from his answers to the open-ended questionnaire, the necessity of attainment of all PSS by students except 'PSS1' which is "distinguishing scientific knowledge, and view and values from each other". Fatih, Tarık and Altan believed the necessity of attainment of all PSS.

Three teachers Fatih, Tarık and Altan believed that students should and could attain 'PSS1'. However, only Fatih among these three teachers attempted to help students attain this skill. Additionally, although Sinan did not believe that students should and could attain ‘PSS1’, Sinan attempted to help students attain ‘PSS1’.

Table 5.18 Beliefs about the attainment of PSS and occurrence frequencies of attempts of teachers to help students attain PSS in their instructional practices

	Sinan			Fatih			Tarık			Altan		
Skills	Believing the necessity	Believing the possibility	Frequency of attempts	Believing the necessity	Believing the possibility	Frequency of attempts	Believing the necessity	Believing the possibility	Frequency of attempts	Believing the necessity	Believing the possibility	Frequency of attempts
PSS1	–	–	1	√	√	1	√	√	0	√	√	0
PSS2	√	√	0	√	–	1	√	–	0	√	√	0
PSS3	√	√	0	√	√	0	√	–	0	√	–	0
PSS4	√	–	0	√	–	0	√	–	0	√	–	0
PSS5	√	–	0	√	–	1	√	–	0	√	–	0
PSS6	√	–	0	√	√	0	√	–	0	√	–	0
PSS7	√	√	0	√	–	0	√	–	0	√	√	0
PSS8	√	–	0	√	–	0	√	–	0	√	–	0
PSS9	√	–	0	√	–	0	√	–	0	√	–	0
PSS10	√	√	0	√	–	0	√	–	0	√	–	0

Finally, although teachers believed that students should attain almost all of PSS, Sinan attempted to help students attain only ‘PSS1’ one time in the second week; Fatih attempted to help students attain ‘PSS1’ one time in the second week, and ‘PSS2’, and ‘PSS5’ one time in the third week; and Tarık and Altan did not attempt to help students attain any of PSS.

5.5.2 Beliefs about the attainment of PTSEO and the extent of reflection of these beliefs in teachers’ instructional practices

Teachers indicated whether they agreed the necessity and possibility of attainment of PTSEO in the open-ended questionnaire. In addition, I calculated the occurrence frequencies of teachers’ attempts to help students attain PTSEO. Table

5.19 presents teachers' beliefs about the attainment of PTSEO and how many times each teacher attempted to help students attain PTSEO.

Table 5.19 Beliefs about the attainment of PTSEO and occurrence frequencies of attempts of teachers to help students attain PTSEO in their instructional practices

	Sinan			Fatih			Tarık			Altan		
Skills	Believing the necessity	Believing the possibility	Frequency of attempts	Believing the necessity	Believing the possibility	Frequency of attempts	Believing the necessity	Believing the possibility	Frequency of attempts	Believing the necessity	Believing the possibility	Frequency of attempts
PTSEO1	√	√	1	√	√	1	√	√	1	√	√	1
PTSEO2	√	√	2	√	–	1	√	√	1	√	√	2
PTSEO3	√	√	0	√	√	0	√	√	0	√	√	0
PTSEO4	√	–	0	√	√	2	√	√	1	√	√	0
PTSEO5	√	√	0	√	√	0	√	√	1	√	√	0
PTSEO6	√	√	0	√	√	0	√	√	0	√	√	0
PTSEO7	√	√	1	√	√	0	√	–	0	√	–	0
PTSEO8	√	√	3	√	–	5	√	√	1	√	√	2
PTSEO9	√	√	1	√	√	0	√	√	2	√	√	0
PTSEO10	√	√	1	√	√	1	√	√	1	√	√	0
PTSEO11	√	√	1	√	√	1	√	√	2	√	√	0
PTSEO12	√	√	8	√	√	4	√	√	5	√	√	0
PTSEO13	√	√	7	√	√	13	√	√	3	√	√	2
PTSEO14	√	√	9	√	–	3	√	–	2	√	–	2
PTSEO15	√	√	5	√	√	4	√	√	5	√	√	0
PTSEO16	√	√	1	√	√	0	√	√	1	√	√	0
PTSEO17	√	√	1	√	√	0	√	√	0	√	√	0
PTSEO18	√	√	2	√	√	3	√	√	0	√	√	0
PTSEO19	√	–	0	√	√	0	√	√	0	√	√	0
PTSEO20	√	√	0	√	√	0	√	√	0	√	√	0
PTSEO21	√	–	0	√	–	0	√	√	0	√	√	0

As shown in Table 5.19, all teachers believed the necessity of attainment of all PTSEO. They also believed that students could attain majority of PTSEO in the classroom. However, although they believed the necessity of students' attainment of all PTSEO and they believed that students could attain majority of them, they did not help students attain many of them in their instructional practices.

Contrary to their beliefs about the necessity and possibility of attainment of PTSEO, teachers did not make attempts for some of them. For example, all teachers believed that students could and should attain 'PTSEO3' which is "realizing that knowledge in physics increases in an accelerated way", 'PTSEO6' which is "realizing that the change of scientific knowledge in physics is generally continuous, but it sometimes occurs as a paradigm shift", and 'PTSEO20' which is "offering a solution by considering needs of individual, society and environment to social problems by using physics and technology for better life"; however, they did not attempt to help students attain them.

None of the participants helped students attain 'PTSEO3' which is "realizing that knowledge in physics increases in an accelerated way", 'PTSEO6' which is "realizing that the change of scientific knowledge in physics is generally continuous, but it sometimes occurs as a paradigm shift", 'PTSEO19' which is "observing how physics and technology is used by society while deciding in environmental problems", 'PTSEO20' which is "offering a solution by considering needs of individual, society and environment to social problems by using physics and technology for better life", and 'PTSEO21' which is "knowing necessary basic principles for safe use of equipment and devices".

Additionally, although three teachers Fatih, Tarık and Altan believed that they could not help students attain 'PTSEO14' which is "explaining the working principle and/or function of technological tools used in daily life by using scientific knowledge", they attempted to help students attain this skill. Another important finding was that teachers Sinan and Fatih who are in the first year of teaching profession more attempted to help students attain PTSEO.

5.5.3 Beliefs about the attainment of ICS and the extent of reflection of these beliefs in teachers' instructional practices

Teachers indicated if they agreed the necessity and possibility of attainment of ICS in the open-ended questionnaire. In addition, I calculated the occurrence frequencies of each teacher's attempts to help students attain ICS. Table 5.20 presents teachers' beliefs about the attainment of ICS and how many times each teacher attempted to help students attain ICS.

Table 5.20 Beliefs about the attainment of ICS and occurrence frequencies of attempts of teachers to help students attain ICS in their instruction practices

	Sinan			Fatih			Tarık			Altan		
Skills	Believing the necessity	Believing the possibility	Frequency of attempts	Believing the necessity	Believing the possibility	Frequency of attempts	Believing the necessity	Believing the possibility	Frequency of attempts	Believing the necessity	Believing the possibility	Frequency of attempts
ICS1	√	–	1	√	–	0	√	–	0	√	√	0
ICS2	√	√	0	√	–	0	√	√	0	√	–	0
ICS3	–	–	0	√	–	0	√	–	0	√	–	0
ICS4	–	–	0	√	–	0	√	–	0	√	√	0
ICS5	–	–	0	√	–	0	√	√	0	√	–	0
ICS6	–	–	1	√	√	0	√	√	0	√	√	0
ICS7	√	√	2	√	–	0	√	√	0	√	–	0
ICS8	√	–	0	√	–	0	√	√	0	√	–	0
ICS9	√	√	0	√	√	0	√	√	0	√	√	0
ICS10	√	–	0	√	–	0	√	√	0	√	√	0

Sinan, as revealed from his answers to the open-ended questionnaire, believed that students should attain many of ICS. Other participants believed the necessity of attainment of all ICS by students. However, all teachers believed that they could not help students attain many of ICS.

Although three teachers Fatih, Tarık and Altan believed that students should attain all ICS, they did not attempt to help students attain them in their instructional practices. Only Sinan attempted to help students attain some of ICS. Additionally, all teachers believed that they could help students attain 'ICS9' which is "using appropriate terminologies in their communications (written, verbal and visual) related to physics", however they did not help students attain this skill.

5.6 Beliefs Related to Factors That Affect Teachers' Teaching According to the THSPC

In this section, I presented the factors that teachers believe to affect their teaching according to the THSPC in order to answer Research Question 7. In the open-ended questionnaire, I asked teachers if it would be possible for students to attain skill objectives. For the skill objectives that they indicated students could not attain, I wanted them to write the reason for why students could not attain those objectives. In addition to open-ended questionnaire, in interviews, I asked teachers what makes teaching physics according to the THSPC easy and difficult. Based on teachers' responses, I calculated the occurrence frequencies of factors that make their teaching according to the THSPC easy that teachers indicated. Table 5.20 presents the beliefs related to factors that make teaching physics according to the THSPC easy and how many times each teacher expressed these beliefs in the interview.

Table 5.21 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics according to the THSPC easy

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is easy to teach physics according to THSPC due to	students' interest in physics lessons	FESIP	5	1		3	9
	students' sufficient readiness level	FESSR			1	1	2
	feasible activities/experiments in the course book	FEFAE	1			1	2

As given in Table 5.21, three teachers believed that students' interest in physics lessons facilitated their teaching according to the THSPC. The following excerpt from the interview with Sinan illustrates this belief:

> Sinan: "Students' participation in discussions and willingness to learn really facilitates. Lessons become more effective due to this participation."
>
> Interviewer: "Are there any other factors which facilitate your teaching physics?"
>
> Sinan: "For example, when I say that I will carry out activities, majority of the students are willing to perform activities. In addition, due to activities which were performed in the science and technology courses in primary schools, students are interested in physics lessons."
>
> Interviewer: "How do you see that students are interested in physics lesson?"
>
> Sinan: "When we talked about the modeling, students have been talking about their previous experiences. It is obvious that students are interested in physics. In addition, there are many events which are related to technology in our environment. Some students follow the developments in technology via media. After some time, they understand that these are related to physics. This also increases students' interest in physics…" (Sis1)

Like Sinan, Fatih believed that students' interest in physics lessons made his teaching physics according to the THSPC easy. The following excerpt from the interview with Fatih illustrates his belief:

> Fatih: "Students' interest facilitates."
>
> Interviewer: "How does it facilitate?"
>
> Fatih: "For example, I could not teach in silent classrooms. I could not teach something to student who look at me silently. Therefore, he/she has to ask me some questions or participate in discussions. And he/she has to answer my questions although his/her answers are wrong. I like this. As present curriculum draws the attention of students and encourages students to participate [meaning to say that participating in lessons], it facilitates my teaching." (Fis1)

Other beliefs making teaching physics according to the THSPC easy were related to feasible activities/experiments in the course book and students' sufficient readiness level. The following excerpt from the interview with Altan illustrates these beliefs:

> Altan: "For example, together we perform easy experiments [meaning to say that the feasible activities in the course book] or we say students that you will study this subject… In addition, when we give students performance homework, they complete their homework

willingly because this homework includes something which students like, there is a visual and they can use technology. Then, being able to use technology encourages."
Interviewer: "Does their ability to use computer facilitate your implementation?"
Altan: "Certainly." (Ais1)

In addition to asking teachers, in the interview, the factors that make their teaching physics according to the THSPC easy, I asked them the factors that make their teaching physics according to the THSPC difficult. According to teachers' responses, I calculated the frequencies of factors affecting their teaching physics according to the THSPC difficult that teachers indicated. Table 5.22 presents the beliefs related to factors that make teaching physics according to the THSPC difficult and how many times each teacher expressed these beliefs in the interview.

As shown in Table 5.22, all participants believed that inadequacy of lesson hours and lack of information and communication technologies made their teaching physics according to the THSPC difficult. In addition, Sinan and Fatih believed that they did not have sufficient pedagogic formation to teach physics according to the THSPC as different from Tarık and Altan. Teachers who worked in Science High School and Anatolian Teacher High School which were composed of mainly high-achieving students believed that university entrance exam made their teaching physics according to the THSPC difficult.

For example, Sinan believed that inadequacy of lesson hours made his teaching physics according to the THSPC difficult. The following excerpt from the interview with Sinan illustrates this belief:

Sinan: "…you saw that almost 90% of students participated in discussions. However, lesson hours are insufficient to deal with students." (Sis1)

Like Sinan, Altan believed that inadequacy of lesson hours made his teaching physics according to the THSPC difficult. The following excerpt from the interview with Altan exemplifies his belief:

Altan: "…some classes are very crowded. For example, we will discuss something in the classroom. We have to listen to ideas of all students. Therefore, we cannot finish the curriculum in time. This is problem for us." (Ais1)

Table 5.22 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics according to the THSPC difficult

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is difficult to teach physics according to THSPC due to	inadequacy of lesson hours	FDILH	2	1	1	5	9
	inadequacy of laboratory environment	FDILE	1	4		4	9
	university entrance exam	FDUEA			4	4	8
	lack of information and communication technologies	FDLIC	1	1	1	2	5
	a great number of students in classrooms	FDGNS	2			2	4
	families' insufficient knowledge about curriculum	FDFIK			1	2	3
	students' low economic status	FDSLE	1		2		3
	students' desire to learn with teacher centered learning approaches	FDSDT	1		2		3
	teacher's insufficient pedagogic formation	FDTIF	1	1			2
	school administration's insufficient knowledge about curriculum	FDSAI	1		1		2
	discipline problems among students in the classroom	FDDPS		1			1

Another factor believed to make teaching physics according to the THSPC difficult indicated by most teachers was inadequacy of laboratory environment. The following excerpt from the interview with Fatih illustrates this belief:

Fatih: "There are many inadequacies in the physical facilities in my school. In fact, you saw our laboratory. We cannot use laboratory. We only demonstrate students some of the laboratory equipments by bringing them into classroom. For example, in the Grade 9, it is expected from teachers to demonstrate wave properties. However, we do not have ripple tank." (Fis1)

Fatih also indicated this belief in the classroom. For example, he said he wanted to, but could not, take the students to the laboratory. He believed that inadequate laboratory conditions impeded his teaching so much that he even talked about it in the classroom as can be seen from the following excerpt from the video-recording:

> Fatih: "Friends! This is a balance." [He brought balance into the classroom and he demonstrated it to students.]
>
> Student 1: "Balance?"
>
> Fatih: "Balance! We tried to organize our laboratory with our chemistry teacher yesterday. We listed equipment in the laboratory."
>
> Student 2: "Where is the laboratory?"
>
> Student 3: "Near the library"
>
> Student 2: "Will we go to laboratory?"
>
> Fatih: "I want you to give me some time to go to laboratory. We try to go to laboratory in second semester although we do not have enough materials." (Fow3)

Tarık believed that university entrance exam made his teaching physics according to the THSPC difficult. The following excerpt from the interview with Tarık illustrates this belief:

> Tarık: "Students react negatively to physics curriculum. There is a mismatch between what they learn in dershane and what we teach."
>
> Interviewer: "How do students react to curriculum?"
>
> Tarık: "Knowledge is transferred to students in dershane. Students solve tests by using rules and formulas… In fact, when I do not teach similar to 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 the teacher [referring to Tarık] 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..." (Tis1)

Similarly, Altan believed that university entrance exam impeded his teaching according to the THSPC. The following excerpt from the video-recordings of Altan illustrates his belief:

> Altan: "In fact, I should not teach vector in detail now [Altan was aware of what they teach by considering THSPC. THSPC does not expect from teachers to teach vector in detail]. However, in the test books, questions which are related to vectors are asked. You cannot solve them if I do not teach them in detail. Therefore, I have to teach them."
>
> Student: "Teacher! Last year, was it asked in university entrance exam?"
>
> Altan: "Yes, they were asked." (Aow4)

Sinan and Fatih believed that they did not have sufficient pedagogic formation to teach physics according to the THSPC. The following excerpt from the interview with Sinan illustrates this belief:

> Sinan: "… I do not have sufficient pedagogic formation to implement this curriculum. I am unfamiliar to implementation of this curriculum."
>
> Interviewer: "Why do you think yourself as unfamiliar to this curriculum?"
>
> Sinan: "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 never heard 5E until I examined the curriculum. At that time, I understood that I did not have sufficient pedagogic formation." (Sis1)

In order to be able to give a complete answer for Research Question 7, I also asked teachers about the factors that affect their teaching physics by using various teaching methods, considering spiral structure, considering real-life context-based approach, integrating knowledge and skill objectives, and considering PSS, PTSEO and ICS. However, I did not ask teachers the factors that make their teaching physics by using various teaching methods, considering spiral structure, considering real-life context-based approach, integrating knowledge and skill objectives easy, because I could not get satisfactory answers for them when the pilot study for the interviews were conducted with one teacher. Therefore, I asked teachers the factors that make their teaching physics easy and difficult only for PSS, PTSEO and ICS. The following sections explain the findings related to these questions.

5.6.1 Beliefs related to factors that affect teachers' teaching by using various teaching methods

I asked teachers the factors that make their teaching by using various teaching methods difficult in the interview. I calculated the occurrence frequencies of factors affecting their teaching by using various teaching methods that teachers indicated. Table 5.23 presents the beliefs related to factors that make teaching physics by using various teaching methods difficult and how many times each teacher expressed these beliefs in the interview.

Table 5.23 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics by using various teaching methods difficult

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is difficult to teach physics by using various teaching methods due to	inadequacy of laboratory environment	FDILE	1	1		2	4
	inadequacy of lesson hours	FDILH		1		1	2
	university entrance exam	FDUEA			1		1
	a great number of students in classrooms	FDGNS				1	1
	teacher's insufficient pedagogic formation	FDTIF	1				1
	lack of information and communication technologies	FDLIC	1				1

As given in Table 5.23, the belief indicated by most teachers was "It is difficult to teach physics by using various teaching methods due to inadequacy of laboratory environment". The following excerpt from the interview with Sinan exemplifies this belief:

> Sinan: "For example, I want to demonstrate students how the volume of liquids and solids are measured in the matter and properties unit. I want to go to laboratory with students."
> Interviewer: "Ok."
> Sinan: "I want to go to laboratory with students in the subject of transformation of heat… 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. I try to do something in the classroom." (Sis1)

Like Sinan, Altan believed that inadequacy of laboratory environment affected his teaching by using various teaching methods negatively. The following excerpt from the interview with Altan illustrates his belief:

> Altan: "Now, for example, I will go to laboratory. However, there are no equipment in the laboratory. Therefore, I could not use laboratory. What can I do? I can only take students to laboratory [meaning to say that he cannot do anything related to experimenting]. I implement my lesson in the laboratory only for drawing attention of students. But, there is no laboratory equipment." (Ais1)

Similar to these teachers, Fatih wanted to teach by using laboratory. However, he believed that inappropriate laboratory environment affected his instruction by considering the use of various teaching methods negatively.

To sum up, three teachers Sinan, Fatih and Altan believed that inadequacy of laboratory environment affected their teaching by using various teaching methods. Fatih and Altan believed that time was not sufficient to teach physics by using various teaching methods.

5.6.2 Beliefs related to factors that affect teachers' teaching by considering spiral structure

In the interview, I asked teachers the factors that affect their teaching by considering spiral structure negatively. I calculated the occurrence frequencies of factors influencing their teaching by considering spiral structure that teachers indicated. Table 5.24 presents the beliefs related to factors that make teaching physics by considering spiral structure difficult and how many times each teacher expressed these beliefs in the interview.

Table 5.24 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics by considering spiral structure difficult

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is difficult to teach physics by considering spiral structure due to	university entrance exam	FDUEA	4	2	2	3	11
	considering the necessity of teaching some topics in the curriculum in detail	FDCNT	2		1	2	5

According to Table 5.24, the factor 'FDUEA' was indicated by all teachers. They believed that it was difficult to teach physics by considering spiral structure due to university entrance exam. The following excerpt from the interview with Sinan illustrates this belief:

> Sinan: "… although I try to implement lessons by considering spiral structure in Grades 9 and 10, you cannot implement by considering spiral structure in Grade 11 due to university entrance exam. Majority of students go to dershane. When they come to lessons, what we teach becomes very easy for them. Therefore, we cannot implement physics lessons by considering spiral structure in Grade 11."
>
> Interviewer: "Why do they think what you teach as easy?"
>
> Sinan: "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 our teachers in dershane solve many questions. Why do not you [Sinan] solve? [meaning to say that students wanted him to solve questions related to university entrance exam] They are used to solve physics problems." (Sis2)

Like Sinan, Altan believed that university entrance exam affected his teaching physics by considering spiral structure negatively. The following excerpt from the interview with Altan exemplifies his belief:

> Altan: "Now, let's think the 'energy' unit. We only mentioned work, power and energy and give some examples related to daily life about them. You [Altan] gave some definitions. But, as I mentioned before, there are some problems. Students bought test books. They said that why did not you [Altan] teach us [students] them. Students go to dershane. They learn them in dershane. Students say that why do not you [Altan] teach them, we [students] cannot solve questions. 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 do not solve the questions in the test books."
Interviewer: "Do you want to teach the topics in detail?"
Altan: "…students will enter university entrance exam. For example, waves are taught in Grade 9 and Grade 12. Now, if I teach waves superficially, students cannot solve the questions which are related to waves. Then, students will have a negative attitude toward waves in Grade 12. Now, if students do not solve questions which are related to energy, they will have negative attitude toward energy up to Grade 11." (Ais2)

Fatih too believed that university entrance exam affected his teaching by considering spiral structure negatively. The following excerpt from the interview with Fatih illustrates his belief:

Fatih: "For example, some students solve questions in the test books. They ask me some questions which they cannot solve in these books. 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(C)=T(K)-273. However, students bring many questions from test books [test books which students used for the preparation of 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." (Fis2)

Moreover, three teachers Sinan, Tarık and Altan wanted to teach some topics in detail. They believed that teaching some topics was necessary before passing the teaching of new topics for students. The following excerpt from the interview with Sinan illustrates this belief:

Sinan: "I could not implement my lessons by considering spiral structure. In fact, for example, when I mentioned the vectors, I recognized that course book did not mention many of the subjects. Course book only mentions vector quantity. However, we will use vectors in 'energy' unit. In addition, we will use vectors in 'force and motion' units. Therefore, I considered the necessity of teaching the vectors in more detail. In addition, I talked about the formulas of kinetic and potential energy."
Interviewer: "Why do you need to talk about them in detail?"
Sinan: "Students sometimes see questions in the test books. They only do not follow our course book. They solve the questions in other books. Therefore, I mention in detail. In addition, I recognized that many of the students were unfamiliar to kinetic and potential

> energy concepts in Grade 11. They cannot solve basic problems which are related to energy in Grade 11." (Sis2)

To sum up, all teachers believed that university entrance exam affected their teaching physics by considering spiral structure negatively. Three teachers believed that there was a need to mention some topics in the THSPC in detail.

5.6.3 Beliefs related to factors that affect teachers' teaching by considering real-life context-based approach

In the interview, I asked teachers the factors that affect their teaching by considering real-life context-based approach negatively. I calculated the occurrence frequencies of factors affecting their teaching by considering real-life context-based approach that teachers indicated. Table 5.25 presents the beliefs related to the factors that make teaching physics by considering real-life context-based approach difficult and how many times each teacher expressed these beliefs in the interview.

Table 5.25 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics by considering real-life context-based approach difficult

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is difficult to teach physics by considering real-life context-based approach due to	students' low economic status	FDSLE	1	2			3
	inadequacy of lesson hours	FDILH				1	1
	students' lack of interest in activities	FDSLI			1		1
	lack of information and communication technologies	FDLIC			1		1

As shown in Table 5.25, Sinan and Fatih believed that students' low economic status affected their teaching by considering real-life context-based approach negatively. They indicated that students were unfamiliar to some examples related to daily life which they gave in the classroom. The following excerpt from the interview with Fatih illustrates this belief:

> Fatih: "I want to say that students have low economic status. Students are unfamiliar to our examples."
> Interviewer: "Why?"
> Fatih: "For example, I talk about the examples related to home appliances. However, some of the students have never seen dish washer… When I talk about some devices, they are really unfamiliar to them." (Fis2)

Tarık believed that it was difficult to teach physics by considering real-life context-based approach due to lack of information and communication technologies and students' lack of interest in activities. The following excerpt from the interview with Tarık exemplifies his beliefs:

> Tarık: "There are no animations and internet [meaning to say that there are no animations related to daily life]. Students cannot reach internet. In addition, we do not like the activities in the course book. We do not like them."
> Interviewer: "Why?"
> Tarık: "I do not believe their 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 waste of time for students. When they [students] perform these activities, they laugh." (Tis2)

In addition, Altan believed that inadequacy of lesson hours affected his teaching by considering real-life context-based approach negatively. The following excerpt from the interview with Altan illustrates his belief:

> Altan: "There is no problem because student can say his ideas freely. It affects positively in the lesson. However, it affects negatively because everybody wants to say their ideas. In this situation, there is a problem in finishing the lesson in time." (Ais2)

As a conclusion, Sinan and Fatih believed that students' low economic status; Tarık believed that lack of information and communication technologies and students' lack of interest in activities, and Altan believed that inadequacy of lesson hours made their teaching physics by considering real-life context-based approach difficult.

5.6.4 Beliefs related to factors that affect teachers' teaching by integrating knowledge and skill objectives

I asked teachers the factors that affect their teaching by using various teaching methods negatively in the interview. I calculated the occurrence frequencies of factors that affect their teaching by integrating knowledge and skill objectives that teachers indicated. Table 5.26 presents the beliefs related to the factors that make teaching physics by integrating knowledge and skill objectives difficult and how many times each teacher expressed these beliefs in the interview.

Table 5.26 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics by integrating knowledge and skill objectives difficult

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is difficult to teach physics by integrating knowledge and skill objectives due to	inadequacy of laboratory environment	FDILE	1	1	2	1	5
	university entrance exam	FDUEA			3		3
	inadequacy of lesson hours	FDILH	1			1	2
	students' lack of interest in activities	FDSLI				2	2
	students' low economic status	FDSLE	1				1
	a great number of students in classrooms	FDGNS				1	1

As can be seen in Table 5.26, all participants believed that inadequacy of laboratory environment affected their teaching physics by integrating knowledge and skill objectives negatively. For example, Sinan thought that there was a need to have a laboratory for students to attain some skills. Therefore, he believed that it was difficult teach physics by integrating knowledge and skill objectives without appropriate laboratory conditions. The following excerpt from the interview with Sinan illustrates his belief:

> Sinan: “When we think our laboratory, there is no equipment. Curriculum wants me to hang simple pendulum 2 meter above the floor. I could not do it in each classroom. If I have well-equipped laboratory, I can.” (Sis2)

Like Sinan, Tarık believed that inadequacy of laboratory environment prevented him to teach physics by integrating knowledge and skill objectives. The following excerpt from the interview with Tarık illustrates his belief:

> Tarık: “I think that it is very difficult to teach by integrating knowledge and skill objectives in the present classrooms. There is a need to have practice areas in the classrooms to perform activities. Or we need appropriate laboratory environment. There is no appropriate laboratory environment in the school.” (Tis2)

Altan believed that a great number of students in the classroom, inadequacy of lesson hours and students’ lack of interest in activities affected his teaching by integrating knowledge and skill objectives negatively. For example, the following excerpt from the interview with Altan illustrates his belief which is “It is difficult to teach physics by integrating knowledge and skill objectives due to students’ lack of interest in activities”.

> Altan: “We need more professional instructional materials. As I said before, when we demonstrate students meter and balance, students say that we know them. For example, we will demonstrate students thermometer and meter in teaching of ‘energy’ and ‘nature of physics’ units; however, they say that why do you [Altan] show them. When they [students] say “why do you show them, we [students] already know them”, even students understand that they [the instruments shown] are simple.” (Ais2)

The teaching experiences of Altan could cause the formation of the belief which is “It is difficult to teach physics by integrating knowledge and skill objectives due to students’ lack of interest in activities”. For example, I observed that Altan wanted to demonstrate students how balance works in the classroom. However, some of the students said that they knew how balance worked. The following excerpt from the video-recordings of Altan illustrates this situation:

> Altan: “This is balance. Friends! What does balance mean? Look! It means that this length is equal to this length. Look! There is a small piece. What is this?...” [He demonstrated students balance. He talked about how it works.]
>
> Student 1: “Teacher! We cannot see.”

Student 2: "We cannot see."

Student 3: "Teacher! They can come to here."

Student 4: "Teacher! We have already known how balance works. Therefore, we do not need to see it. It is sufficient to listen." [She thought that there was no need to see it, because she knew balance.]

Altan: "However, I want to say that you need to see how it works."

Student 4: "Teacher! We can guess." (Aow1)

To sum up, all participants believed that it was difficult to teach physics by integrating knowledge and skill objectives due to inadequacy of laboratory environment.

5.6.5 Beliefs related to factors that affect teachers' teaching by considering PSS

In the interview, I asked teachers the factors that make their teaching physics by considering PSS. However, I did not ask Tarık and Altan the factors that make teaching physics by considering PSS easy, because they indicated that they could not teach physics by considering PSS. Therefore, I calculated the occurrence frequencies of factors affecting teaching physics by considering PSS positively that Sinan and Fatih indicated. Table 5.27 presents the beliefs related to factors that make their teaching physics by considering PSS easy and how many times each teacher expressed these beliefs in the interview.

Table 5.27 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics by considering PSS easy

Beliefs		Code	Teachers		Total
			Sinan	Fatih	freq.
It is easy to teach physics by considering PSS due to	students' interest in physics lessons	FESIP	2	3	5
	teacher's opportunity to give more examples about daily life	FETOG		2	2
	students' sufficient readiness level	FESSR	1		1

Sinan and Fatih believed that students' interest in physics lessons made their teaching physics by considering PSS easy. The following excerpt from the interview with Sinan illustrates this belief:

Sinan: "For example, if there are students who are interested in carrying out hands-on activities, they influence their friends. Students compete with each other. Therefore, implementing lessons becomes easier." (Sis3)

In addition, Fatih believed that having an opportunity to give more examples about daily life made his teaching physics by considering PSS easy. The following excerpt from the interview with Fatih illustrates his belief:

Fatih: "We can talk about many examples from the environment. Therefore, students want to talk. When we talk about examples, students become interested. When we ask students how these tools work and why this machine does not work, students become interested."

Interviewer: "How does having an opportunity to give more examples about daily life affect your instruction?"

Fatih: "I mean that we can talk about more examples. For example, I ask students how you will overcome the global warming or why this lamb is not working. You can find many examples which are related to physics." (Fis3)

In addition, teachers indicated some factors that make their teaching physics by considering PSS difficult in the interview. I calculated the occurrence frequencies of factors that affect their teaching by considering PSS that teachers indicated. Table 5.29 presents the beliefs related to factors that make their teaching physics by considering PSS difficult how many times each teacher expressed these beliefs in the interview.

As given in Table 5.28, three teachers Fatih, Tarık and Altan believed that university entrance exam affected their teaching by considering PSS negatively. The following excerpt from the interview with Tarık illustrates this belief:

Interviewer: "Why do students want you to solve physics problems?" [Tarık indicated that he could not teach physics by considering PSS because students wanted him to solve questions on the blackboard instead of performing activities. Therefore, I asked this question to Tarık]

Tarık: "Students' success is evaluated according to their achievement in the university entrance exam. For example, students want to have good jobs. Therefore, they want us to solve more questions to be successful in university entrance exam. Students' previous learning experiences affect us. Students are used to memorize knowledge due to their previous teachers. They want us to behave like their previous teachers. Students think that it is right to take notes in the classroom. Students do not inquire." (Tis3)

Table 5.28 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics by considering PSS difficult

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is difficult to teach physics by considering PSS due to	students' low economic status	FDSLE	2		2		4
	discipline problems among students in the classroom	FDDPS	2	2			4
	university entrance exam	FDUEA		1	1	1	3
	inadequacy of lesson hours	FDILH				2	2
	inadequacy of laboratory environment	FDILE	1			1	2
	students' desire to learn with teacher centered learning approaches	FDSDT			2		2
	a great number of students in classrooms	FDGNS	1				1
	students' lack of interest in activities	FDSLI				1	1

In addition, Sinan and Fatih indicated that they faced discipline problems when they attempted to help students attain PSS. 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 this belief:

> Sinan: "… you will separate students into groups in problem solving. There are discipline problems in the classroom. Therefore, some of the students lose their attention. For example, everybody wants to talk. However, you cannot deal with each student. Therefore, some of the students become uninterested in next activities."
>
> Interviewer: "Are there any other factors?"
>
> Sinan: "I cannot trust students. For example, we need some instructional materials while performing activities. I am afraid of students because we have spoiled students. They can harm their friends. Therefore, I do not want to bring some of the equipment such as lighter

> and penknife. For example, we performed an activity which was related to energy transformation. When I turned to blackboard, some of the students were throwing the marbles to each other." (Sis3)

Like Sinan, Fatih believed that discipline problems in the classroom affected his teaching by considering PSS negatively. The following excerpt from the interview with Fatih illustrates his belief:

> Fatih: "In our some classrooms, we cannot carry out any activities. When you try to perform some activities, you lose the control of students. You are afraid of bringing materials into the classroom because there are very spoiled students. For example, if you want to do something in the classroom, students and teachers in other classrooms can be disturbed. In addition, we spend our many time to quite students. We cannot perform many of the activities." (Fis3)

Teachers' responses to open-ended questionnaire showed that the most indicated factor that makes teaching physics by considering PSS difficult was inadequacy of laboratory environment. For example, Fatih believed that students could not attain 'PSS2', 'PSS4', 'PSS5', and 'PSS8' due to inadequacy of laboratory environment, 'PSS7' due to inadequacy of laboratory environment and discipline problems among students, and 'PSS9' due to students' insufficient readiness level. For example, the following excerpt from the open-ended questionnaire illustrates the reason of why students could not attain 'PSS7' which is "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 very spoiled students."

Sinan believed that students could not attain 'PSS1' due to students' desire to learn with teacher centered learning approaches, 'PSS4', 'PSS5', 'PSS9' due to inadequacy of laboratory environment, 'PSS6' due to a great number of students in the classroom and discipline problems among students, and 'PSS8' due to inadequacy of laboratory environment and lack of information and communication technologies. For example, the following excerpt from the open-ended questionnaire illustrates the reason of why students could not attain 'PSS4' which is “recognizing appropriate experimental equipment or tools and using them safely”:

> “Due to inadequacy of laboratory environment. Many of the laboratory equipment are broken. Therefore, we cannot bring them into classroom. Therefore, this skill cannot be attained in this situation.”

Tarık believed that students could not attain ‘PSS2’, ‘PSS3’, ‘PSS4’, ‘PSS5’, ‘PSS6’, ‘PSS7’, ‘PSS8’ and ‘PSS9’ due to inadequacy of laboratory environment. Altan believed that students could not attain ‘PSS3’, ‘PSS4’, ‘PSS5’, ‘PSS6’, ‘PSS9’ and ‘PSS10’ due to inadequacy of laboratory environment and ‘PSS8’ due to lack of information and communication technologies. For example, the following excerpt from the open-ended questionnaire illustrates the reason of why students could not attain ‘PSS9’ which is “expressing findings obtained after the analysis of data as models such as mathematical equations”:

> “It cannot be attained due to inappropriate laboratory conditions”

As a conclusion, all participants believed that it was difficult to teach physics by considering PSS due to inadequacy of laboratory environment. They thought that there was a need to have appropriate laboratory conditions to teach physics by considering PSS. Additionally, three teachers Fatih, Tarık and Altan believed that university entrance exam affected their teaching physics by considering PSS negatively.

5.6.6 Beliefs related to factors that affect teachers’ teaching by considering PTSEO

I asked teachers the factors that make their teaching physics by considering PTSEO easy and difficult in the interview. I calculated the occurrence frequencies of factors that affect their teaching by considering PTSEO that teachers indicated. Table 5.29 presents the beliefs related to factors that make their teaching physics by considering PTSEO easy and how many times each teacher expressed these beliefs in the interview.

Table 5.29 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics by considering PTSEO easy

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is easy to teach physics by considering PTSEO due to	teacher's opportunity to give more examples about daily life	FETOG	2	2	2	2	8
	students' interest in physics lessons	FESIP	2				2
	students' sufficient readiness level	FESSR	1				1
	widespread use of technology	FEWUI			1		1
	interesting pictures and examples in the course book	FEIPE	1				1

All participants believed that it was easy to teach physics by considering PTSEO due to teacher's opportunity to give more examples about daily life. The following excerpt from the interview with Tarık illustrates this belief:

> Tarık: "We can talk about more examples from life. For example, when we talk about the electric, we mention the electrical instillations, transformer and transformation of energy from hydroelectric centrals to our homes. Instead of directly mentioning how the electric is produced, we try to discuss them. We have been teaching satellite frequencies. We have been teaching the working principle of cars and their pollution to environment. These are all good examples from life. We can talk about many examples from life." (Tis3)

Similarly, Fatih believed that he had an opportunity to give more examples about daily life, while he was teaching by considering PTSEO. The following excerpt from the interview with Fatih illustrates this belief:

> Fatih: "I think that physics-technology-society-environment objectives are part of the life. Therefore, you can talk about many examples which are related to life. For example, you can mention that cell phone is working due to electromagnetic waves." (Fis3)

Sinan believed that interesting pictures and examples facilitated his teaching by considering PTSEO. The following excerpt from the interview with Sinan illustrates this belief:

> Sinan: "For example, pictures in the course book facilitate. There was an interesting example in the course book. It illustrated two cars in the energy unit. For example, the image of one of the car was very beautiful; however, it consumed more oil. We mentioned efficiency in this unit." (Sis3)

Differently, Tarık believed that widespread use of technology facilitated his teaching by considering PTSEO. The following excerpt from the interview with Tarık exemplifies his belief:

> Tarık: "For example, students can reach internet everywhere."
>
> Interviewer: "How does it affect?"
>
> Tarık: "For example, we have been teaching energy sources. When we have an internet, we can reach pictures or news which are related to energy sources via internet. Students can learn more easily." (Tis3)

In addition, teachers indicated some factors that make their teaching physics by considering PTSEO difficult in the interview. I calculated the occurrence frequencies of factors that affect their teaching by considering PTSEO that teachers indicated. Table 5.30 presents the beliefs related to the factors that make teaching physics by considering PTSEO difficult how many times each teacher expressed these beliefs in the interview.

As can be seen in Table 5.30, Fatih and Altan believed that it was difficult to teach physics by considering PTSEO due to inadequacy of laboratory environment. The following excerpt from the interview with Fatih illustrates this belief:

> Fatih: "First of all, inadequacy of laboratory environment. Students see many of our examples in television; they cannot experience them in the laboratory." (Fis3)

Like Fatih, Altan believed that inadequacy of laboratory environment affected his teaching by considering PTSEO negatively. The following excerpt from the interview with Altan exemplifies his belief:

Altan: "For example, when we help students attain some objectives, we need laboratory. Helping students attaint these objectives takes too much time. There is a need to have small number of students in the classroom and appropriate laboratory environment. It is impossible to help students attain these objectives in two hours in a week." (Ais3)

Table 5.30 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics by considering PTSEO difficult

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is difficult to teach physics by considering PTSEO due to	inadequacy of laboratory environment	FDILE		2		2	4
	a great number of students in classrooms	FDGNS	1			2	3
	inadequacy of lesson hours	FDILH				1	1
	students' low economic status	FDSLE	1				1
	insufficient number of programs in media about physics and technology	FDINP			1		1
	lack of information and communication technologies	FDLIC	1				1

Different from other teachers, Tarık believed that insufficient number of programs in media about physics and technology impeded his teaching physics by considering PTSEO. The following excerpt from the interview with Tarık illustrates his belief:

Tarık: "There are not enough television programs which are related to physics and technology."

Interviewer: "How does it affect?"

Tarık: "It impedes. If students do not know anything about the physics and technology, we cannot draw attention of students. If students know something, they raise their fingers and they want to talk." (Tis3)

In addition, teachers indicated some factors that made their teaching physics by considering PTSEO difficult when they answered the questions in the open-ended questionnaire. For example, Sinan believed that students could not attain ‘PTSEO4’, and ‘PTSEO21’ due to inadequacy of laboratory environment, and PTSEO19’ due to lack of information and communication technologies and students’ low economic status. The following excerpt from the open-ended questionnaire illustrates the reason of why students could not attain ‘PTSEO19’ which is “observing how physics and technology is used by society while deciding in environmental problems”:

> “It is difficult to help students attain this skill because we do not have computer laboratory and technology classroom in our school. In addition, our students cannot reach information and communication technologies due to their low economic status.”

Fatih believed that students could not attain ‘PTSEO2’, ‘PTSEO8’, ‘PTSEO14’ and ‘PTSEO21’ due to inadequacy of laboratory environment. The following excerpt from the open-ended questionnaire illustrates the reason of why students could not attain ‘PTSEO21’ which is “knowing necessary basic principles for safe use of equipment and devices”:

> “I think that we need laboratory to help students attain this objective. It is not sufficient to mention safety rules in the classroom.”

Tarık believed that students could not attain ‘PTSEO7’ and ‘PSTEO14’ due to inadequacy of laboratory environment. The following excerpt from the open-ended questionnaire exemplifies the reason of why students could not attain ‘PTSEO7’ which is “realizing that existing scientific knowledge, when a new evidence arises, is limited, corrected or renewed by testing”:

> “There is no laboratory environment in the school”

Altan believed that students could not attain ‘PTSEO14’ due to inadequacy of laboratory environment and lack of information and communication technologies, and ‘PTSEO21’ due to inadequacy of laboratory environment. The following excerpt from the open-ended questionnaire illustrates the reason of why students could not attain ‘PTSEO14’ which is “explaining the working principle and/or function of technological tools used in daily life by using scientific knowledge":

> "We cannot help students attain this due to lack of computer and laboratory."

Consequently, all teachers believed that inadequacy of laboratory environment affected their teaching by considering PTSEO negatively. In addition, three teachers believed that it was difficult to teach physics by considering PTSEO due to lack of information and communication technologies.

5.6.7 Beliefs related to factors that affect teachers' teaching by considering ICS

In the interview, I asked teachers the factors that make their teaching physics by considering ICS easy and difficult. I calculated the occurrence frequencies of factors that affect their teaching by considering ICS that teachers indicated. Table 5.31 presents the beliefs related to factors that make their teaching physics by considering ICS easy and how many times each teacher expressed these beliefs in the interview.

Table 5.31 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics by considering ICS easy

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is easy to teach physics by considering ICS due to	students' sufficient readiness level	FESSR				4	4
	widespread use of technology	FEWUI			2	1	3
	students' interest in using information and communication technologies	FESIUI	1				1
	being a young teacher	FEBYT		1			1

As can be seen in Table 5.31, teachers indicated different factors that make their teaching physics by considering ICS easy in the interview. For example, Altan believed that students' sufficient readiness level in using information and communication technologies facilitated his teaching by considering ICS. The following excerpt from the interview with Altan illustrates his belief:

> Altan: "…for example, we crate a discussion environment in the classroom. We discuss ideas. Everybody talks about their ideas. Then, I want students to investigate. They do not say that where will we [students] investigate. Students are aware of this. They know how to use technology. For example, last week, I asked students that was the glass solid or liquid. Some of them said solid because it can be broken, some of them said liquid and some of them said plasma. There was a serious discussion in the classroom. Then, students disappeared. Students can investigate the answer of this question from the internet in the school in the break due to information." (Ais4)

Tarık and Altan believed that widespread use of technology made their teaching physics by considering ICS easy. The following excerpt from the interview with Tarık exemplifies this belief:

> Tarık: "First of all, internet. For example, when we give students homework, they firstly use internet. Recently, you can find internet everywhere…" (Tis4)

Sinan believed that students' interest in using information and communication technologies made his teaching physics by considering ICS easy. The following excerpt from the interview with Sinan illustrates his belief:

> Sinan: "Students like investigating something by using internet. When we assign research homework, they become more interested. Therefore, they become more willing to participate in discussions. Our lessons become more entertaining." (Sis4)

Fatih indicated 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 easy due to his age. The following excerpt from the interview with Fatih illustrates his belief:

> Fatih: "Age difference between me and students facilitate. There is no huge difference between my age and student."
>
> Interviewer: "How does it affect?"
>
> Fatih: "We can understand students' emotions better. We can easily communicate with students. In addition, there are students who have high-self confidence. Therefore, we can make students participate in discussion easily. If you do not hurt their feelings, they can express themselves." (Fis4)

In addition, teachers indicated some factors that make their teaching physics by considering ICS difficult in the interview. I calculated the frequencies of factors affecting their teaching by considering PTSEO that teachers indicated. Table 5.32 presents the beliefs related to the factors that make teaching physics by considering ICS difficult and how many times each teacher expressed these beliefs in the interview.

Table 5.32 Beliefs and occurrence frequencies of these beliefs related to the factors that make teaching physics by considering ICS difficult

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is difficult to teach physics by considering ICS due to	lack of information and communication technologies	FDLIC	1	3	1	2	7
	inadequacy of lesson hours	FDILH	2	1		1	4
	students’ low economic status	FDSLE	1	1		1	3
	students’ insufficient readiness level	FDSIR	1			2	3
	a great number of students in classrooms	FDGNS	1			1	2
	discipline problems among students in the classroom	FDDPS		1			1

All participants believed that lack of information and communication technologies made their teaching physics by considering ICS difficult. For example, the following excerpt from the interview with Fatih illustrates this belief:

> Fatih: “If we have had projectors or smart board, we would help students attain information skills better. In addition, our laboratory was not appropriate to perform some activities.” (Fis4).

Similarly, Tarık believed that lack of information and communication technologies made his teaching physics by considering ICS difficult. The following excerpt from the interview with Tarık exemplifies his belief:

> Tarık: "We do not have computer and internet in the school. They impede." (Tis4)

Altan too believed that lack of information and communication technologies made his teaching physics by considering ICS difficult. The following excerpt from the interview with Altan illustrates his belief:

> Altan: For example, one factor that makes difficult it [referring to teaching physics by considering ICS] is that there is no computer in the classroom environment. (Ais4)

Three teachers Sinan, Fatih and Altan believed that it was difficult to teach physics by considering ICS due to students' low economic status. For example, the following excerpt from the interview with Fatih illustrates this belief:

> Fatih: "For example, many of the students live in huge families. Number of the family members is sometimes 12 or 13. They have low economic status. They cannot interact with technology more. For example, some of the families do not have television. Students cannot watch television." (Fis4)

In addition, two teachers Sinan and Altan believed that students' insufficient readiness level affected their teaching by considering ICS negatively. The following excerpt from the interview with Sinan illustrates this belief:

> Sinan: "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 performing power point. 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 to change the place of texts and pictures." (Sis4)

The teaching experiences of Sinan could cause the formation of the belief which is "It is difficult to teach physics by considering ICS due to students' insufficient readiness level". For example, he wanted students to prepare a poster which was related to renewable energy sources in the classroom (Sow10). 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. The following excerpt from the video-recordings of Sinan illustrates his teaching in the classroom:

> Student: "Teacher! I want to ask a question."
>
> Sinan: "Yes, ask."
>
> Student: "Teacher! Can we stick on prints on the paper?"
>
> Sinan: "I do not want it. 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 to with each other. Is it Ok?" (Sow10)

Similarly, Altan believed that students' insufficient readiness level made his teaching physics by considering ICS difficult. The following excerpt from the interview with Altan illustrates his belief:

> Altan: "Some of the students cannot use computer effectively. For example, there are some students who come from villages in our school. For example, they are not able to use 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." (Ais4)

In addition, similar to factors that teachers indicated in the interview, they indicated some factors that made their teaching physics by considering ICS difficult when they answered the questions in the open-ended questionnaire. Sinan believed that students could not attain 'ICS1' due to lack of information and communication technologies, 'ICS3', 'ICS6', and 'ICS8' due to lack of information and communication technologies and students' low economic status, and 'ICS4' and 'ICS5' due to students' insufficient readiness level. He did not write anything for 'ICS10' in the open-ended questionnaire. The following excerpt from the open-ended questionnaire exemplifies the reason of why students could not attain 'ICS6' which is "preparing presentations with correct outputs and appropriate for one's aims":

> "When the presentations of students were evaluated, we realized that pictures and visuals were not in harmony."

Fatih believed that students could not attain 'ICS1', 'ICS2', 'ICS3', 'ICS4' and 'ICS10' due to students' insufficient readiness level, 'ICS5' due to university entrance exam, 'ICS7' and 'ICS8' due to lack of information and communication technologies. The following excerpt from the open-ended questionnaire exemplifies the reason of why students could not attain 'ICS8' which is "making an effective presentation by using appropriate technological media and devices":

> "There are no these technological facilities."

Tarık believed that students could not attain 'ICS1', 'ICS2', and 'ICS4' due to lack of information and communication technologies. The following excerpt from the open-ended questionnaire illustrates the reason of why students could not attain 'ICS1' which is "using different sources of information":

> "There is no Internet in the classroom environment. There are not any places in the school to use Internet"

Altan believed that students could not attain 'ICS2', 'ICS3', 'ICS5', 'ICS7', and 'ICS8' due to lack of information and communication skills. The following excerpt from the open-ended questionnaire exemplifies the reason of why students could not attain 'ICS7' which is "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 computer and over-head projector in the classroom environment"

To sum up, all teachers believed that it was difficult to teach physics by considering ICS due to lack of information and communication technologies. In addition, the factors 'inadequacy of lesson hours' and 'students' low economic status' that physics teachers believed were indicated by most teachers.

5.6.8 Summary of the results related to factors that teachers believe to affect teaching physics according to the THSPC

I asked teachers the factors that affect their teaching by using various teaching methods, integrating knowledge and skill objectives, and considering spiral structure, real-life context-based approach, PSS, PTSEO, and ICS to get complete answer for Research Question 7. I presented the factors that teachers believe to affect their teaching according to the THSPC in Sections 5.6, 5.6.1, 5.6.2, 5.6.3, 5.6.4, 5.6.5, 5.6.6, and 5.6.7. They believed that some factors made their teaching physics according to the THSPC easy. I presented, in Table 5.33, the overall beliefs related to factors that affect teaching physics according to the THSPC positively and the overall occurrence frequencies of these beliefs.

Table 5.33 Overall beliefs and overall occurrence frequencies of these beliefs related to factors that make teaching physics according to the THSPC easy

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is easy to teach physics according to THSPC due to	students' interest in physics lessons	FESIP	9	4		3	16
	teacher's opportunity to give more examples about daily life	FETOG	2	4	2	2	10
	students' sufficient readiness level	FESSR	2		1	5	8
	widespread use of internet	FEWUI			3	1	4
	feasible activities/experiments in the course book	FEFAE	1			1	2
	students' interest in using information and communication technologies	FESIUI	1				1
	being a young teacher	FEBYT		1			1
	interesting pictures and examples in the course book	FEIPE	1				1

On the other hand, they believed that some factors made their teaching physics according to the THSPC difficult. I presented, in Table 5.34, the overall beliefs related to factors that affect teaching physics according to the THSPC negatively and the occurrence frequencies of these beliefs.

Table 5.34 Overall beliefs and overall occurrence frequencies of these beliefs related to factors that make teaching physics according to the THSPC difficult

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is difficult to teach physics according to THSPC due to	university entrance exam	FDUEA	4	3	11	8	26
	inadequacy of laboratory environment	FDILE	4	8	2	10	24
	inadequacy of lesson hours	FDILH	5	3	1	12	21
	students' low economic status	FDSLE	7	3	4	1	15
	lack of information and communication technologies	FDLIC	4	4	3	4	15
	a great number of students in classrooms	FDGNS	5			7	12
	discipline problems among students in the classroom	FDDPS	2	4			6
	students' desire to learn with teacher centered learning approaches	FDSDT	1		4		5
	considering the necessity of teaching some topics in the curriculum in detail	FDCNT	2		1	2	5
	students' lack of interest in activities	FDSLI			1	3	4
	families' insufficient knowledge about curriculum	FDFIK			1	2	3
	teacher's insufficient pedagogic formation	FDTIF	2	1			3
	students' insufficient readiness level	FDSIR	1			2	3

Table 5.34 (continued)

Beliefs		Code	Teachers				Total
			Sinan	Fatih	Tarık	Altan	freq.
It is difficult to teach physics according to THSPC due to	school administration's insufficient knowledge about curriculum	FDSAI	1		1		2
	insufficient number of programs in media about physics and technology	FDINP			1		1

The beliefs related to factors that make teaching physics according to the THSPC difficult indicated by all teachers were university entrance exam, inadequacy of laboratory environment, inadequacy of lesson hours, students' low economic status, and lack of information and communication technologies. The interesting result was that although Sinan and Fatih who are in the first year of teaching profession believed that teachers' insufficient pedagogic formation and discipline problems among students in the classroom affected their teaching physics according to the THSPC negatively, Tarık and Altan did not have these beliefs. In addition, whereas Tarık and Altan believed that it was difficult to teach physics according to the THSPC due to students' lack of interest in activities and families' insufficient knowledge about curriculum, Sinan and Fatih did not have these beliefs.

CHAPTER 6

DISCUSSION, CONCLUSIONS, SUGGESTIONS AND LIMITATIONS

This chapter includes discussion of the results, conclusions, suggestions and limitations.

6.1 Discussion of the Results

The results of this study showed that participants believed that teaching physics according to the THSPC had some strengths. For example, participating teachers in this study believed that the THPSC helped students use their skills, become interested in physics lessons, relate physics to their daily life, and have a permanent knowledge. Ajzen (1988) called the beliefs related to strengths of performing a particular behavior as behavioral beliefs. In this regard, beliefs related to strengths of teaching physics according to the THSPC can be considered as behavioral beliefs about the THSPC in this study. Although there are no studies about teachers' behavioral beliefs related to the THSPC in the literature, the results of this study can be compared with the studies concerned about teachers' beliefs related to constructivism, inquiry, science and technology issues, and problem solving because the THSPC emphasizes them. For example, Beck et al. (2000) found that teaching of subcomponents of Constructivist Learning Environment Survey helped students develop their skills, become interested in lessons and involve in learning. In addition, Haney et al. (1996) found that implementing lessons by considering inquiry strand in Ohio Science Model helped students increase their interest, learn independently and relate science to their daily life. Similar to results of these studies, I found that participating teachers in this study believed that teaching physics according to the THSPC helped students become interested in lessons, use their skills and relate physics to their daily life.

I also found similar results in this study to that of Tsai (2001). He found that the teacher in his study believed that implementing lessons by considering STS practices (these practices are similar to PTSEO in the THSPC in terms of some aspects) encouraged students to be willing to attend discussions and use their skills. Like in the study of Tsai (2001), one of the participants of this study believed that teaching physics by considering PTSEO helped students participate in discussions.

In addition, participants believed that there were some weaknesses of the THSPC. For example, some of them believed that the orders of topic were not appropriate and how to help students attain the skill objectives in the THSPC were not explained in detail. However, the data results of this study showed that the number of the strengths of the THSPC indicated by participants were more than the number of weaknesses of the THSPC. In this regard, participants could consider that there were more positive aspects of the THSPC than negative aspects of the THSPC.

One of the research questions of this study was concerned with teachers' beliefs about how to teach physics according to the THSPC. The results of this study showed that all participants believed that they could teach physics according to the THSPC by creating a discussion environment and giving examples from daily life. I think that this finding shows that participants could perceive that they are required to teach physics by using generally these techniques. However, the reality is not like what teachers seem to have perceived. Teachers are required to use various teaching methods to teach physics in the THSPC. For example, it is suggested in the THSPC that teachers can use the inquiry based-learning and constructivist teaching methods for the units 'nature of physics' and 'energy' (MoNE, 2007). However, none of the participants mentioned the techniques related to inquiry and constructivism in the interviews and open-ended questionnaire. The reason for this could be that they might not believe in the effectiveness of the use of these techniques or they might not have sufficient knowledge about these techniques.

Additionally, important finding of this study related to teachers' beliefs about teaching physics according to the THSPC was that teachers Sinan and Fatih who are in the first year of teaching profession believed that they could teach physics according to the THSPC by carrying out hands-on activities. However, Tarık and Altan did not mention this technique in the interview, although teachers are required to use hands-on activities in their instruction (MoNE, 2007). I think that the reason of this can be that Sinan and Fatih are more willing to teach physics according to the THSPC or school types where teachers worked can affect the formation of this belief. Tarık and Altan who worked in the schools composing of mainly high-achieving students could think that students did not need to perform any activities to learn physics because they were hard-working and successful. In addition, some factors such as university entrance exam or inadequacy of laboratory environment could affect the use of various teaching methods as they indicated in the interviews and open-ended questionnaire. Ajzen (1988) called these factors affecting the performance of behavior as control belief and Ford (1992) called them context beliefs. It is obvious that these beliefs certainly have a great effect on the implementation of the THSCP in desired manner.

Moreover, participants attempted to help students attain PTSEO more than they attempted to help students attain PSS or ICS. They could believe that helping students attain PTSEO was easier than helping students attain PSS and ICS. For example, 'inadequacy of laboratory environment' and 'lack of information and communication technologies' were two of the factors teachers stated that make teaching physics by considering PTSEO, PSS and ICS difficult. However, these factors were indicated more for PSS and ICS. Therefore, they could give more importance to attainment of PTSEO in their instructional practices. In addition, when PSS and ICS in the THSPC were examined, students might need to have some instructional materials for attaining these skills. For example, skills such as "making an effective presentation by using appropriate technological media and devices (internet, computer, projection device, overhead projector, slide, etc.)", "determining appropriate measurement tool to measure variables", "recognizing appropriate experimental equipment or tools and using them safely", and "making experimental setups to test the formulated hypothesis" requires additional equipments/tools or instructional materials. Due to such reason, teachers could give more importance to attainment of PTSEO which does not require extra materials.

Such context beliefs and control beliefs that teachers hold related to the THSPC could affect their teaching physics by considering PSS and ICS more.

Other research question of this study was related to teachers' beliefs about the necessity and possibility of attainment of skill objectives in the THSPC. The results of this study showed that although participating teachers in this study believed both necessity and possibility of attainment of majority of the skill objectives in the 'nature of physics' and 'energy' units, they did not attempt to help students attain them. Several researchers (e.g., Bryan & Abell, 1999; Levitt, 2001; Mansour, 2009; Mellado, 1998; Richmond & Anderson, 2003; Rubba, 1991; Simmons et al., 1999; Smith & Southerleand, 2007; Uzuntiryaki et al., 2010; Tondeur et al., 2007) also found that there could be sometimes inconsistency between teachers' beliefs and their instructional practices. This inconsistency can be due to teachers' insufficient knowledge about how to teach physics according to the THSPC or their misinterpretation of some of the skill objectives in the THSPC. In addition, the reason of this can be due to some of the weaknesses of the THSPC as some participants of this study indicated. For example, two participants believed that the THSPC did not mention how to help students attain skill objectives in detail.

Another important finding related to attainment of skill objectives was that although participants believed both the necessity and possibility of attainment of some skill objectives, they did not help students attain them. For example, all teachers believed that students should and could attain the skill objectives "realizing that knowledge in physics increases in an accelerated way", "realizing that the change of scientific knowledge in physics is generally continuous, but it sometimes occurs as a paradigm shift", "offering a solution by considering needs of individual, society and environment to social problems by using physics and technology for better life" and "using appropriate terminologies in their communications (written, verbal and visual) related to physics"; however, they did not attempt to help students attain them. There can be some reasons why teachers did not attempt to help students attain these skills. For example, they could not understand what actually these skill objectives say. The content of the 'nature of physics' and 'energy' units cannot be appropriate to help students attain these skill objectives. For one reason or another, participants might have ignored these skill objectives.

The final research question in this study was related to factors that affect teachers' instructional practices according to the THSPC. Some of the factors that teachers believed were similar to the factors found by 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 teachers in this study believed that these factors affected their instructional practices by considering PTSEO negatively. For example, they indicated that time was not enough to discuss physics and technology relationship 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 findings of the study of Luft (1999). He investigated teachers' salient beliefs about problem solving demonstration classroom. He found that participants believed that insufficient class hours and insufficient materials affected their teaching by considering SSCS (search, solve, create and share) problem solving instruction negatively. In addition, participants believed that they did not have enough competencies in their instructional philosophy and science background to teach according to SSCS problem solving instruction (Luft, 1999). Similarly, some of the participants of this study believed that inadequacy of lesson hours and inadequacy of laboratory environment affected their instructional practices by considering PSS negatively. In addition, Sinan and Fatih in this study believed that they did not have sufficient pedagogic formation to teach physics according to the THSPC.

Additionally, when the studies related to the THSPC were examined, there were some similarities between my study and these studies although these studies were not concerned with teachers' beliefs. For example, Ergin et al. (2011) and Baybars and Kocakülah (2010) found that teachers thought that that 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 physics according to suggested activities in the THSPC.

This study differed from other studies in the literature in terms of some aspects. I found that teachers who were in different types of schools sometimes had different beliefs. Although researchers (e.g., Briscoe, 1991; Bryan & Abell, 1999; Drake & Sherin, 2006; Eick & Reed, 2002; Mellado, 1998) found that 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. I 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 ‘university entrance exam’ more than the teachers 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. I think that students’ ideas about learning could affect the formation of these beliefs. Students might want to be successful in university entrance exam which measures only students’ cognitive skills, and therefore, they might want to develop their cognitive skills by solving questions in the test books instead of performing hands-on activities in the classroom. In this regard, they could make their teachers teach physics by solving physics problems similar to problems asked in university entrance exam.

In addition, while Sinan and Fatih who are 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. I think that year of teaching experience could seriously 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 pedagogic formation. 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. The reason of this difference again can be school types where teachers worked. The schools of Sinan and Fatih had students having some discipline problems. They indicated that they faced some discipline problems while performing some hands-on activities in the classroom.

This study also allowed us to understand physics teachers' beliefs related to PSS, PTSEO and ICS in detail. 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 by helping students attain ICS. However, this belief was not mentioned for other skill areas. The teacher thought that his small age difference between him and students facilitated his communication with students. In this regard, he could believe that being a young teacher facilitated his instruction by considering ICS.

Finally, Ford (1992) called the beliefs related to environmental factors as 'context beliefs'. On the other hand, Ajzen (1985) called these beliefs as 'control beliefs' in the theory of planned behavior. Because some beliefs found in this study related to factors that affect teaching physics according to the THSPC, these beliefs can be considered as context or control beliefs about the THSPC. In addition, I found teachers' beliefs related to strengths of teaching physics according to the THSPC and weaknesses of the THSPC. Ajzen (1985) called these beliefs related to strengths and weaknesses as behavioral beliefs. Therefore, the beliefs related to strengths of teaching physics according to the THSPC and weaknesses of the THSPC can be considered as behavioral beliefs about the THSPC.

Additionally, according to Ajzen's theory of planed behavior, behavioral, normative and control beliefs of individuals affect their behavior. Although this theory was used only for identifying teachers' beliefs related to the THSPC in this study, the results of this study showed that beliefs, especially the control beliefs related to the THSPC affected behaviors of teachers in the classroom. As participants indicated in the interviews and open-ended questionnaire, they could not teach physics according to what they are required in the THSPC due to some factors such as inadequacy of laboratory environment and lack of information and communication skills. Control or context beliefs of teachers were more influential than the behavioral beliefs of teachers in their teaching physics according to the THSPC.

6.2 Conclusions

According to results of this study, conclusions about teachers' beliefs related to the THSPC are as follows;

- Participating teachers in this study believed that there were some strengths of teaching physics according to the THSPC. All of them believed that the THSPC helped students use their skills, become interested in physics lessons, relate physics to their daily life, and have a permanent knowledge.
- Participants of this study believed that the THSPC had some weaknesses. However, the number of these weaknesses was comparatively small when compared to its strengths. Some participants believed that orders of topic in the THSPC were not appropriate and the THSPC did not mention how to attain objectives in detail.
- All participating teachers believed that they could teach physics according to the THSPC by giving examples from daily life and creating a discussion environment.
- Participants who are in the first year of teaching profession believed that they could teach physics according to the THSPC by carrying out hands-on activities and giving students research homework. They tried to carry out hands-on activities and give students research homework in their instructional practices.
- More experienced participants did not perform any hands-on activities or give students research homework in their instructional practices as they believed to teach physics according to the THSPC.
- Participants who are in the first year of teaching profession used teaching techniques 'giving examples from daily life' and 'creating a discussion environment' in their instructional practices more than the more experienced participants used.

- Although all participants believed the necessity of attainment of majority of PSS, and ICS in the ‘nature of physics’ and ‘energy’ units, they seldom attempted to help students attain them in their instructional practices.
- All participants believed both necessity and possibility of attainment of majority of PTSEO by students; however, they did not attempt to help students attain many of them.
- All participants gave more importance to attainment of PTSEO by students than attainment of PSS and ICS.
- Participants who are in the first year of teaching profession attempted to help students attain more PTSEO than more experienced teachers.
- Participants believed that there were some factors making their teaching physics according to the THSPC easy. All of them believed that it was easy to teach physics according to the THSPC due to ‘teacher’s opportunity to give more examples about daily life’.
- Participants believed that there were some factors making their teaching physics according to the THSPC difficult. All of them believed that it was difficult to teach physics according to the THSPC due to ‘university entrance exam’, ‘inadequacy of laboratory environment’, ‘inadequacy of lesson hours’, ‘students’ low economic status’ and ‘lack of information and communication technologies’.

6.3 Suggestions

According to results of this study, following suggestions can be made for curriculum developers, Ministry of National Education and further research;

6.3.1 Suggestions for curriculum developers

- Participants believed that the THSPC had some weaknesses. These weaknesses can be an obstacle in front of the implementation of the THSPC in desired manner. For example, teachers believed that the orders of topic in the THSPC were not appropriate. Also, they believed that more detailed explanation on how objectives can be attained should be provided. Therefore, in the revision of the THSPC in the following years, the order of topics should be re-considered. The part about the explanation of how to help students attain objectives should be added to the THSPC.

- All participating teachers in this study believed that students should and could attain some skill objectives “realizing that knowledge in physics increases in an accelerated way”, “realizing that the change of scientific knowledge in physics is generally continuous, but it sometimes occurs as a paradigm shift”, “offering a solution by considering needs of individual, society and environment to social problems by using physics and technology for better life” and “using appropriate terminologies in their communications (written, verbal and visual) related to physics” in the THSPC. However, they did not help students attain them. They could not understand what these skill objectives mean. Therefore, in the revision of the THSPC in the following years, the meanings of these objectives should be considered again. If there is actually a problem in the meaning of these objectives, they can be written more clearly.

6.3.2 Suggestions for Ministry of National Education

- There was sometimes an inconsistency between what participants believed and what they did in the classroom. Although they believed that there was a need to help students attain majority of the skill objectives in the ‘nature of physics’, and ‘energy’ units, they did not attempt to help students attain majority of them in the classroom. As participants indicated, some factors could affect the attainment of these skills negatively or teachers could not be knowledgeable enough about how to help students attain these skills. Therefore, the factors affecting teaching physics according to the THSPC negatively should be minimized and teachers should be trained about how to help students attain these skills.
- Participants believed that they could teach physics according to the THSPC by using small number of teaching techniques. However, it is required that teachers can use various teaching methods such as inquiry-based learning in the THSPC. Therefore, physics teachers should be trained about the use

of various teaching methods for better teaching physics according to the THSPC.

- The most indicated factors that participants believed to make teaching physics according to the THSPC difficult were related to university entrance exam, limited lesson hours and inadequacy of physical and technological facilities. Therefore, either lesson hours should be increased or the content should be decreased to fit the existing time allocation. University entrance exam should be prepared by considering the content of the THSPC. Physical and technological facilities of schools should be improved for more effective implementation of the THSPC.
- Some of the beliefs of participants can 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 environment 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.
- The results of this study showed that participants sometimes could perceive some of the skill objectives differently from what the THSPC indicates. Therefore, they could have some beliefs affecting teaching physics according to the THSPC negatively. To overcome these misperceptions, teachers should be informed about what actually the skill objectives say.

6.3.3 Suggestions for further research

- This study identified some of teachers' beliefs related to the THSPC. These beliefs can affect the implementation of the THSPC negatively. For example, teachers believed that it was difficult to teach physics according to the THSPCS due to inadequacy of laboratory environment and lack of information and communication technologies. Therefore, they could completely leave teaching physics according to the THSPC. However, they can help students attain some skills in the THSPC without using laboratory. Therefore, studies on how to change teachers' beliefs related to the THSPC should be conducted.

- This study focused on only four physics teachers' beliefs related to the THSPC. Different beliefs related to the THSPC can be found by increasing the number of participants.
- The participating teachers in this study were not informed about the THSPC in their pre-service education years and they did not attend any in-service teacher training programmes related to the THSPC. This study should be replicated with teachers who were knowledgeable enough about how to teach physics according to the THSPC. In this regard, different beliefs related to the THSPC can be found.
- This study only focused on teachers' beliefs about the attainment of PSS, PTSEO and ICS and the extent of reflection of these beliefs in their instructional practices. However, teachers are required to teach physics according to the THSPC by also considering the attainment of positive attitude and values (AV). Because the skills related to AV are more general when compared with PSS, PTSEO and ICS, it is very difficult to decide whether teachers help students attain the skills related to AV in their instructional practices. In this regard, teachers' beliefs related to AV were not investigated in this study. I think that understanding whether physics teachers attempt to help students attain AV is based on defining some teacher characteristics. These teacher characteristics can help students attain AV. Therefore, teachers' beliefs related to AV should be investigated after defining some teacher characteristics which can cause students to attain AV.
- In this study, participants were only observed in teaching of 'nature of physics' and 'energy' units. Only their beliefs related to attainment of some skill objectives in 'nature of physics' and 'energy' units were investigated. Teachers can have different beliefs related to attainment of other units in the THSPC. Therefore, their beliefs related to attainment of skill objectives in other units should also be investigated.

6.4 Limitations

Limitations of this study can be as follows;

- There were only four participants in this study and they were male. Therefore, generalizing the results of this study cannot be appropriate. Teachers who really teach physics according to the THSPC can have different beliefs and there can be some differences between male and female teachers.
- In interviews, there is a possibility that participants could have answered the questions by considering not only the THSPC but also the course book available.
- Participants were not informed about the THSPC in their pre-service education years. In addition, they did not participate in any in-service training programmes related to the THSPC.
- Participants were observed only in teaching of 'nature of physics' and 'energy' units. Therefore, teachers' beliefs can only be generalized to these units.

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APPENDIX A

INTERVIEW 1

1. What can be the strengths of teaching physics according to the Turkish High School Physics Curriculum?
2. What can be the weaknesses of the Turkish High School Physics Curriculum?
3. What factors would make it easy for you to teach physics according to the Turkish High School Physics Curriculum? Can you give some examples? How do these factors affect your instruction?
4. What factors would make it difficult for you to teach physics according to the Turkish High School Physics Curriculum? Can you give some examples? How do these factors affect your instruction?
5. Turkish High School Physics Curriculum does not emphasize only the use of one teaching method and approach. It advocates the use of various teaching methods. What factors would make it difficult for you to teach physics by using various teaching methods?

INTERVIEW 2

1. Turkish High School Physics Curriculum was prepared by considering spiral structure. What factors would make it difficult for you to teach physics by considering spiral structure?
2. How do you teach physics by considering real-life context-based approach? What can be the strengths of teaching physics by considering real-life context-based approach? What factors would make it difficult for you to teach physics by considering real-life context-based approach?
3. What do you think about the integration of knowledge and skill objectives in the Turkish High School Physics Curriculum?
4. What factors would make it difficult for you to teach physics by integrating knowledge and skill objectives?

APPENDIX B

INTERVIEW 3

1. Turkish High School Physics Curriculum includes some skill objectives. For example, it includes problem solving skills. What can be the strengths of teaching physics by considering the problem solving skills?
2. What factors would make it easy for you to teach physics by considering the problem solving skills? How do these factors affect your instruction by considering the problem solving skills?
3. What factors would make it difficult for you to teach physics by considering the problem solving skills? How do these factors affect your instruction by considering the problem solving skills?
4. How do you help your students attain the problem solving skills?
5. Turkish High School Physics Curriculum includes the physics-technology-society-environment objectives in addition to the problem solving skills. What can be the strengths of teaching physics by considering the physics-technology-society-environment objectives?
6. What factors would make it easy for you to teach physics by considering the physics-technology-society-environment objectives? How do these factors affect your instruction by considering the physics-technology-society-environment objectives?
7. What factors would make it difficult for you to teach physics by considering the physics-technology-society-environment objectives? How do these factors affect your instruction by considering the physics-technology-society-environment objectives?
8. How do you help your students attain the physics-technology-society-environment objectives?

INTERVIEW 4

1. Turkish High School Physics Curriculum gives importance to information and communication skills in addition to the problem solving skills and the physics-technology-society-environment objectives. What can be the strengths of teaching physics by considering the information and communication skills?
2. What factors would make it easy for you to teach physics by considering the information and communication skills? How do these factors affect your instruction by considering the information and communication skills?
3. What factors would make it difficult for you to teach physics by considering the information and communication skills? How do these factors affect your instruction by considering the information and communication skills?
4. How do you help your students attain the information and communication skills?

APPENDIX C

THE QUESTIONNAIRE OF PHYSICS TEACHERS' BELIEFS ABOUT THE ATTAINMENT OF PSS, PTSEO AND ICS

This questionnaire was prepared to identify physics teachers' beliefs about the necessity and possibility of attainment of some skills/objectives in the 'nature of physics' and 'energy' units by students. This questionnaire consists of questions about the necessity and possibility of attainment of the problem solving skills, physics-technology-society-environment objectives and information and communication skills in the 'nature of physics' and 'energy' units by students. It is wanted from you to indicate to agree or disagree on necessity and possibility of attainment of some skills/objectives by students. After that, you will explain why you agreed or disagreed on the necessity of and possibility of attainment of skills/objectives by students. In addition, if you agree on the possibility of attainment of some skills/objectives, you will explain how you will help students attain them in the classroom.

It is important for the physics educators to answer the questions in the questionnaire honestly. In this regard, your honest answers can seriously contribute to development of physics education in high schools.

Thank you for your interest in this questionnaire.

Name/Surname: ....

Gender: ....

Age: ....

Graduated University/Department: ....

Teaching Experience Year: ....

Education Level: Master ( ) PHd ( )

Please indicate the institutions which you worked and dates.

1. ....

2. ....

3. ....

If you attend any seminars, and courses related to physics education, please indicate their names and dates.

1. ....

2. ....

Part I (Problem Solving Skills)

Problem Solving Skills	Students should attain this skill		Students can attain this skill in the classroom	
Distinguishing scientific knowledge, and view and values from each other	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Formulating a testable hypothesis for an identified problem	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Determining appropriate measurement tool to measure variables	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Recognizing appropriate experimental equipment or tools and using them safely	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Making experimental setups to test the formulated hypothesis	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	

Part I (Problem Solving Skills) (continued)

Problem Solving Skills	Students should attain this skill		Students can attain this skill in the classroom	
Performing adequate number of measurements to reduce measurement errors	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Analyzing data collected in experiments and observations by using tables, graphs, statistical methods or mathematical calculations	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Using calculator, calculation sheet, graphing software etc. when performing numerical calculations in the process of analysis and modeling	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Expressing findings obtained after the analysis of data as models such as mathematical equations	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Realizing the probable sources of error during problem solving	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	

Part II (Physics-Technology-Society-Environment Objectives)

Physics-Technology-Society-Environment Objectives	Students should attain this objective		Students can attain this objective in the classroom	
Defining physics and comprehending it as one of the basic sciences helping to understand the events in the universe	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Comprehending testable, questionable, falsifiable and evidence-based structure of physics	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Realizing that knowledge in physics increases in an accelerated way	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Realizing that scientific knowledge in physics is not always absolutely true; it is valid under certain conditions and limitations	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Explaining the role of evidences, theories and/or paradigms (ideas agreed upon by consensus by scientists) in change of scientific knowledge in physics	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Realizing that the change of scientific knowledge in physics is generally continuous, but it sometimes occurs as a paradigm shift	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	

Part II (Physics-Technology-Society-Environment Objectives) (continued)

Physics-Technology-Society-Environment Objectives	Students should attain this objective		Students can attain this objective in the classroom	
Realizing that existing scientific knowledge, when a new evidence arises, is limited, corrected or renewed by testing	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Realizing key physics concepts (change, interaction, force, field, conservation, measurement, probability, scale, equilibrium, matter-energy relationships, space-time structure, resonance, entropy etc…)	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Relating physics to other sciences in terms of scientific and technological applications	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Examining the historical development of interaction between physics and technology	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Determining and explaining with examples the contribution of a technological innovation to development of scientific knowledge in physics	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	

Part II (Physics-Technology-Society-Environment Objectives) (continued)

Physics-Technology-Society-Environment Objectives	Students should attain this objective		Students can attain this objective in the classroom	
Determining and explaining with examples the contribution of scientific knowledge in physics to development of technology	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Comprehending the importance of relationship between physics and technology in solving problems in daily life	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Explaining the working principle and/or function of technological tools used in daily life by using scientific knowledge	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
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)	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Understanding that precautions can be taken against negative effects of technology, these effects can be reduced and eliminated again with technological and physical innovations	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	

Part II (Physics-Technology-Society-Environment Objectives) (continued)

Physics-Technology-Society-Environment Objectives	Students should attain this objective		Students can attain this objective in the classroom	
Participating in contemporary discussions based on physics and technology that can affect the future of individual, society and environment	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Comparing the benefits of technology in terms of its balancing effect on economic, environmental and social costs	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Observing how physics and technology is used by society while deciding in environmental problems	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Offering a solution by considering needs of individual, society and environment to social problems by using physics and technology for better life	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Knowing necessary basic principles for safe use of equipment and devices	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	

Part III (Information and Communication Skills)

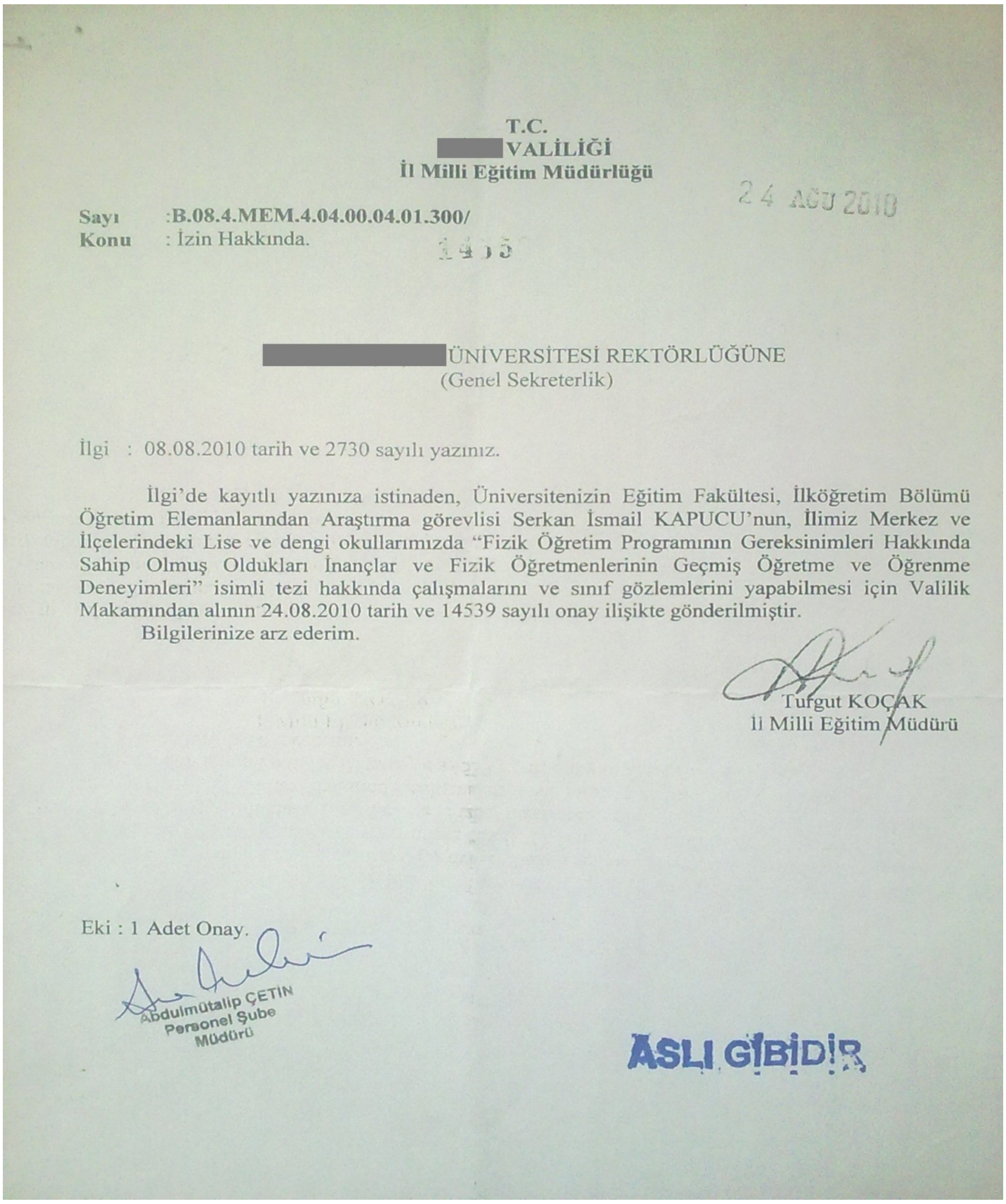
Information and Communication Skills	Students should attain this skill		Students can attain this skill in the classroom	
Using different sources of information	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Controlling whether the sources of information is reliable and valid	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Using multiple search criteria	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Searching, finding and choosing the information appropriate for one's aim	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	
Synthesizing information and obtaining new information	I agree □	I do not agree □	I agree □	I do not agree □
	Why?		Why?, How?	

Part III (Information and Communication Skills) (continued)

Information and Communication Skills	Students should attain this skill		Students can attain this skill in the classroom	
Preparing presentations with correct outputs and appropriate for one's aims	I agree ☐	I do not agree ☐	I agree ☐	I do not agree ☐
	Why?		Why?, How?	
Using different formats such as text, number, picture, graph, diagram or table as much as possible while preparing presentation	I agree ☐	I do not agree ☐	I agree ☐	I do not agree ☐
	Why?		Why?, How?	
Making an effective presentation by using appropriate technological media and devices (internet, computer, projection device, overhead projector, slide, hologram and video etc.)	I agree ☐	I do not agree ☐	I agree ☐	I do not agree ☐
	Why?		Why?, How?	
Using appropriate terminologies in their communications (written, verbal and visual) related to physics	I agree ☐	I do not agree ☐	I agree ☐	I do not agree ☐
	Why?		Why?, How?	
Expressing complex information in a clear, understandable and concise way	I agree ☐	I do not agree ☐	I agree ☐	I do not agree ☐
	Why?		Why?, How?	

APPENDIX D

PERMISSION LETTER FROM PROVINCIAL DIRECTORATE OF NATIONAL EDUCATION



T.C.
[redacted] VALİLİĞİ
İl Milli Eğitim Müdürlüğü

24 AGU 2010

Sayı :**B.08.4.MEM.4.04.00.04.01.300/**
Konu : İzin Hakkında.

[redacted] ÜNİVERSİTESİ REKTÖRLÜĞÜNE
(Genel Sekreterlik)

İlgi : 08.08.2010 tarih ve 2730 sayılı yazınız.

İlgi'de kayıtlı yazınıza istinaden, Üniversitenizin Eğitim Fakültesi, İlköğretim Bölümü Öğretim Elemanlarından Araştırma görevlisi Serkan İsmail KAPUCU'nun, İlimiz Merkez ve İlçelerindeki Lise ve dengi okullarımızda "Fizik Öğretim Programının Gereksinimleri Hakkında Sahip Olmuş Oldukları İnançlar ve Fizik Öğretmenlerinin Geçmiş Öğretme ve Öğrenme Deneyimleri" isimli tezi hakkında çalışmalarını ve sınıf gözlemlerini yapabilmesi için Valilik Makamından alının 24.08.2010 tarih ve 14539 sayılı onay ilişikte gönderilmiştir.

Bilgilerinize arz ederim.

Turgut KOÇAK
İl Milli Eğitim Müdürü

Eki : 1 Adet Onay.

Abdulmütalip ÇETİN
Personel Şube
Müdürü

ASLI GİBİDİR

T.C.
[redacted] VALİLİĞİ
İl Milli Eğitim Müdürlüğü

Sayı :B.08.4.MEM.4.04.00.04.01.300/ 24 AĞU 2010
Konu : İzin Hakkında,

1453

VALİLİK MAKAMINA
[redacted]

İlgi : [redacted] Rektörlüğünün, 08.08.2010 tarih ve 2730 sayılı yazısı.

İlgi'de kayıtlı yazıda, [redacted] Eğitim Fakültesi İlköğretim Bölümü Öğretim Elemanlarından Araştırma görevlisi Serkan İsmail KAPUCU'nun, İlimiz Merkez ve İlçelerindeki Lise ve dengi okullarımızda "Fizik Öğretim Programının Gereksinimleri Hakkında Sahip Olmuş Oldukları İnançlar ve Fizik Öğretmenlerinin Geçmiş Öğretme ve Öğrenme Deneyimleri" isimli tezi hakkında çalışmalarını ve sınıf gözlemlerini yapabilmesi teklif edilmektedir

[redacted] Üniversitesi Eğitim Fakültesi İlköğretim Bölümü Öğretim Elemanlarından Araştırma görevlisi Serkan İsmail KAPUCU'nun, İlimiz Merkez ve İlçelerindeki Lise ve dengi okullarımızda **"Fizik Öğretim Programının Gereksinimleri Hakkında Sahip Olmuş Oldukları İnançlar ve Fizik Öğretmenlerinin Geçmiş Öğretme ve Öğrenme Deneyimleri"** isimli tezi hakkında çalışmalarını ve sınıf gözlemlerini İlimiz Merkez İlçe ve 7 İlçede bulunan Ortaöğretim Kurumlarında yapması Müdürlüğümüzce uygun görülmüştür.

Makamlarınızca da uygun görüldüğü takdirde olurlarınıza arz ederim.

Turgut KOÇAK
Milli Eğitim Müdürü

OLUR
23../08/2010
Bahadır GÜNEŞ
Vali a.
Vali Yardımcısı

Eki : İlgi Yazı.

Abdulmütalip ÇETİN
Personel Şube
Müdürü

ASLI GİBİDİR

APPENDIX E

Interview Transcript of One Case Teacher

Interviewer: Ortaöğretim Fizik Dersi Öğretim Programına göre fizik öğretmenin güçlü yönleri neler olabilir?
Altan: Şimdi hocam güçlü yönleri şunlardır. Daha çok görsellik ön planda. Yani tahtadan ziyade laboratuar ön planda. Hatta şu sıkıntı var; Türkiye'nin eğitim sistemi her yerde aynı olmadığı için şu sıkıntılar ortaya çıkıyor; laboratuar şartları yeterince yok. Laboratuar şartları yeterince olmadığı için o noktada sıkıntı oluyor. Yani öğretim programı güzel fakat, şu anki Türkiye şartlarına göre yetersiz. Türkiye şartları o programa göre yetersizdir. Okulların çoğunda laboratuar odası var ama laboratuar malzemesi yok ya da laboratuar malzemesinin olduğu yerde öğretmen onları kullanacak yeterlilikte değil. Ondan dolayı eksiklikleri de var.
Interviewer: Soruyu tekrardan sormak istiyorum. Ortaöğretim Fizik Dersi Öğretim Programına göre fizik öğretmenin güçlü yönleri var mı?
Altan: Öğreniciyi daha çok derse ilgili kılıyor, eğer uygulanırsa. Çünkü görsellik ön planda olduğu için öğrenci unutmuyor ve günlük hayatla bağdaştırmış. Soyut değil biraz daha böyle pratiklik ön planda. Pratiklik ön planda olduğu için öğrencinin daha çok dikkatini çekiyor. Fiziğe karşı bir ilgi besliyor.
Interviewer: Başka var mı?
Altan: Onun dışında sayısala karşı fizik dersine karşı ilgi alaka besliyor. Onun dışında başka bir şeyim yok yani.

Interviewer: Ortaöğretim Fizik Dersi Öğretim Programının zayıf yönleri neler olabilir?
Altan: Zayıf olarak dediğim gibi; işte hocam teorikten çok pratik ön planda. Pratik yapacak ortamlar fazla yok.
Interviewer: Tek laboratuar imkanı mı yok? Başka var mı?
Altan: Laboratuar yok. Bazı sınıfların kalabalık olması. Şimdi bir mesele açılıyor; bir mesele açtığınızda öğrencilerin hepsinin görüşüne başvurursanız bu sefer müfredat yetişmiyor. Bu sonra sıkıntı oluyor. Çünkü niye; görsellik ön planda. Bir öğrenci kalkıp bir deneyle uğraştığı zaman iki ders ya da bir ders yiyor. Ya da laboratuar değil de dışarıdaki bir olayı gözlemlemek için dışarı alıp götüreceğiniz yere bazen imkan olmuyor. Ya da götürdüğünüz zaman iki saatten fazla bir zamanınız gidiyor. Diğer derslere yetişemiyoruz o noktada sıkıntı oluyor. Yani birde şu anki öğretim programında mesela şeyde fazla soru bankalarında öğrenciler olsun, ÖSS sınavında başarılı olup güzel bir yere yerleşmek ailenin yani en büyük hedefi budur. Öyle olunca bu seferde soru bankalarında, dershanelerde olsun; sorulan sorularla, sınavlarda çıkan sorularla şu anki öğretim programının tam daha bağdaştırılamamış. Tam olarak bağdaşmadığı içinde sıkıntı oluyor. Ve ders yetişmiyor hocam. Yani çünkü teorik gibi değil. Teorikte mesela diyelim bir sürü konuyu bir saatte anlatabilirsiniz ama pratikte ama öyle değil. Pratikte ancak bir deneyle dersi işleyebiliyorsunuz.
Interviewer: Bunların dışında var mı?
Altan: Hocam birde şunu söyleyeceğim. Mesela doğudaki bir okulun şartları ile bir kolejdeki öğrenci şartları aynı değil.
Interviewer: Kolej olarak değil de onu batıdaki bir Milli Eğitim okulu ile kıyaslayalım.
Altan: Yani kıyaslasak şimdi diyelim; bunu [1]X şartları için konuşuyorum: X'in bir ilçesindeki eğitim şartları ile batıda aynı şartlar yok mesela.

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[1] Bu çalışmanın yapıldığı il.

Interviewer: Biz sadece sizin karşılaşmış olduğunuz sorunlarla konuşsak daha iyi olur. Bu Türkiye'nin çünkü genel bir sorunudur. Şu an sizin kendinizin görmüş olduğu sorunlar nelerdir?
Altan: Kendimizin görmüş olduğu şudur mesela; bina var, laboratuar odası var ama laboratuar malzemesi yok. Ciddi anlamda olmayınca çok basit bir iki tane malzeme var. Böyle her deneyi karşılayacak malzememiz yok. Olmadığı içinde sıkıntı ortaya çıkıyor yani.
Interviewer: Başka olumsuz bir yön var mı?
Altan: Başka dedim ya hocam sınıfın kabalık olması. 9. sınıflarda daha bölüm belli değil. Bölüm olmadığı için öğrenci sayısı her halükarda 30'un üstünde. Yani 30'un üstünde olduğu için her öğrencinin fikrine başvuramıyoruz. Ya şu deney hakkında sen ne düşünüyorsun; iki, üç tane öğrenci zaten yorum yapıyor. Öbürleri de yorum yapınca, hocada yorum katınca ders bitiyor. Hani mesela 15 kişilik 20 kişilik sınıflar olsaydı fazla bir sıkıntı olmazdı. Şimdi teorik değil pratiktir yani.
Interviewer: Programın başka zayıf bir yönü yok mu? Sadece programın kendisinide düşünebilirsiniz.
Altan: Zayıf yönlerinden bir tanesi bazı konuların öğretim programının içinde olmaması. Bunlardan bir tanesi madde ve özelliklerini işlerken sıvıların kaldırma kuvvetinin verilmemiş olması olumsuz bir yönüdür. Ya da basınç konusunun verilmemiş olması olumsuz bir yöndür bunun dışında.
Interviewer: Niye olumsuz?
Altan: Şimdi şu var mesela; sıvıların kaldırma kuvveti öğrenciye verilmediği zaman bu sefer madde ve özellikleri biraz eksik kalıyor. Yani konuya tam hakimiyet söz konusu olmuyor. Onun içinde olumsuz yönde etkileyecektir. Yani sonuçta basınç konusu, sıvıların basıncıdır, basınç kuvveti, sıvıların basıncı verildiği zaman bu sefer sıvılar konusunda çocuk daha iyi öğreniyor. Çünkü madde özelliklerinde de sıvılar var, basınçta da sıvılar var. Ve biraz daha hakimiyeti sağlar. Ondan dolayı olmaması olumsuz yönde etkiliyor yani. Ondan sonra sarmal yapıdaki şu sıkıntılar: öğrenci iş güç enerji görüyor ama teferruatlı görülmüyor. Ondan sonra araya bir ara veriliyor. Bir yıldan sonra öğrenci konuları ciddi anlamda tekrarlamadığı için Lise 3'de tekrar iş güç enerji görecek. Eee araya bir senelik bir ara verildikten sonra tekrar o konunun görülmesi çocuğun sil baştan o konuyu tekrardan öğrenmesine sebep oluyor. Yani çocuk konuyu unutuyor. Yani hemen akabinde olsaydı mesela Lise 2'de olsaydı ya da bir bütün olarak işlenseydi iş güç enerji, tamamen bir bütün olarak işlenmesi, daha güzel olurdu. Onun için enerjinin bir bütün olarak işlenmesi ya da araya uzun bir zaman girmeden işlenmesi daha makul olurdu.
Interviewer: Bir bütün olarak işlediğiniz zaman 2 yıl sonra tamamen unutmuyacak mı?
Altan: Bir bütün olarak işlense zaten 9. sınıftaki bir öğrenci iş güç enerjinin bütün kavramlarını anlayacak seviyede değil. Bunun içerisinde çizgisel hız var açısal hız var. Ondan sonra dairesel hareket icabında olabiliyor. Kuvvet, hareket, ivme bunların hepsi olabilir. Mesela enerji dönüşümlerinde şunda bunda. Eee öğrenci zaten şimdi onları bilmiyor. En uygunu konunun Lise 3'de bir bütün olarak işlenmesi. Lise 1'den ziyade Lise 3'de tamamen uygulanması işlenmesi. Yani bu gerçektende olumsuz yönde etkiliyor. Çünkü fazla teferruata da giremiyoruz. Çünkü çocuklar o şeyde değil, o kıvamda değil. Yüzeysel geçiliyor. İki sene sonra çocuklar o konuyu unutmuş olarak karşımıza çıkıyor. Ondan sonra yeni öğretim yönteminde şu sıkıntı da var. Şimdi 9. sınıftaki öğrenci için bilgiyi bulup onun doğruluğunu ya da yanlışlığını araştırması isteniyor. 9. sınıftaki öğrenci daha fizikteki bir sürü kavramı bilmiyor. Çocuk diyor ki ben masaya güç uyguluyorum. Yani çocuk daha kuvvet ile güç arasındaki farkı bilmiyor. Kalkıp ona bilginin doğruluğunu araştırması soruluyor. Bu da bence çok uçuk kaçık düşüyor yani. Yani bu üst sınıflarda biraz fiziksel kavramları öğrendikten sonra bu yeterliliğe geldikten sonra olsa daha güzel olur. Üniversitede bilimsel araştırma teknikleri diye bir ders veriliyor yüksek lisans öğrencilerine. Hani teknikler öğrenildikten sonra araştırılması istenir. Teknikleri öğrenmeden bilginin doğruluğunu ya da yanlışlığını Lise 1'deki öğrenci kavrayamaz yani. Çünkü daha çocuk güçle kuvvet arasındaki farkı bilmiyor. Ondan sonra bunun gibi bir sürü fiziksel ibareyi bilmiyor. Kalkıp nasıl güvenilirliğini geçerliğini tartışacak.
Interviewer: Burada bilgi kaynağının güvenirliliğini tartışılıyor.
Altan: Diyelim ki bir akademisyenin yapmış olduğu çalışmanın güvenilirliğini 9. sınıftaki bir çocuk nasıl araştıracak ki, güvenilirliğini diyelim o bilgi kaynağının.
Interviewer: Başka var mı?
Altan: Öğretim programında konuların nasıl işleneceği daha net olarak nasıl uygulanacağı sıkıntılı. Öyle olunca biz öğretmenler olarak o noktada sıkıntılar çekebiliyoruz. Buda bizi olumsuz yönde etkiliyor. Şimdi tamam öğretim programı sayfalarca yazılmış. Ama tam olarak teferruatlı bir şekilde nasıl uygulanacağından bahsedilmemiş.
Interviewer: Teferruatlı derken her bir kazanım için mi diyorsunuz?

Altan: Kazanım olsun ondan sonra diğer kazanımın nasıl kazandırılacağı. Öyle olmayınca tamam bahsedilmiş işte yeni öğretim metotlarının şu özellikleri var falan. Ama nasıl uygulanacağı bilinmiyor ya da biz bilmiyoruz tam olarak. Bilmeyince de sıkıntılar ortaya çıkıyor. Bu da bizi olumsuz yönde etkiliyor yani. Bizide öğrencileride.
Interviewer: Başka var mı?
Altan: Başka şu anda aklımda yok.

Interviewer: Ortaöğretim Fizik Dersi Öğretim Programına göre fizik öğretmeyi kolaylaştıran unsurlar nelerdir. Örnekler verebilirmisiniz? Bu unsurlar öğretiminizi nasıl etkiliyor?
Altan: Hocam haftada zaten iki saat fizik dersi var. Haftada! Günde değil haftada! İki saatte bunların kaç tanesi yapılabilir? Ondan sonra mesela bu şeylerde görselliğin ön plana çıkması için doküman noktasında bir akıllı tahtanın olması gerekiyor bazı yerlerde. Ondan sonra bazı şeylerin öğrencilerin dikkatini çekmesi için görsellikte ise projektör olsun, bilgisayar olsun bu tür araçların kullanılması gerekiyor. Peki iki saatlik derste kaç tanesi yapılabilir ki? Yani ders sayısı artırılsa hiç olmazsa şöyle olur hocam diyelim ki.
Interviewer: Şöyle düşünün siz şu anda öğretim programını uygulamak istiyorsunuz. Bu esnada sizin işinizi kolaylaştıran bir unsur var mı?
Altan: Günlük hayatla bağdaştırdığı için bize bir kolaylık sağlıyor. Öğrencinin dikkatini çekebiliyor. Ondan sonra öğrenciler derse daha ilgililer. Çünkü soyut değil somut kavramlar var. Günlük hayatla ilişkilendirildiği için öğrenci derse daha ilgili oluyor ve daha dikkatli dinliyor. Gürültüden ziyade derse katılım ön plana çıkıyor bu noktada bize kolaylık sağlıyor.
Interviewer: Başka var mı?
Altan: Onun dışında mesela çok basit deneyleri öğrencilerle beraber yapıyoruz. Veya öğrenciye sözlü bir şekilde gidin şu konuya hazırlık yapın diyoruz. Gidip hazırlık yapabiliyor büyük çapta olmadığı sürece ilgisini çekiyor. İlgileniyor da. Mesela bu seneki programdan dolayı bazı öğrencilere soruyorum içinizde fizikçi olmak isteyen var mı? Öğrencilerin hemen hemen büyük bir kısmı biz fizikçi olmak istiyoruz diyor. Çünkü niye ilgilerini çekiyor. Bu noktada güzel yani.
Interviewer: Kolaylaştıran başka bir unsur var mı?
Altan: Şu an öğrenci merkezli olduğu için ve görsellik ön planda yeni öğretim programında. Bakıyoruz şimdi kaynaklar olsun, şeyler olsun yani işlemden ziyade görsellikle, günlük hayattan verilen örneklerle işimizi kolaylaştırıyor ve somutlaştırıyor. Öğrencinin iç aleminde de böyle daha kalıcı oluyor. Ve fiziğe karşı muhabbeti artıyor, sevgisi artıyor. Sevgisi artınca fiziğe bir ilgi alaka duyuyor öyle olunca. Eee öyle olunca öğrencinin derse ilgi ve alakası bizim işimizi çok kolaylaştırıyor.
Interviewer: Öğrencinin ilgi ve alakası nasıl kolaylaştırıyor?
Altan: Mesela öğrenci derse ilgili ve alakalı olunca hem anlatılan şeylere karşı bir dikkatle dinleme. Sanki ihtiyacı varmış gibi o konuya. Niye çünkü çevresinde görüyor. O noktada bir de seviyor mesela. Görsellik ön planda olduğu için dersi seviyor. Sevdiği için daha dikkatli bir şekilde dersi dinliyor. Bu yüzden ders daha güzel bir havada işleniyor. Öğrenci anlıyor. O noktada işimizi kolaylaştırıyor şu anki öğretim yöntemi. Onun dışında bir de öğrencilere her hangi performans ödevi olsun ödevi isteyerek çünkü niye onun ilgisinin çekebilecek konular içerisinden olduğu için, görsellik ön plandan olduğu için, kendisi teknolojiyi kullanabildiği için, ondan sonra şu anki şeyde teknolojiyi kullanması teşvik ediliyor.
Interviewer: Bilgisayarı kullanabilmesi işinizi kolaylaştırıyor mu?
Altan: Kesinlikle.

Interviewer: Ortaöğretim Fizik Dersi Öğretim Programına göre fizik öğretmeyi zorlaştıran unsurlar nelerdir? Örnekler verebilirmisiniz? Bu unsurlar öğretiminizi nasıl etkiliyor?
Altan: Olumsuz etmenler mi?
Interviewer: Sizin programı uygulamanızı zorlaştıran unsurlar nelerdir?
Altan: Öncedende bahsettiğim şekilde hocam sınıfta fazla katılım olunca bu sefer yetiştirme endişesinden dolayı.
Interviewer: Sınıfta katılım aslında iyi bir yönü ama bu sizi ters yönde etkiliyor.
Altan: Olumsuz yönde etkiliyor.
Interviewer: İki saatlik ders dediniz mesela. Bu nasıl etkiliyor sizi?
Altan: İki saatlik ders mi?
Interviewer: Evet.

Altan: Hocam iki saatlik ders olunca, haftada iki saat öğrenci ile görüşebiliyoruz. Haftada iki saat öğrenci ile görüştüğümüz için mesela tenefüslerde de genelde 11. sınıf, 12. sınıfların sorularını çözmek zorunda kalıyorum. Onlar biraz daha işlemek zorundalar ve bu yüzden 9. sınıflarla fazla ilgilenme fırsatımız olmuyor. Hani boş derste olmadığı için, tek fizikçiyim başka fizikçi olmadığı için şu sıkıntı oluyor; haftada sadece iki saat öğrenci ile yüz göz olabiliyorum.
Interviewer: Haftada kaç saat derse giriyorsunuz?
Altan: Haftada yaklaşık 28 olması lazım. 28 ama derslerde de dediğim gibi şey kalmıyor. Teneffüsler de bile boş kalamıyorum hani. Boş olsaydı hiç değilse öğrencilerin fikirlerini öğrenirdik. Daha çok laboratuar ön plana çıkardı. Ama yok! O olmadığı için teneffüslerde bile doğru dürüst öğretmenler odasına uğrayamıyorum (öğrencilerin sorduğu sorulardan dolayı). Bir de anadolu öğretmen lisesi olduğu için öğrenciler biraz daha bilinçli gayretli çok daha fazla şey istiyorlar. Ama tek kişi olduğumuz zamanda o sıkıntı ortaya çıkıyor. Yani en azından iki saatten fazla olsaydı iki saat teorik, iki saat laboratuar olsaydı ya da iki saat laboratuar bir saat teorik olacak kadar bir şey olsaydı yine biraz daha farklı olurdu.
Interviewer: Anladım. Soru bankaları dershaneler dediniz bunlar ders işleyişinizi nasıl etkiliyor?
Altan: Hocam şimdi dershanelerin bir kısmı ya da soru bankalarına bakıyorsunuz; mesela vektörler konusu tamam. Normalde diyelim fiziğin doğasından fazla işlenmemesi sadece değinilip geçilmesi gerektiren ama dershanelerin soru bankasına bakıyorsunuz yaprak testlere bakıyorsunuz daha önceki müfredatta sorulan vektör soru tipleri var. Ya da kuvvet soru tipleri var. Eee şimdi velisi gidiyor ona yaprak test alıyor. Çözmesi için çocuk oturuyor. Eğer biz onları göstermezsek çözmüyor. Çözemeyince fiziğe karşı bir şeyi oluyor ön yargısı oluşuyor. Velide görüyor çocuğum çözemiyor. Çocuk çoğu dershaneye gidiyor. Dershanede aynı şeyle karşılaşınca bu sefer fizikten de nefret etmeye başlıyor. Ben çalışıyorum ben yapamıyorum demek ki bende iş yok. Diyor kendine güvensizlik geliyor velide bu sefer diyor ki niye yapamıyorsun acaba. Okulda mı bir sıkıntı var acaba okulda gösterilmedi mi. Bu seferde öğrenci diyor ki bize okulda gösterilmedi hiç. Bu sefer o sıkıntılar ortaya çıkıyor. Öğrenci bu sefer sayısalcı olmaktan vazgeçiyor. Elimizde eleman kalmıyor yani.
Interviewer: Siz ne yapıyorsunuz böyle bir durumda?
Altan: Şu anki müfredatta fazla içine dalmıyorum ama yüzeysel olarakta olsa bahsetmek zorundayım. Ama daha çok sınavdaki şeyler ön plana çıkıyor.
Interviewer: Sınavda çıkabilecek soruları mı çözüyorsunuz?
Altan: Evet. Onlara yakın şeyler. Çünkü öyle olunca öğrenci bakıyorum fiziğin doğası ile ilgili bir mesele ortaya atıldığı zaman kendi yorumunu yapıyor. Yaprak testteki soruları da yapınca kendi daha ilgili oluyor. Çünkü diyor ki ben yorumda yapıyorum, yaprak testte çözüyorum. Denemede de yapıyorum, dershanede de dereceye giriyorum diyince çocuk fiziği daha çok seviyor. Bu sefer ikinci dönemdeki branşlaşmadan dolayı öğrenci sayısal dersleri tercih ediyor. Yani öğrenciyi sayısaldan mahrum etmemiş oluyoruz ya da öğrenci sayısaldan kopmamış oluyor.
Interviewer: Başka zorlaştıran bir unsur var mı?
Altan: Hocam çok fazla konu yani. Şunu söyleyim şimdi iki saat için konu sayısı çok çok fazla. Yani bazı konuların böyle elenmesi lazım.
Interviewer: Mesela hangisi?
Altan: Mesela fiziğin doğasında ya da ondan sonraki enerji konusunda ısı sıcaklık var. Ondan sonra normalde iş güç enerji konusunda basit makineler var. Öğrenci basit makineyi bilmiyor. Şimdi biz öğrenciye basit makineyi göstermeden iş güç enerjiyi gösteriyoruz. Öğrenci hareketli makara mantığını bilmiyor. Kalkıp hareketli makara ile ilgili bir iş güç enerji sorusu çözmeye çalışacaksınız öğrenci diyor ki bunu bilmiyorum ki. Yani bir alt yapı hazır değil. Yani öğrencinin alt yapısı hazır olmayınca ne olacak; basit düzeyde sadece bazı soru tiplerini öğrenciye verebilirsiniz. Böyle olunca da öğrenci kaynakta görüyor hareketli makara. Sonra o sıkıntı tekrar ortaya çıkıyor. Yani çocuk basit makine bilmeden denge bilmeden tamam kalkıp iş güç enerjiyi veriyoruz. Mesela orda yine sıkıntı orda ortaya çıkıyor. Çünkü iş güç enerji içerisinde basit makineler var. Denge konusu var ondan sonra dairesel hareket var. Eğik düzlem var onların hemen hemen hepsinin sentezi gibi bir şey yani o seferde sıkıntı ortaya çıkıyor yani.
Interviewer: Anladım. Başka var mı?
Altan: Hocam işte dedim ya dershanelerde işlenen konular uyumsuz. Dershanelerin anlatımı farklı. Yani öğrenci geliyor hocam diyor ki biz bunu böyle görmedik sen bunu böyle görmediysen ne yapacağız. Orda yine sıkıntı ortaya çıkıyor. Bide hocam bu konuda olsun velilerin olsun, özel öğretim dershanelerin olsun yeterince Milli Eğitim tarafından bilgilendirilmemesi ya da o noktada

sıkıntı başlıyor. Bilgilendirilse işte yeni bir sınav sistemi olacak yeni sınav sisteminde bu konular içirilecek ondan dolayı hazırlıklı olun. Şu anda çocuk yapamıyor olabilir. Çünkü şu anki içerik farklı ama dört sene sonra çocukların karşısına şu anki müfredata uygun soru tipleri gelecek denilse, ona göre işte dershaneler olsun veliler bilinçlendirilse, dershaneler ona göre bir şeyin içerisine girse daha güzel olur yani.
Interviewer: Başka var mı aklınıza gelen?
Altan: Şu an için yok.

Interviewer: Ortaöğretim Fizik Dersi Öğretim Programı sadece bir öğrenme yöntem ve yaklaşımının kullanımına vurgu yapmamaktadır. Farklı öğretim yöntemlerinin kullanabileceğini savunmaktadır. Farklı öğrenme yöntemlerini düşünerek fizik öğretmenizi zorlaştıran unsurlar nelerdir?
Altan: Şimdi hocam mesela laboratuar kullanacağım laboratuarda o konu ile ilgili hiç malzeme yok. Öyle olunca laboratuarı kullanamıyorum. Sadece ne yapabilirim öğrenciyi laboratuara götürebilirim. İşte laboratuarda o dersi işlerim. Öğrencinin dikkatini çekmek için ya da öğrenci derse ilgili olsun diye. Ama laboratuar malzemesi yok o konu ile ilgili. İkincisi mesela tartışma ortamı oluşturacağım. Ama sınıf kalabalık. Şimdi sınıf kalabalık olunca bu sefer tartışmaya girsek değil iki saatte normalde iki saatte bitmesi gereken bir konu ise değil iki saatte sekiz saatte bitmez. Bu seferde şu sıkıntı ortaya çıkıyor bir öğrencinin fikrini alıyorsunuz bazı öğrencilerin fikirlerini almazsanız öğrenci size karşı küsüyor. Daha çocuk yani diyor öğretmen beni kaldırmadı, bende şunu demek istemiştim bu sefer bu sıkıntı ortaya çıkıyor. Sadece tahtada olduğu zamanda yani biraz şey oluyor soyut anlamda kalıyor. Soyut anlamda da öğrenci dersini anlıyor. Anladı ama günlük hayatta hangi noktalarla bağdaşıyor bu seferde o sıkıntı ortaya çıkıyor yani.
Interviewer: Başka var mı?
Altan: Başka şu anda aklıma gelmiyor hocam.
Interviewer: Niye genelde tahtada soru çözüyorsunuz?
Altan: Şimdi dediğim şekilde tartışma ortamı oluşturduğum zamanda az önce bahsettim ya diyelim günlük hayatta laboratuarı kullandığımızda ya da tartışma ortamı oluşturduğumuz zamanda müfredatı yetiştirememe ya da az önce söylediğim şekilde test çözemiyor. Her hafta mesela yani öğrenciye deneme yapıyoruz. Eee bu sefer öğrenci denemeyi yapamıyor daha karar verme sürecinde olan bir çocuk yani acaba sayısalı mı tercih etsem tm yi mi tercih etsem bu noktada bir öğrenci. Şunu söyleyim anadolu öğretmen lisesi neticede. Hani belli bir potansiyel ile gelen öğrenciler. Eee bu potansiyel ile de gelen öğrenci bir okulda sıkıntı yaşandı yani bakıyorum anadolu lisesi ama bir tane sayısal sınıf var. Normalde anadolu liselerinde sayısal sınıf daha çoğunlukta olması gerekir. Sebep nedir işte fizik dersi. Öğrencilere sorduğumuzda %99 nerdeyse ben fizik dersinden dolayı TM'ci oldum diyor. Ne zaman 9. sınıfta. Ondan dolayı tahtada eğer öğrencinin karşısına çıkabilecek soru tiplerini çözmezsem bu seferde o sıkıntı ortaya çıkacak.

Interviewer: Ortaöğretim Fizik Dersi Öğretim Programı sarmal yapıyı düşünerek hazırlanmıştır. Sarmal yapıyı düşünerek fizik öğretmenizi zorlaştıran unsurlar nelerdir?
Altan: Sarmal yapıyı pek işlemiyorum hocam. İşlememememin sebebi de şudur: şimdi öğrenci daha 8. sınıftan çıkmış sınav psikolojisinden çıkmış gelmiş çocuk. Ve çok gayretli öğrenciler var mesela. Çünkü böyle bir potansiyeli var bu okula gelmişler. Bakıyorsun mesela sadece iş güç enerjiyi ele alalım iş güç enerji dediğimizde sadece iş nedir güç nedir işte günlük hayatta bir iki noktada değiniyorsunuz. Tanımlarla sözel ifadelerle geçtiniz. Ama az önce bahsettiğim şekilde yine problem oluyor. Öğrenci gitmiş soru bankası almış geliyor. Diyor ki hocam siz bunları niye bize anlatmadınız. Öğrenci gidip dershaneye gidiyor ders dinliyor. Dershane mantığında onları görüyor geliyor. Hocam işte biz bunları niye işlemedik bunları yapamıyoruz. Ondan sonra işte veli geliyor hocam işte öğrencinin fizik netleri çok düşük. Bu neden böyle yani komple bir problem oluyor bu sefer. Eee şimdi aynı şekilde birazdan bahsettim mesela eğik düzlem; eğik düzlem kullanılıyor. Raylı sistem kullanılıyor ya da hareketli makara kullanılıyor. Eee şimdi ben hareketli makaraya değinmeden geçsem yarısı dönmeye yarısı ötelemeye gidiyor mantığı ile gitmesem bu sefer şu sıkıntı ortaya çıkacak. Az önce söylediğim şekilde çocuk fizikten nefret etmeye başlıyor yapamıyorum çünkü diyor. Şu sıkıntı oluyor ben iş güç enerjiyi görmüşüm Lise 2'ye gidiyor Lise 2'de sayısalcı oluyor. Bölüm kalktı ama sayısal derslerini tercih ediyor. Onları tercih ettikten sonra çocuk gidiyor ki dışarıda ki ÖSS mantığındaki kitapları soruları alıyor. Kendine iş güç enerji görmüşüm diyor. Çünkü şu var bu bilinçle öğrenciye verilemiyor yani. Şimdi sadece yüzeysel tefarruatına varmadan işleyeceğiz ama. 11. sınıfta tekrar göreceksiniz. Çünkü 11. sınıfa kadar bu

müfredat yine değişiyor. Mesela basit makineleri göremiyor öğrenci ta 11. sınıfa kadar. Bunu dediğiniz zaman çocuk dersten kopabilir. Ne de olsa 11. sınıfta görecem diye daha tefarruatlı. Çocuk Lise 2'ye geçiyor kendine bir soru bankası alıyor ya da yaprak test alıyor. Yaprak testin içerisine bakıyor ben iş güç enerji gördüm. Yaprak test ya da soru banklarını şeyden alıyor bakıyor. Bir sürü farklı soru tipi. Eee biz bunların hiç birisini görmedik hiç birisini görmedik. Öyle olunca öğrenci madem Lise 1'de gördük niye Lise 3'de göreceğiz. Bu sefer bu sıkıntı ortaya çıkıyor yani bir konuyu iki sefer göstermektense onun seviyesine uygun bir sınıfta gösterilmesi bence daha mantıklı olur yani.
Interviewer: Yani bütün konuların tek tek.
Altan: Seviyesine uygun bir sınıfta işlenmesi daha uygun olur.
Interviewer: Hepsinin anlatılması taraftarımısınız?
Altan: Şu anki öğrenci 9. sınıf öğrencisi yarın sınava girecek iş güç enerji YGS konusudur. Şimdi YGS konusunu öğrenci Lise 3'de görecek. Eee TM'yi seven öğrenci iş güç enerji yapabilir yapması gerekiyor. Ama şimdi iş güç enerjiyi sadece yüzeysel gördüğü için sınavdan yapamıyor. Bu TM'yi seçen dili seçen öğrenci içinde bir kayıptır. Ondan dolayı ben şunun taraftarıyım; mesela diyelim bir konu işlenecekse sınıf seviyesine uygun bir şekilde bir bütün olarak işlenmesi. Eğer bütün olarak parça parça işlenirse bir sürü konu var. Birde o konular dalgalar konusu 9'da var 12'de var. Eee şimdi yüzeysel değindiğin zaman çocuk dalgaları yapamıyor. Dalgalara karşı bir ön yargısı oluşuyor. Lise 4'de de dalgalara karşı bir ön yargısı oluşuyor. Şu anda iş güç enerjiyi öğrenci testlerde çözemesin, denemelerde yapmasın iş güç enerjiye karşı çocuk 11. sınıfa kadar ön yargılı olacak. 11. sınıfa gelince bu iş güç enerjiyi ben zaten yapamıyordum diyor. Bu sefer bu sıkıntı ortaya çıkıyor. Ondan dolayı bence hani iş güç enerjiden ziyade maddelerin özellikleridir diğer kısımlardır böyle daha çok öğrencinin anlayabileceği sıvıların kaldırma kuvveti ile ilgili ondan sonra ne diyeyim vektör kısmı ile ilgili bazı konular alt yapı oluşturacak şekilde oluşturulsun. Çünkü şunu söyleyim moment öğrenci fiziğin hemen hemen her yerinde kullanılıyor. Momenti sıvıların kaldırma kuvvetinde kullanıyor. Momenti düzgün dairesel hareket de kullanıyor. Momenti iş güç enerji konusunda kullanıyor. Eee şimdi öğrenci momenti bilmiyor. Biz Lise 2'de hareket konusundan sonra momenti içeren soru tipleri var. Ama çocuk momenti bilmiyor ki. Nasıl ki rasyonel sayılar matematikte her yerde kullanılıyor momentte böyle her yerde kullanılıyor. Ondan dolayı bence en güzel şey sınıf seviyesine uygun konular seçilip alt yapı oluşturacak yani zemin etüdü gibi öğrenciye vermek. Bir daha o konuyu baştan vermenin bir şeyi yok. Zaman kaybından başka bir şey değil. Konular teferruatlı incelenmediği için ciddi anlamda bir öğrenme olmuyor. Sadece yüzeysel bir bilgiye sahip oluyor. Yani bu sefer öğretmende sıkıntı yaşıyor. Öğretmen içinde şu sıkıntı oluyor: öğretmen öğrenciye konuyu anlattım diyor ama öğrenci soru getiriyor. Biz bunları görmedik diyor bu sefer. Öğretmen hem öğrenci nezlinde, hem velisi nezlinde sıkıntıya giriyor. Eee ama şu var ilerki zamanda çocuğun psikolojisine etki ediyor. Zaten en önemli şeyde bu değilmidir; çocuğun bir derse karşı ilgisini beslemek. O dersin şu anki maalesef velilerde ve öğrencilerdeki en büyük ölçüt derslerde denemelerde yapıyor mu yapamıyor mu? Şimdi zaten ölçtüğümüz yanlış ölçme olunca bu sefer yapamıyor. Yapamıyorsa o zaman ailede moralman çöküyor. Çocuğunda morali çöküyor bu sefer faydadan çok zarar dokunuyor.
Interviewer: Tamam.
Altan: Ha bu kimlere verilebilir TM'ci olanlara ya da birinci sınıflara öğrencilere denilse. Birinci sınıftaki derslerin çoğu seçmeli olsaydı isteyen mesela fiziği alır isteyen almaz bu sefer kendisi aldığı için teferruata inmeden bahsedersiniz ilgisini çektiği için. Ama branş seçmiş öğrenciye bunu yaptığınız zaman sıkıntı olur.

Interviewer: Yaşam temelli yaklaşımı düşünerek fiziği nasıl öğretiyorsunuz?
Altan: Derse geçmeden önce günlük hayattan bahsediyoruz bahsediyoruz bahsediyoruz. Sizce bu nasıl olmalıdır diyoruz. Öğrenci kendince yorum yapıyor yorum yapıyor ilgisinin çekiyor. Ondan sonra yok işte fizikte şöyle şöyle bir şey var bu şekilde izah ediliyor. Öğrenci hocam bize baştan söyleseydin biz zaten bilirdik. Bu sefer öyle olunca çocuk artık unutmuyor. Dersede ilgili oluyor ve önceden bir sürü yorum yapıyor. Kendi yaptığı yorumun doğruluğunu da yanlışlığına fizik kurallarını öğrendikten sonra, eğer yanlışsa ha demek ki ben bunu yanlış biliyormuşum, eğer doğruysa bak fiziktede böyle diyor diyor o şekilde anlatıyorum yani.

Interviewer: Yaşam temelli yaklaşımı düşünerek fizik öğretmenin güçlü yönleri neler olabilir?

Altan: Hocam önceden çocuk kendi fikrini söylüyor ya. Kendi fikrini söyleyince mesela kendisine göre doğrusu yanlışı artık mesela fiziksel olarak izahı yapıldıktan sonra veya formülle artık neyse bu sefer çocuk yanlış yaptığı şeyi bu sefer kabul ediyor. Doğruysa da biraz daha böyle seviniyor ondan dolayı mesela biraz daha ilgili alakalı oluyor derse.
Interviewer: Bunun yaşam temelli yaklaşımla ilişkisi nedir?
Altan: Şimdi mesela önce bir meseleden bahsediyorsunuz.
Interviewer: Tamam.
Altan: Daha fiziksel olarak onun izahını yapmadan önce.
Interviewer: Tamam
Altan: Fikri ortaya attınız tartışma ortamı oluştu herkes kendi fikrini beyan ediyor. O bir şey söylüyor o bir şey söylüyor. Böyle olunca herkes hani fiziksel olarak izahını söyledikten sonra çocuk şartlanıyor. Hani ötesine çıkamıyor. Fizik öyle diyorsa öyledir. Ama o fiziksel şeyi ortaya atmadan önce yani fiziğin kuralını ortaya sürmeden çocuk kendi fikrini özgürce söylüyor. Saçma bile olsa çünkü bilmiyor gerçeğini. Ya da bilse bile artık ona göre söylüyor. Böyle olunca herkes kendi fikrini pervasızca söylüyor. Tabiri caizse atış serbest oluyor ya da fikrini söylemek serbest oluyor. Ondan sonra bunu yapınca katılım daha fazla oluyor. Derse ilgi daha fazla oluyor. İlgi daha fazla olunca bu sefer arkadaş böyle böyle olur bu kuraldır formülüdür bu böyle olur deyince çocuk artık fikrini söyledi zaten kalkıp pişmanlık duygusu da yaşamıyor. Öğrendiği zamanda daha çok hoşuna gidiyor. Ama yok işte önce kuralı söylüyorsunuz kuralı söyledikten sonra sizce bu nasıl olur bu budur ise böyledir yani artık fikrini söylemiyor. Korkuyor birazcık. Çekiniyor yanlış bir şey söylermiyim saçma bir şey olur mu o noktada artık çekingen oluyor.
Interviewer: Başka güçlü bir yönü var mı?
Altan: Öğrencinin derse katılımını sağlıyor. Özgürce bir şekilde söylemesini sağlıyor. Ondan sonra bir öğrenciye diğer öğrenci işte fikrin saçmadır diye eleştirmiyor.
Interviewer: Başka var mı?
Altan: Derse katılımını sağlıyor. Ondan sonra derse karşı olan ön yargısı bir nevi kırılıyor.
Interviewer: Nasıl kırılıyor ön yargı?
Altan: Mesela kuralı söyleyip ondan sonra izah ettiğiniz zaman çocuk açılamıyor. Ama fikir iddaa ortaya atıyorsunuz, ortaya attıktan sonra hani bir deli bir kuyuya taş atar herkes kendince bir şey yapıyor. Bakıyor çocuk herkes derse katılıyor o da bir şeyler söylemek istiyor, o da kalkıp bir şeyler söylüyor. O da bir şeyler söyleyince çocuk artık farkında olmadan yavaş yavaş derse katılıyor. Derse katılması ne demek dersin onun ilgisini çekmesi demek. Eee ders ilgisini çekince o derse karşı bir muhabbeti oluşuyor. Muhabbeti oluşunca artık zincirleme devam ediyor ve bir noktadan sonra bakıyorsun derste konuşmayan çocuk bülbül gibi şakıyor yani.
Interviewer: Başka var mı?
Altan: Başka şu da var hocam. Yani söylemediğiniz için çocuk çok günlük hayattaki meselelerle bağdaştırabiliyor. Çünkü şartını söylememişsiniz kanunu söylememişsiniz artık neyse kuralını formülünü söylemediğiniz için çocuk günlük hayatta bağdaştıramasa bile kendi iç aleminde bağdaştırabiliyor bir şekilde. Yaşadığı olaylarla gördüğü şeylerle bağdaştırıyor onu. Örnek göstererek derse katılmaya çalışıyor. Yani nasıl biraz daha içten oluyor.
Interviewer: Nasıl hissediyorsunuz bunu?
Altan: Nasıl hocam bakıyoruz mesela çocuk anlatırken daha önce başından geçmiş bir olayı anlatıyor. Kendi iç aleminde onu bağdaştırıyor. Aslında pek bir bağ yok gibi görünüyor ama çocuk aklında nasıl bir bağ kurmuşsa. Bize göre bağ yok ama çocuğa göre bağ var.
Interviewer: Acaba yanlış bir bağ mı kuruyor?
Altan: Bazen yanlış bağ kuruluyor. Yani ama neticede derse katılımını sağlıyor.
Interviewer: Bir yandan iyi bir yandan kötü.
Altan: Bir yandan iyi bir yandan kötü. Ama şu var işte izah yapıldıktan sonra çocuğa diyorsun işte senin söylediğin böyle değil de böyle olması gerekiyor. Bu sefer çocukta kabul ediyor yani. Yani hocam kimse rencide olmuyor o derste. Şu andaki en büyük sıkıntılardan bir tanesi öğrenci acaba kalksam yanlış bir şey söylermiyim. Fiziğin kuralı orda kaidesi orda acaba arkadaşlara rezil olur muyum. Çünkü bu çok önemli bir şeydir. Şu anda mesela erkek çocukları kız çocuklarına karşı kız çocukları erkek çocuklarına karşı bazıları laf şeyine giriyor. Bu kadar saçmalık olur mu ne alakası var tarzda. Ama orda kimse bir şey diyemiyor. Kimsenin bilgisi orda net değil herkes kendine göre yorum yapıyor. O kuralıda bilmedikleri için herkes kendine göre yorum yapıyor. Yorum yapıldıktan sonra artık diyorsun arkadaşlar böyle böyle. Ondan sonra kimse kimseyi eleştirmiyor kimse kimseye bir şey demiyor. Çünkü şunu söyleyim beyin fırtınası gibi bir şey oluyor. Herkesin bir yorumu

olduğu zaman bazen de çok orjinal fikirler ortaya çıkıyor. Hani mesela yıllardır öğretmeniz bir soru tipine bir formüle göre hep klasik mantıkla bakmışız. Bazen bakıyorsunuz mesela çocuk çok farklı bir şey diyor gerçektende insan düşünüyor ha ben bunu niye hiç düşünmemiştim diyorsunuz. Örnekler vermenin de çok faydası oluyor yani
Interviewer: Başka var mı?
Altan: Az öncede söylediğim şekilde şimdi şunu biliyor öğrenci; yaşam ile fiziği bağdaştırdığımızda fiziğin günlük hayatta olsun ondan sonra yaşamın her noktasında olsun fiziğin olmazsa olmazlardan bir tanesinin olduğunun farkına varıyor. Bununda şu faydası oluyor: mesela az önce söylediğim şekilde artık her şeye fizik gözü ile bakıyor. Yani artık fizik gözlüğünü takıyor. Olaylara hadiselere fizik kuralları ile fizik kanunları ile cevap bulmaya çalışıyor. Öyle olunca öğrencinin ufku gelişiyor. Yani artık gözündeki sıradanlık bozuluyor. Yani ne şu olay oluyor: doğal olay ama oluyor sadece, ama fizik ile hayatı bağdaştırdığınızda bu sefer oluyor ama nasıl oluyor, niçin oluyor, olmasının sebepleri nedir bu tür sorularla bu sefer cevap bulmaya çalışır. Yani bir kanun, kaide onu artık öyle şey olarak kabul etmez. Sorgulayıcı bir özellik kazanıyor artık çevredeki olaylara karşı. Böyle bir faydası oluyor. Ondan sonra fizik dersi daha güzel işleniyor. Çünkü neden çevresindeki olaylardan fizik dersi ile ilgili örnek verildiği zaman öğrenci hani yaşadığı somut örneklerde olduğu için daha bir ilgili oluyor. Ondan sonra biraz daha araştırma ihtiyacı duyuyor öğrenci.
Interviewer: Neyi araştıracak?
Altan: Çevresindeki olayları en basitinden kalorifer petekleri niye aşağıya takılıyor yukarı takılmıyor.
Interviewer: Başka var mı?
Altan: Ondan sonra florosan lambaların çalışma prensipleri. Yıllardır öğrenci görüyor mesela. Doğduğundan beri biliyor. Ama öğrencilere sordum mesela: yıllardır utanmadan o lambanın altında aydınlanıyorsunuz hiç merak ettiniz mi. Çoğu dediki yok hocam. Peki artık bundan sonra çoğu şeyi merak ediyor musunuz: evet. Çünkü çevremizdeki her şeyin içinde fizik ile ilgili bir kanun var. Yani çevresine artık hayretle bakıyor. Yani öğrenciyi çevresine hayretle baktırıyor. Böyle sıradan göz ile bakmıyor.
Interviewer: Başka var mı?
Altan: Sınıf içerisinde iletişimde çok bir faydası oluyor yaşam temelli olunca. Çünkü hiç fizik dersi ile alakalı olmayan bir öğrenci bile çevresindeki olayların farkında. Eee şimdi öyle olunca fizik kurallarını bilmese bile çevresindeki olaylardan yorum yaparak derse katılımını sağlıyor. Öyle olunca hiç derse ilgisi olmayan bir öğrenci bile fizikle böyle yıldızları barışmayan öğrencinin bile derse katılımını sağlıyor. Ondan sonra çevresindeki olayları şey yaptığınızda icabında deneyler mesela basit düzeydeki çevremizdeki deneylerden mesela. Çünkü merak uyandırıyor. Çevresindeki olaylardan bahsedildiği için. En basit mesela diyelim bir futbol maçından bile topa vuruluşu eğik atış hareketlerinden bahsettiğiniz zaman çocuk futbolu çok seviyor. Ama fizikten nefret ediyor öyle olunca. Orda bile fizik kurallarının olduğundan bahsettiğimizde çocuk fiziğe karşı bir ilgi duymaya başlıyor. Ondan sonra bilgisayardaki oyunlardan tutun öğrencinin ilgisini çekebilecek her şey.
Interviewer: Başka var mı?
Altan: Başka yok hocam.

Interviewer: Yaşam temelli yaklaşımı düşünerek fizik öğretmenizi zorlaştıran unsurlar nelerdir?
Altan: Öğrenci kendi fikrini özgürce söyleyebildiği için problem olmuyor. Dersde bu olumlu etkiliyor. Olumsuz yönde ise herkes fikrini beyan etmek istiyor. Bu seferde dersin işlenmesinde yetiştirme noktasında sıkıntı oluyor. Hani bir fikir ortaya atılıyor o fikirde öğrenci yorum yapıyor. O yorum yapmak istiyor o yorum yapmak istiyor. Eee sizin işlemek istediğiniz kısımda zaten sınırlı. Bu durumda da dersin aksaması bir problem oluşturuyor.
Interviewer: Başka var mı?
Altan: Eğer ciddi anlamda sınıfa bir hakimiyet yoksa öğretmenlerde şu sıkıntı ortaya çıkacak: herkes fikir beyan edince sınıfta bir gürültü patırtı. Ama şu var öğrencilerle baştan konuşulursa böyle parmak kaldırın herkesin fikrini birbirine müdahale etmediğinde çok daha güzel oluyor.
Interviewer: Başka var mı?
Altan: Yok hocam.

Interviewer: Ortaöğretim Fizik Dersi Öğretim Programında bilgi kazanımları ile beceri kazanımlarının iç içe hazırlanmış olmasını nasıl karşılıyorsunuz?

Altan: Eğer şartlar müsaitse laboratuar artı teorik bilginin verileceği şartlar uygunsa çok güzel olur. Ama şunu söyleyim teorik bilgi veriyorsunuz ama beceri ortamı yok. Nasıl diyeyim laboratuar şartı yok. Böyle olunca bu seferde fazla bir faydası olmuyor. Yoksa eğer ki imkanı varsa laboratuar kullanımı güzel olursa, ondan sonra öğretmende vereceği öğretmende bir potansiyele sahipse çok mükemmel olur. Yani iki kanatlı kuş gibi olur.
Interviewer: Öğretim programında herşey laboratuarda olacak denilmiyor.
Altan: Şimdi şunu söyleyim laboratuarın dışında da mesela öğrencinin mesela meseleden bahsedersiniz, meselenin cazipliğinden de bahsedersiniz konu hakkında. Ondan sonra öğrenci ev şartlarında ya da artık okul yurt nerde kalıyorsa ona göre kendi iç aleminde bazı meseleler hakkında yorum yapar, benzetme yapar. Gerekirse bazı basit deneyleri mesela sınıf ortamında da yapılabilir illa laboratuar şartı olacak diye bir şey yok. Onu öğrencinin evde yapabilme şartını da söylüyoruz. Şu şu yapabilirsiniz ama şunu söyleyim sınıfın kalabalık olması da bir dezavantajdır. Şimdi belli kazanımlar teorik ya da pratik bilgiler olacak. Ama öğrenci sayısı da ona uygun olacak.
Interviewer: Bilgi ve beceri kazanımlarının iç içe hazırlanmış olmasının iyi olduğunu söylediniz. Sizce bu neden iyi?
Altan: Yani şunu söyleyim. Mesela teorik bilginin yanında pratik bilgi verildiği zaman öğrencinin daha fazla ilgisini çekiyor. Öğrencinin daha fazla merakını çekiyor öyle olunca. Ve bir daha çocuk unutmuyor. Çünkü teorik kendisi uyguluyor, kendisi yapıyor ve ömrünün sonuna kadar da onu unutmuyor. Ve o derse karşı bir ilgisi oluyor, alakası oluyor. Bu biyolojide de böyledir, kimyada da böyledir, fizikte de böyledir. Ama sadece teorik olduğu zaman. Nasıl diyeyim sahilde plaja yazılan yazı gibi. Dalga getirir onu siler götürür. Ama laboratuar şartlarında olduğu zaman taşa kazınan yazı gibi oluyor iz bırakıyor.
Interviewer: Peki bunu yapmak kolay mı?
Altan: Yapmak şunu söyleyim eğer imkanlar varsa kolaydır. İmkan dediğim; dedim ya iki saat ders olmayacak. Ondan daha fazla olacak. Öğrenci sayısı ona uygun olacak. Ondan sonra laboratuar şartları uygun olacak. Öğretmen ona uygun olacak. Öğrenci potansiyelinin o şartlara uygun olması hepsinin önemi var yani.
Interviewer: Öğrenci potansiyeli öğretmenin uygunluğu dediniz.
Altan: Evet.
Interviewer: Öğretmenin uygunluğunu açar mısınız biraz?
Altan: Şimdi şunu söyleyim. Türkiye şartlarında en az bir fizik öğretmeni.
Interviewer: Hayır kendiniz için düşünün.
Altan: Kendim için. Eğer bir laboratuar varsa laboratuarı malzemeyi kullanacak bilgiye sahip olması lazım. Yani ikincisi; o noktada çünkü şunu söyleyim mesela, bazı laboratuarlarda öyle malzeme var ki malzeme bir şekilde okula verilmiş. Ya da okul onu almış ama malzemenin nasıl kullanılacağı hangi amaçla kullanılacağı çünkü şunu söyleyim.
Interviewer: Dedikleriniz doğru siz kendiniz için bunlara sahipmisiniz?
Altan: Bunlara teorik bilgide nisbeten sahibiz. Ama pratikte şu an pratik yapacağımız alan olmadığı için orada mesela şu anda fazla bir şey yapamıyorum işin açıkçası.
Interviewer: Tamam. Başka var mı?
Altan: Dedim ya öğrenci. Daha orijinal profesyonel malzemesinin olması mesela. Metreyi daha öncede bahsettim; metre, eşit kollu terazi hocam biz zaten bunları biliyoruz geçin. Öğrencinin kendisi bunları diyor. Ya biz zaten metreyi biliyoruz, termometreyi biliyoruz. Şimdi ısı sıcaklık konusunda termometre, birim konusunda metreyi göstereceğiz çocuğa. Hocam bunu bize niye gösteriyorsunuz ki biz zaten metreyi biliyoruz deyince öğrenci bile artık onların basit olduğunu anlıyor. Daha böyle nasıl diyeyim profesyonelce hazırlanmış deney malzemesi, konuları böyle daha farklı bir şekilde izah edebileceğimiz laboratuar şartlarının olması. Yoksa metre bana da basit geliyor, öğrencilere de basit geliyor işin açıkçası. Bu metredir anadolu öğretmen lisesindeki arkadaş metreyi görüyorsunuz işte santimetrelerle milimetrelerle bölünmüş felan filan bunun bir mantığı yok bence. Çok basit geliyor. Yani eşit kollu terazide aynı şekilde. Bu bakkallarda kullanılan manavlarda kullanılan. Birde şu var mesela dijital makineye geçmişiz, öğrenici diyor hocam zaten onları kimse kullanmıyor. Ondan sonra öğrencilerin kendileri onları biliyor. Yani basit düzeydeki şeyler olunca öğrencide işin açıkçası fazla kaile almıyor. Öğrenicide işin zaten formalite icabı olduğunu biliyor. Ama daha ciddi şeyler olsa laboratuar şartlarında denenecek öğrencinin dikkatini çekebilecek.
Interviewer: Öğrenci potansiyeli dediniz bunun yanında. Öğrenci potansiyeli ile bilgi ve beceri kazanımlarının iç içe verilmesi arasında nasıl bir ilişki var?

Altan: Şimdi şunu söyleyim mesela. Öğrenci potansiyelinin bu noktada teorik bilgiyi veriyorsunuz ama normal birisi ise.
Interviewer: Teorik bilgi yanında beceriyi de vereceksiniz.
Altan: Şimdi öğrenci teorik bilgiyi anlayana kadar canı çıkıyor. Öğrenci seviyesi düşük olunca kalkıp bunun yanında laboratuarda beceriyi de verdiğiniz zaman imkanı yok yani. Bir konuyu ancak bitirebilirsiniz. Ama şu avantajımız var bizim anadolu öğretmen lisesi olduğumuz için şu var; öğrenci her ikisini çok hızlı kapabiliyor eğer varsa.
Interviewer: Anladım.

Interviewer: Bilgi ve beceri kazanımlarını iç içe vermeyi düşünerek fizik öğretmenizi zorlaştıran unsurlar nelerdir?
Altan: Bazen müfredatda anlatılması gereken veya uygulamamız gereken şeyleri uygulayamıyoruz. O becerinin hepsini, kazanımları öğrenciye sunamıyoruz. Hem daha önce bahsettiğimiz şekilde zaman kısıtlaması hem laboratuar şartları deneylerin hepsinin olmaması. Çok fazla şeylerden bahsedemiyoruz yani.
Interviewer: Başka var mı?
Altan: Ondan sonra sınıfın kalabalık olması. Bunlardan dolayı bütün kazanımlara veya şeylere değinemiyoruz. Bir kısmına ancak değinebiliyoruz.
Interviewer: Yani bunların sizin karar vermenizi etkilediğini düşünüyorsunuz.
Altan: Kesinlikle.

Interviewer: Ortaöğretim Fizik Dersi Öğretim Programı bazı beceri kazanımlarını içermektedir. Örneğin program problem çözme becerilerini içermektedir. Problem çözme becerilerini düşünerek fiziği öğretmenin güçlü yönleri neler olabilir?
Altan: Şimdi problem çözme becerilerinde işin içinde laboratuarda var ama şimdi problem çözme becerisinde bizim gördüklerimiz teorik. Yani laboratuar şartlarındaki pratik değil teorik bizim gördüğümüz. Problem çözme becerisi olduğu için bizim şu andaki işleyiş tarzımıza daha çok işte teorik test üzerinde soru üzerindedir. Ondan dolayı işte müfredattaki diğer bazı kısımları işleyemiyoruz. Yani müfredatta var olan problem çözme becerisini işin açıkçası kullanamıyoruz. Kullanmağımız için sadece test veya sorularla öğrencilerin problem çözme becerilerini geliştirmeye çalışıyoruz. Sadece bazı şeyleri işte sorgulamada bulunuyoruz.
Interviewer: Peki şu şekilde sorsam; müfredatta vurgulanan problem çözme becerilerinin sizce ne tür faydaları olabilir?
Altan: Şimdi şunu söyleyim. Eğer gerçekten de o şartlar müsait olsa öyle uygun bir zemin olsa çok çok faydası olur. Ama şunu söyleyim bazı şeylerde çok uçuk kaçmış. Yani şu anda doktorasını yapabilecek bir elemana verilebilecek bazı şeyler isteniyor öğrencilerden mesela. Bu da bazı kısımlar çok uçuk kaçık kaçmış. Ama diğerlerinde müsait bir zemin ortam olursa ve öğrenciye yeterince ders saati verilirse olabilir. Çok ta güzel olur. Ama maalesef şu anki şartlarda uygun değildir. Yani mesela ortam olsa bile iki saatlik derstir bu bir. Bir ikincisi o denilen bahsedilen şeyleri uygulamak için epey zaman gerekiyor. Maalesef o yok. Ondan sonra bide şu anki ailelerinde öğrencilerinde belki öğrenciler yapmak ister ama ailelerin de şu andaki Türkiye'deki sınav sisteminin de istediği bu değil.
Interviewer: Çok çok faydalı olabilir dediniz. Bu çok çok faydalı olanlar nelerdir?
Altan: Türkiye'de şu ana kadar ya da müfredat değişine kadar hep teorikti. Genel olarak öğrenci mesela sadece bazı kavramlara alışmıştı. Ama şu anki müfredatda sorgulama ondan sonra sorguladıktan sonra araştırma.
Interviewer: O zaman siz problem çözme becerisinin faydası olarak çocuklara sorgulama becerilerini mi kazandıracağını düşünüyorsunuz?
Altan: Sorgulama becerisini ondan sonra merak uyandırıyor çocukta. Merak uyandırıyor. Merak uyandırdıktan sonra onla ilgilenme ilgilenirken bir şeyler üretme.
Interviewer: Şimdi sorgulama becerisini biraz daha açabilirmiyiz? Neyi sorgulayacağız?
Altan: Sorgulama bir şeyi çevremizde olan bir olayı böyle artık sıradan gözüyle bakmayacak. Acaba neden bu böyledir niye böyledir. Mesela en basit geçende bahsediyorduk. Çocuklara soruyorsunuz mesela yani işte yer çekim kuvveti var yer çekimi kuvveti mesela diyelim aşağı yönde dünyanın merkezine doğru, niye toprağa ektiğimiz fidan yer çekime kuvvetine zıt yönde hareket ediyor. Mesela bu tip şeyleri çocuklar merak ediyor birde günlük hayatta gördüğü şeyler olduğu için onlar artık. Mesela geçen şunu söyleyim; öğrenci bazen geliyor işte hocam bu neden böyledir diyor. Yani

ben merak ediyorum da hiç sebebini bulamadım. Sizce neden böyledir. Ondan sonra çevresindeki bazı olayları merak ediyor gökyüzü neden mavidir?
Interviewer: Problem çözme becerilerini merak ediyor?
Altan: Tetikliyor bunları yani problem çözme becerisini kazanınca çocuk artık ister istemez çevresine bu gözle bakıyor.
Interviewer: Başka var mı?
Altan: Birde yapısında varsa bir kabiliyet o kabiliyetin ortaya çıkmasına sebep oluyor. Yani çocuk kabiliyetlidir ama uygun bir zemin bulamamıştır. Ama o tür şeyler olduğunda yapısındaki o kabiliyet cevher ortaya çıkınca çocuk bu sefer daha üretken bir kişi olmaya başlıyor yani.
Interviewer: Başka var mı?
Altan: Onun dışında bir de şu var mesela. Artık çocuk bazı şeyleri takliden yapmıyor. Mesela bazı şeyler vardır ki teorikte hoca anlatıyor bu böyledir tamam bitti. Ama problem çözme becerisini kazandıktan sonra icabında hocanın söylediği şeyleri bile yargılayabiliyor sorgulayabiliyor. Yani taklidi artık tamamen kabul etmiyor. Sorgulamadan mantığına uymadan kabul etmiyor. Hocam bu neden böyledir diye sorgulayabiliyor. Yani nasıl diyeyim hazmetmeden yemiyor artık. Öyle bir şey elde ediyor icabında. Mesela kafasına uymayan bir şey olduğunda hocaya hocam bu niye böyle benim mantığıma uymadı; bunun sebebi ne olabilir. Böyle olunca bu sefer çocuğun eleştiri demeyim de merakını da uyandırıyor.
Interviewer: Başka var mı?
Altan: Şu an için yok.

Interviewer: Problem çözme becerilerini düşünerek fizik öğretmenizi zorlaştıran unsurlar nelerdir? Bunlar sizin problem çözme becerilerini düşünerek öğretiminizi nasıl etkiliyor?
Altan: Laboratuar şartlarının yeterli olması gerekiyor. Tam donanımlı bir laboratuar olması gerekiyor. Olmadığı zaman bazı şeyler eksik kalabiliyor yani.
Interviewer: Neler eksik kalıyor?
Altan: Mesela bazı deneylerinin yapılması noktasında. Ondan sonra problem çözme becerisindeki bazı deneylerin biraz daha ciddi biraz daha nasıl diyeyim daha profesyonelce deneyler olması daha güzel olurdu. Çok basit olan deneylerde öğrenci fazla kaile almıyor. İşin açıkçası ondan dolayı işimiz biraz zorlaştırabiliyor.
Interviewer: Daha profesyonel zor deneyler istiyorsunuz.
Altan: Zorluktan ziyade daha farklı daha görülmemiş, daha duyulmamış öğrenicinin daha fazla ilgisini çekecek deneyler. Mesela sıradan bir deney ama öğrenci karşılaşmamış ya da duymamış. Duyduğu zaman ilgisini çekebilecek merak uyandırabilecek.
Interviewer: Siz öğrencilerin meraklı olmadığını nerden biliyorsunuz?
Altan: Çünkü şunu söyleyim mesela eşit kollu terazinin mantığı onunla ilgili bir deney düşünelim. Mesela şimdi zaten onu öğrenci biliyor. En basitinden ısı ve sıcaklık ile ilgili bir olay; poşete su koyup altına çakmağı yakmak. Normalde genel itibariyle öğrencinin fazla duymadığı şaşırdığı hayret ettiği bir olaydır. Bu tarzdan illa zor olacak diye bir şey yok. Farklı yani öğrencinin dikkatinin çekebilecek öyle sıradanlaşmış deneyler değil.
Interviewer: Başka var mı?
Altan: Ha zorlaştıran kısmında şu var; her öğrenci derse katılınca zaman sıkıntısı yaşıyoruz. Ondan sonra her öğrenciye fikrini beyan etmesi için ders yetmez.
Interviewer: Tamam. Bir de laboratuar dediniz. Laboratuar malzemelerinin olmaması nasıl etkiliyor?
Altan: Mesela şimdi her hangi bir konuya geldik. O konudan laboratuarda deney yapmanız gerekiyor. Ama bakıyorsunuz laboratuarda malzeme yok. Ve malzeme olmayınca o deneyi artık sadece teorik bahsediyorsunuz. Ya da artık şartlar varsa bazı malzemeleri tedarik edip yapılabilecekse yapabilirsiniz. Yoksa o deney o şekilde teorik bir şekilde anlatılır geçilir. Yani hayali bir şekilde öğrencinin gözünde canlandırılabilecek bir şekilde.
Interviewer: Başka var mı?
Altan: Zorlaştıran noktalardan bir tanesi aslında zorlaştıran değil de şu cihet de sıkıntı oluyor: öğrenciye şu anki müfredattan bahsettiğiniz zaman o şekilde ders işlemeye kalktığınızda öğreniciden şu şekilde tepkide alabiliyorsunuz. Hocam bu anlatılan kısımlar kitaplarda sorulmuyor, kitaplarda şunlar soruluyor diyor. Ve biz o soruları çözemeyiz bize onları anlat. Bu tip taleplerde bulunan öğrencilerde oluyor. Bu da bizi bazı noktalarda bize sıkıntı oluşturuyor. Çünkü şunu söyleyim daha öncede bahsettik: öğrenci mesela soru bankası almış soru bankasında çözmesi

gereken soruları çözemiyor dokunamıyor. Ona çünkü niye şu anki müfredatta daha çok teorikten ziyada pratik ön planda. Sadece onlar işlense bu seferde o kısım geride kalır. Ve öğrenci bu seferde fizikten soğumaya başlıyor. Biz niye onları işlemiyoruz niye yapmıyoruz diye. Eğer çıksaydı kitaplarda çıkardı, kitaplarda yok o zaman biz niye işliyoruz. O tür sıkıntılar bu sefer karşımıza çıkıyor yani.
Interviewer: Anladığım kadarıyla siz problem çözme becerilerini sınıfta pek kazandıramıyorsunuz?
Altan: Müfredatın istediği şekilde kazandıramıyoruz.

Interviewer: Ortaöğretim Fizik Dersi Öğretim Programı problem çözme becerilerine ek olarak fizik-teknoloji-toplum-çevre kazanımlarınıda içermektedir. Fizik-teknoloji-toplum-çevre kazanımlarını düşünerek fiziği öğretmenin güçlü yönleri neler olabilir?
Altan: Şimdi öğrenci bazen şunu diyebiliyor: hocam bu konu çok saçma ne gereği var ki. Günlük hayatı nerde kullanıyoruz ki. Şimdi bazı teorik derslerde bunu mesela yapabiliyorlar. Mesela matematikdeki bazı konularda. Şimdi fizikte öğrenci onu dediği zaman; bak arkadaş diyoruz işte şurada şurada şurada kullanılıyor. Öyle deyince çocuk diyor; hocam ben bu kadar bilmiyordum önemli bir konu olduğunu. Öyle olunca bu sefer şunu söyleyim çocuk çevresindeki her yerde, her şeyde fizik olduğu bilincine varıyor.
Interviewer: Sorumuzu tekrar hatırlatayım: öğrencilere fizik-teknoloji-toplum-çevre kazanımlarını kazandırarak fiziği öğretmenin güçlü yönleri neler olabilir?
Altan: Bu sefer çocuk fiziği böyle ehemmiyetsiz işe yaramayan bir ders olarak görmüyor. Gerçektende her yerde kullanılabilecek bir ders olarak algıladığı için daha fazla bir ilgi alaka gösteriyor. Ondan sonra çevresindeki bazı olaylar hakkında daha farklı fikir üretmesini sağlıyor. Derslerde daha ilgili oluyor. Yani dersi artık böylece boş teorik bir ders olarak algılamıyor. Yani o yönden çok çok faydası oluyor.
Interviewer: Başka var mı?
Altan: Çocuğun şunu da söyleyim mesela çevresinde ihtiyaç olan bir ihtiyacı olduğu ya da ihtiyaç hissettiği bir mesele vardır çevresinde. Ya da bir şey vardır ona ihtiyacınız vardır. Onu elde etmek için çaba harcarsınız. Çocukta şunu söyleyim fiziğin çok ehemmiyetli bir ders olduğunu anlayınca onu öğrenmek onunla ilgili bazı meseleleri düşünmek için çaba harcamaya başlıyor bu noktada epey.
Interviewer: Fizik-teknoloji-toplum-çevre kazanımları öğrencilerin düşünmek için çaba harcamasını nasıl sağlıyor.
Altan: Mesela en basit diyelim bilgisayardan tutalım ya da asansör sistemine kadar bunların mesela fizik ile alakalı kurallar kaideler olduğunu. Ondan sonra en basit şunu da diyebilirim ÖSS sınavında da şu anki sınav sisteminde de çok ciddi anlamda bir yer tuttuğunu. Günlük hayatta da fiziğin her yerde kullanıldığını. Mesela en basitinden vidadan tutun kapı koluna kadar momentten, torktan tutun bilmem neye kadar. Öyle olunca çocuk bir deney yaparken, bir şeyler yaparken diyor ki mesela fiziğin şu kurallarının kullanırsam daha iyi olur. Ve gerçektende günlük hayatta çok noktada fizik olduğu için çocuk şunu düşünüyor. Eğer mesela ben şunları yaparsam fiziğin şu kurallarını uygularsam daha başarılı şeyler yaparım diye düşünüyor öyle olunca. Onun gibi mesela çevremizde bazı diğer olaylar ya da arabaların ya da uçakların yükselmesinin sebebi basınç farkından dolayı. Kanat yapısı şöyle olacak ki üstteki basıncı kesebilsin alttaki basınç onu yükseltebilsin. Çocukta diyor ki o zaman ben makine mühendisi olursam bende şöyle şöyle bir şey ona benzer bir şeyi üretime geçirmek için çaba harcıyor. Çocuk kendini biraz mecburi hissediyor eğer makine mühendisliğine gitmek isteyecekse. Ondan dolayı mesela az önce dedim pilot örneği gibi çocuk bu sefer derse ilgili. Çocuk bu sefer o dersi öğrenmek için çaba harcıyor. Ben bu konuyu öğreneyim ondan sonra kendime göre bir şeyler üretmeye başlayım o şekilde yani.
Interviewer: Başka var mı?
Altan: Geçen mesela ara sınıflarda şunu sordum: içinizde fizikçi olmak isteyen var mı dedim. Yılın başında çoğu öğrenci hemen hemen hiç bir öğrenci ben fizikçi olmak istiyorum demedi. Ama son zamanlarda öğrencilerin bir kısmı ben fizikçi olmak istiyorum, nükleer fizikçi olmak istiyorum. Niye işte; şunu yapmak istiyorum diyor. Hatta baktım böyle nükleer fizik hakkında bazı şeyler okumuş yani çaba harcamış onu öğrenmek için. Dedim niye nükleer fizikçi olmak istiyorsun işte. Şu var mesela Ermenistan'ın şuranın buranın nükleer enerji santrali var bizim yok. Bende nükleer enerji santrali olan bir yerde çalışmak istiyorum daha fazla enerji üretmek için. Böyle olunca çocuk bir çabanın içerisine giriyor bir gayretin içerisine giriyor. Yani artık 9. sınıftaki bir öğrenci nükleer

fizik ile ilgili bir şeyler öğrenmek için çaba harcıyor. Ya da kendini böyle fizikçi olacaksa onu öğrenmek zorundayım çocuğu öyle bir duruma sokuyor.
Interviewer: Anladım. Başka var mı?
Altan: Birde şu var mesela. Bakıyorum mesela bazı çocuklar okulda öğrendiği şeyi gidip ailesi ile paylaşıyor. Yani ders içerisindeki bazı şeyleri gidip babasına soruyor baba bu nasıldır sence. Babası cevap vermiyor. Bu sefer annesine soruyor. Bu sefer farkında olmadan anne babasının ilgisine de fiziğe çekiyor. Ve onlarında merak duygusunu uyandırıyor. Eee bu noktada çok güzel bir yönü var.
Interviewer: Anne ve babasına fizik-teknoloji ile ilgili ne soruyor?
Altan: Mesela icabında az önce bahsettik ısı ve sıcaklıktan işte poşette su ısıtmak. Ondan sonra böyle ilgisini çeken şeyler. Sınıfta onu gördükten sonra yapılmadığını gördükten sonra gidip işte ailesi ile böyle bir şey olur mu olmaz mı sizce. Onların merak duygusunu uyarmak annesinin babasının. Bu sefer böyle olunca ailesi de fizik dersine farkında olmadan iştirak ediyor. Böyle olunca fizik ile toplum iç içe oluyor. Ha düşünün mesela 9. sınıfta bir öğrenci fizik dersi gördü. Her hangi bir ilgisini çeken bir konu. Bu sefer o ilgisini çeken konuyu annesine babasına da anlatmaya başlıyor.
Interviewer: Başka var mı?
Altan: Fizik ve teknoloji ile alakalı şeylerden bahsedildiği zaman çocuk daha büyük bir ilgi ile derse iştirak edebiliyor. Derse katılabiliyor. Ondan sonra çevresindeki olaylardan bahsedildiği zaman fizik ile alakalı olaylardan öğrencinin fiziği iç aleminde daha değerli kılabiliyor. Öyle olunca mesela öğrenci dersi daha dikkatli dinliyor, daha ilgili alakalı dinliyor. Bu başarı noktasında etkiliyor.
Interviewer: Başka var mı?
Altan: Teknoloji özellikle her gün gelişiyor. Her gün böyle farklı farklı şeyler ortaya çıkıyor. Bunların fizikte gerçekleştiğini öğrencilere anlattığınızda öğrenci bununla hayretle kalıp fiziğe karşı ilgi duyabiliyor.
Interviewer: Tamam.

Interviewer: Fizik-teknoloji-toplum-çevre kazanımlarını düşünerek fizik öğretmenizi kolaylaştıran unsurlar nelerdir? Bu unsurlar fizik-teknoloji-toplum-çevre kazanımlarını düşünerek öğretmenizi nasıl etkiliyor?
Altan: Kolaylaştıran, şu anki teknolojik aletlerden epey örnek verme imkanımız var. Bu noktada işimiz çok kolaylaştırıyor. Ve öğrencinin anlaması da çok daha kolay oluyor. Çünkü çevrede onula ilgili bir sürü somut örnek var. Hem öğrencinin algılaması hem de bizim bol örnek vermemiz öğrencinin anlamasını kolaylaştırıyor. Zorlaştıran cihet de eğer onunla ilgili bir deney yapılacaksa bu cihet bizi zor duruma sokar. Belki örnek veriyoruz ama şu tamam diyor ama belki o malzemeyi bulma noktasında sıkıntı yaşıyoruz.
Interviewer: Onun dışında başka bir şey yok mu? Siz fizik-teknoloji-toplum-çevre kazanımlarını hepsini kazandırabiliyor musunuz?
Altan: Hepsini şu anda kazandırmanız imkânsız gibi bir şey.
Interviewer: Bunun tek sebebi laboratuar mı?
Altan: Yok hayır. Öğrenci sayısının fazla olması.
Interviewer: Peki tek fizik-teknoloji-toplum-çevre kazanımlarına has işinizi zorlaştıran bir unsur var mı?
Altan: İşte bahsettiğimiz teknolojik malzemeleri hemen tedarik edemememiz o noktada bizim işimizi zorlaştırıyor. Yani onun dışında birde dediğim şekilde müfredatta bahsedilen şeyler biraz çok uçuk.
Interviewer: Uçuk kaçık derken?
Altan: Bazı kazanımları öğrenciye nasıl diyeyim bahsedilen her şeyi öğrenciye kazandırmak hem epey zaman gerektiriyor hem de iyi bir laboratuar şartı olsun. Öğrenci sayısının ideal olması bunların hepsi olsun ki o kazanım kazandırılsın. Öğrenciye iki saatlik ders programında bunların hepsinin öğrenciye kazandırmak biraz imkansız yani.
Interviewer: Başka kolaylaştıran ya da zorlaştıran unsur var mı?
Altan: Başka şu anda aklıma gelmiyor. Peki teknolojik kaynaklardan vereceğiniz örneklerin bol olması ders işleminizi nasıl etkiliyor?
Altan: Şimdi öğrenci o teknolojik aletleri duymuş görmüş. Ya da izlemiş artık muhakkak bir şekilde haberdardır. Öyle olunca mesela dersle hiç alakası olmayan öğrenci bile çünkü bazı öğrenciler var dersle hiç alakası yok. Ama teknolojik malzemelerden çok iyi anlıyor. Çocuğun bile diğerlerinin bile derse ilgili olmasını sağlıyor. Mesela öyle öğrenciler var ki bilgisayarı çok mükemmel

kullanabiliyor. Eee bilgisayarla ilgili bir örnek verdiğinizde o çocuk bilgisayarı çok iyi kullanabildiği için hoşuna gittiği için dersi çok iyi dinliyor. Onunla ilgili örnek vermek istiyor. O noktada işimizi kolaylaştırıyor yani.
Interviewer: Deney dediniz. Deney ile ilgili malzemelerin olmaması ders işleyişinizi nasıl etkiliyor.
Altan: Şimdi hepsi değil.
Interviewer: Kazandırabilecekleriniz veya kazandıramayacaklarınız hangileri?
Altan: Yani şunu söyleyim. Bütün bütün zorlaştırıyor demiyorum. Olmaması da bir boşluk. Boşluğu da var için içerisinde yani.

Interviewer: Fizik-teknoloji-toplum-çevre kazanımlarını öğrencilerinize nasıl kazandırıyorsunuz?
Altan: O kısımlar dediğim gibi derse girdiğimde, az öncede bahsettim. Öncellikle şunu söyleyim fiziğin özellikle işleyeceğim konunun günlük hayatta şurada şurada şurada geçerli olduğunu. O olmazsa olmaz dediğim mesela dersin bir 10-15 dakikasını bazen alıyor. Öğrencinin o şekilde dikkatini çekiyorum fizik ve toplum şeyini. Onu o şekilde sağlıyorum. Ve öğrencilerinde gidip kendilerini de gözlemleyip gerçekten onun farkına varmasını sağlamaya çalışıyorum. O şekilde bahsederek sağlamasına çalışıyorum.
Interviewer: Derslerin başında günlük yaşantıdan örnekler vererek ama genelde siz konuşarak mı?
Altan: Bazen öğrenciye kendi fikrini de soruyorum. Sadece ben konuşsam o zaman da hiç bir anlamı kalmaz. Öğrenci o zaman ben öğretmen olduğumdan sadece saygıdan susar. Ama sizce siz bu konu hakkında ne düşünüyorsunuz dediğiniz zaman bu sefer öğrencilerde kendi fikirlerini söylüyor. Yoksa tek taraflı olmaz yani. Öğrenci derse katılsın bir ilgi alaka göstersin.

Interviewer: Problem çözme becerilerine ve fizik-teknoloji-toplum-çevre kazanımlarına ek olarak Ortaöğretim Fizik Dersi Öğretim Programı bilişim ve iletişim becerilerine de önem vermiştir. Bilişim ve iletişim becerilerini düşünerek fiziği öğretmenin güçlü yönleri neler olabilir?
Altan: Şimdi bilişim ve iletişim göze alındığında bir kere görsellik ön plana çıkıyor. Mesela bilgisayar kullanılıyor icabında, projektör kullanılıyor icabında televizyon kullanılıyor. Cdler getirilip öğrenciye farklı şeyler anlatılabiliyor. Görsellik ön planda olduğu için bilişim olarak öğrenciye unutmuyor. Ve öğrenci o derse daha fazla ilgi gösterebiliyor. Görsel olduğu için teorik olmadığı için biraz nasıl diyeyim laboratuar şartları gibi. Aynı şekilde mesela laboratuar tam donanımlı olursa bu da bir bilişim ve iletişim becerisidir. Bu sefer öğrenci yaptığı deneyleri unutmuyor bu bir. Bir ikincisi teorikten çok pratik yaptığı için daha çok hoşuna gidiyor.
Interviewer: Laboratuar şartlarının bilişim ve iletişim becerileri ile ilişkisi nedir?
Altan: Şunu söyleyim laboratuar şartlarında bir bilgisayar. Ondan sonra bir projektör ondan sonra mesela nasıl diyeyim; materyaller, televizyon olsun bir cd olsun bunlar olduğu zaman bunlarda neticede bir laboratuar malzemesidir. Yani her ne kadar sınıflarda kullanılsa bile bunlarda laboratuar şartlarında kullanıldığı zaman daha destekli daha donanımlı olur. Böyle olunca daha iyi olur öğrenci için.
Interviewer: Başka var mı?
Altan: Öyle olunca dediğim şekilde başka fiziğe karşı bir ilgisi olur. Ondan sonra kendisi bir şeyler yaptığı için daha farklı bir gayretin içerisine giriyor. Acaba bende ne yapabilirim diye. Görsellik ön planda olduğu için öğrencinin daha çok hoşuna gidecek daha kalıcı olacak. O faydası olur yani.
Interviewer: Başka var mı? Biraz düşünün isterseniz.
Altan: Bilişim ve iletişim; öğretmenin ifade edemediği şeyler iletişimde sıkıntı olmaz. Laboratuar şartlarında iletişimle mesela öğretmenin iletişim problemi diyelim. Ama bunu bilişim ile çok rahatlıkla anlatabilir. Nasıl daha basit indirgenmiş deneyleri bilgisayarla gösterebilir.
Interviewer: Bu güçlü bir yön değil. Bu bir kolaylık. İşinizi kolaylaştırıyor. O soruya geleceğiz.
Altan: Ama öğrenciye de faydası oluyor neticede. Öğretmenin tam anlatamadığı veya öğrenme imkanlarının sınırlı olduğu bir yerde öğretmen bilgisayar ile onu anlattığı zaman kolaylık sağlıyor. Ona yardımcı da oluyor yani.
Interviewer: Başka neler olabilir?
Altan: Birde ondan sonra öğrencinin becerilerini artırıyor.
Interviewer: Ne becerisi?
Altan: Mesela teknolojik bir malzemeyi bilimde nasıl kullanabileceğini. O noktada mesela çok istifadeli olabilir. Öğrenci mesela şu anki genç kesime bakıyoruz bilgisayara çok mükemmel hakim. Hoşuna da gidiyor. Bununda bilimde kullanılabileceğini algılıyor. Öyle olunca bu sefer hoşuna

giden bir işi bilimde kullandığı zaman ona daha fazla ilgi alaka gösteriyor. Ve öğrencinin mesela nasıl diyeyim onun bilgide kullanmasının kabiliyeti becerisi artıyor.
Interviewer: Başka var mı?
Altan: Başka öğrencinin dediğim şekilde mesela bir sürü bilimsel programlar var bilgisayarda. Bu sefer öğrencinin o becerilerini de artırıyor bu programları kullanmak.
Interviewer: Bu programı kullanmak öğrencinin hangi becerisini artırıyor?
Altan: Mesela fizik ile ilgili verilen veriler, değerler bunları bilgisayarda kullandığı zaman o becerisini artırıyor öğrencinin onları kullanma becerisi.
Interviewer: Tamam. Başka var mı?
Altan: Ondan sonra bilişim olduğu zaman laboratuar şartlarında denenemeyen pahalı olabilecek deneyleri bilgisayar üzerinde daha ucuza indirgeyebilir.
Interviewer: Siz mi, çocuklar mı?
Altan: Bizler.
Interviewer: O zaman sizin için bu kolaylaştıran bir unsur.
Altan: Bu bizim için kolaylaştırıcı oluyor. Ama öğrenciye de sunma imkanımız olduğu için o şekilde de öğrenci içinde bir nevi nedir hani becerisini biraz daha şey yapabilir kazandırabilir. Çünkü normalde yapılamayacak bir şeyi soyut dahi olsa öğrenciye kazandırılabiliyor. Mesela bazı şeyler var diyelim. Bunlar imkansız gibi bir şey. Bazı üniversitelerin laboratuar şartlarıdır falan götürüp gezdiremiyoruz. Ama bir bilgisayar ile başka bir üniversitenin çekilmiş videosunu orda öğrenciye rahatlıkla gösterebiliyoruz. Bilgiye daha kolay ulaşılabiliyor. Daha kolay ulaşmasını sağlıyor daha doğrusu.
Interviewer: Başka var mı?
Altan: Bunlardan biri de öğrencinin mesela her hangi bir konu hakkında araştırma yapmak istediği zaman internet olsun mesela internetten ulaşmak istediği bilgiye çok rahat ulaşabilir. Buda onun bilgi araştırma becerisini artırıyor. Bir ikincisi mesela diyelim bir sunum yapacak öğrenci. Bu sunum mesela grafiklerle ondan sonra şemalarla tablolarla çok rahat hazırlayabilir. Görselliği ön plana çıkararak yani kalkıp onun hakkında sadece teorik bilgi vermekle kalmıyor. O dediğim şekilde grafiklerle tablolarla çok renkli güzel bir şekilde bir sunum yapabilir. Ondan sonra bazı deneyler var mesela diyelim. İmkan yoktur ya da tehlikeli bir deneydir mesela. Bir atom bombasının yapısını öğrenciye kalkıp normal şartlarda gösteremezsin. Ama bilgisayar şartlarındaki bazı patlamaları laboratuarda göstermediğimiz için bilgisayar şartlarında gösterirsek öğrenci daha çok teorikten ziyade pratikte gördüğü için daha iyi algılar. Bu da anlama becerisini artırır öğrencinin.
Interviewer: Başka var mı?
Altan: Ondan sonra mesela fizik ile ilgili makaleler olsun yazılar olsun bilimsel araştırmalar olsun bunları internet ortamında çok rahat bulup bunlar hakkında böyle bilgi toplayabilir. Buda dediğim şekilde bilgiye ulaşma becerisini artırır. Ya da merak duygusunu artırır öyle olunca. Buda kolaylık sağlıyor öğrenciye öğrenci için bilişim noktasında. Ha iletişim noktasında da devamlı hani bilim anlamında bir iletişimde bulunuyor gibi duruma girer. Çünkü şu var mesela bulunduğu il için konuşayım. Karşında eğer bilgisayar olmasaydı internet olmasaydı kaç tane bilim adamına ulaşıp fikrini beyan edebilirdi. Ama ulaşamaz ama aklına takılan bir şeyi bir bilim adamının MSN'sine ya da hemen aklına takıldığı bir şeyi gönderebilir. Onun cevabını alabilir öyle olunca dedim ya bu sefer sorgulama, soru sorma, araştırma becerisini artırıyor. Bu noktada çok kolaylıkta sağlıyor.

Interviewer: Bilişim ve iletişim becerilerini düşünerek fizik öğretmenizi kolaylaştıran unsurlar nelerdir? Bu unsurlar bilişim ve iletişim becerilerini düşünerek öğretmenizi nasıl etkiliyor?
Altan: Şimdi işimi kolaylaştıran destekleyen noktalar şunlar: mesela sınıfta bir tartışma ortamı oluşuyor. Bir fikir ortaya atılıyor. Fikir ortaya atılınca herkes fikrini beyan ediyor. Sınıfta ciddi anlamda bir iletişim oluşuyor. Çünkü ortak bir payda oluşuyor. Ondan sonra öğrencilere şunu diyorum: bunu bir araştırın. Öğrenciler demiyor bunu nerden araştıracağız. Öğrenci artık bunun farkındadır. Bilişimi kullanabiliyor. Geçen mesela sınıfta şunu dedim: sizce cam katımıdır sıvımıdır. Şimdi işte bazıları kırılabildiği için katıdır. Bazıları dedi hocam işte sıvı olabilir. Bazıları işte plazma olabilir. Falan filan. Sınıfta işte böyle bir tartışma ortamı oluştu ciddi anlamda. Ondan sonra baktım öğrencilerin çoğu ortalıktan kayboldu. Meğersem gidip internetten araştırıyorlar. Yani okul ortamında bile teneffüste bile öğrencinin onu araştırma imkanı olabiliyor bilişim sayesinde. Ondan sonra diğer ders geldi. Herkes işte hocam bazı bilim adamları işte şu tarzda katıdır bazıları şu sebepten olduğu için sıvıdır. Böyle işte sınıfta bir şey oluştu. Yani öğrenci hem bilgiye ulaşabildi.
Interviewer: Bu durumda sizin işinizi kolaylaştıran unsur nedir?

Altan: Eğer o olmasaydı en basit camın sıvımı, katımı olduğunu ortaya attığımızda öğrenci gidip onu araştıramazdı. Araştıramayınca sınıfa geldiği zaman bazıları katıdır sıvıdır derdi. Ama farklı bilgiler elde edemezdi. Ha bu sınıfa gelip öğrencilerin araştırması benim işimi kolaylaştırıyor. Niye çünkü yapmam gereken öğrenciye merak duygusunu uyandırmaktı. Öğrenciye merak duygusunu uyandırdıktan sonra bu sefer öğrenci o meraktan dolayı rahat durmuyor. Gidiyor bilgiyi araştırmaya çalışıyor. Peki bilgiye ulaşabiliyor mu, ulaşıyor. Ne vasıtası ile ulaşıyor bilişim vasıtasıyla ulaşabiliyor. Böyle olunca amaç yerine getirilmiş oluyor. Öğrencinin bilgisayar kullanıyor olması benim işimi çok kolaylaştırdı. Yani bilgiye ulaşmasını bildiği için. Eee şimdi eğer öğrenci bilgisayarı kullanamıyorsa, interneti kullanamıyorsa ondan sonra bilgiye ulaşamıyorsa bizim işimiz zorlaşıyor. Ama öğrencinin bilgisayarı kullanması bile bizim işimizi çok kolaylaştırıyor. Öğrencinin evinde bilgisayar olması bizim işimiz çok kolaylaştırıyor. Öğrencinin yine bu meseleyi ailesi ile annesi babası ile tartışması bizim işimiz çok kolaylaştırıyor. Niye annesi babası da kendi fikirlerini mesela bazı öğrencilerimiz var babası üniversitede hocadır ya da öğretmendir. Onlarla bile mesela iletişimde olması bizim işimizi kolaylaştırıyor. Çünkü onlarda kendi fikirlerini beyan edince bu sefer okuldaki bazı bahsedilen meseleler aile ortamında bile tartışılmaya başlanıyor. Ve öğrenci annesinin babasının fikrinide getirip söyleyebiliyor. Yani iletişimden dolayı eğer o yoksa bu sefer evdeki internetten bilgiye ulaşabiliyor. Bu seferde bizim işimiz kolaylaşmış oluyor. Çünkü öğrenci artık ulaşabilir bilgiye. Bilgisayarı kullanması, anne babası ile iletişiminin iyi olması bizim işimizi çok kolaylaştırıyor. Ya da o değil de kalkıp dershaneye gittiği zaman dershanedeki hocasına gitmesi, o hocası ile iletişimde bulunması bile bizim işimizi çok kolaylaştırıyor. Ya da gidip bir kaynağı taraması dediğim şekilde üniversitedeki abisine ablasına bu iletişimde bulunması bile bizim işimizi çok ciddi anlamda kolaylaştırıyor.

Interviewer: Bilişim ve iletişim becerilerini düşünerek fizik öğretmenizi zorlaştıran unsurlar nelerdir? Bu unsurlar bilişim ve iletişim becerilerini düşünerek öğretmenizi nasıl etkiliyor?
Altan: Zorlaştıran nokta şu mesela: bilgisayarın sınıf ortamında olmaması.
Interviewer: Bu şu anda zorlaştırıyor mu?
Altan: Ama sınıfta projektör olsaydı ondan sonra bilgisayar olsaydı sınıflarda en azından projektör olsaydı biz bilgisayarı kendimiz getirip şey yapabilirdik. O işimiz zorlaştırıyor. Çünkü hemen ulaşamıyoruz.
Interviewer: Bilgisayar ve projektörün olmaması sizin bilişim ve iletişim becerilerini kazandırmanızı nasıl etkiliyor?
Altan: Sınıfta mesela öğrencilere bir şey göstereceksiniz ama olmadığı için göstermiyorsunuz. Sınıf ortamında o noktada bizi çok olumsuz etkileyebiliyor yani.
Interviewer: Siz göstermek istiyor musunuz?
Altan: Kesinlikle. Çünkü bizim işimizi kolaylaştırıyor. Hem görsellik olduğu için öğrencinin dikkatini çekiyor. Öğrenci derse daha ilgili oluyor. Yani hem biz kaybediyoruz hem öğrenci kaybediyor.
Interviewer: Anladım. Başka var mı zorlaştıran?
Altan: Zorlaştıran diğer? Peki ha şudur: bilgisayarı yeterince kullanamayan öğrenciler var. O noktada işimiz zorlaşır. Mesela köyden gelen öğrenciler var bizde. Mesela bilgisayara yeterince hakim değil. Hakim olmadığı için bilgisayar öğretiminde yeterince bilgisayar dersi almadığı için o noktada 9. sınıflarda sıkıntı yaşayabiliriz. Üst sınıflarda sıkıntı yaşamayız çünkü üst sınıftaki öğrenciler bilgisayara hakim olabiliyor kullanabiliyor. Kullanıyorlar şey yapıyorlar. Ama 9. sınıf öğrencilerinin de köyden daha yeni gelen öğrenciler olmuş kazanmış gelmiş. Daha doğru dürüst bilgisayarı kullanmamış. O noktada sadece biraz sıkıntı yaşayabiliriz.
Interviewer: Başka var mı?
Altan: Mesela diyelim biz daha önce bahsettik. Sınıf ortamında bir tartışma ortamı oluşturduğumuzda sınıf kalabalık 30 kişinin üstünde. Eee her bir öğrenciye bir dakika versek 30 dakika olur. Sınıfta hep böyle yeni öğrencilerin olduğu gayretli SBS ile gelmişler. Eee bu öğrencilerin her birisine bir dakika verdiğinizde bir dakikadan fazlada sürebilir. Bazı öğrenciler hiç böyle kendilerini tutamıyor devam ediyor. Eee şimdi verdiğim zaman çok uzun süre olur. Buda bir dersin bitmesine sebep olur. Sadece bir fikrin tartışması noktasında. Ama o noktada sadece bize zararımıza olur. Yani zaman sıkıntısı yaşarız orda.
Interviewer: Başka var mı?
Interviewer: Siz öğrencilere bir araştırma ödevi verdiğiniz zaman tahmini bunu kaç kişi araştırıyor?

Altan: Şimdi bilgisayara ulaşabilecek öğrencilerin hemen hemen hepsi araştırıyor. Mesela şimdi bazı öğrenciler pansiyonda kalıyor. Her isteyen öğrenciye istediği zaman bilgisayara ulaşamıyor mesela. Bazı öğrencilerimiz var ailesinden internet var bilgisayar var onlar onlara ulaşabiliyor.
Interviewer: Nedir sizce bu oran?
Altan: Bu oran şöyle diyebilirim %40 civarındadır. Diğerleri ulaşmadığı için sıkıntı oluyor mesela. Pansiyondan gelen öğrenci var az önce bahsettim. Mesela köyden gelmiş bu adamın evinde zaten bilgisayar yok. Köyünde de internet yok. Kimde vardır internet; ya okul öğretmeninde vardır o da zor. Bazı köyler var mesela uzaktadır sıkıntılıdır. Pansiyonda kalan öğrenicide her istediği anda internete ulaşamıyor. Ulaşsa bile çok sınırlı kısıtlı yani. Eee şimdi buda bizi olumuz yönde etkileyebiliyor. Çünkü öğrenci her istediği zaman ulaşamıyor. Ha şu olur mesela eğer okulda internet sınırsız öğrenci her istediği zaman ulaşabiliyor. Ondan sonra öyle bir imkan olsaydı sıkıntı olmazdı. Ama öğrenci her istediği an internete ulaşamadığı için sıkıntı oluyor. Bazı öğrencilerin ailesinde interneti var bilgisayarı var ama o noktada bazı öğrencilerin imkanları yok.

Interviewer: Bilişim ve iletişim becerilerini öğrencilerinize nasıl kazandırıyorsunuz?
Altan: Öncelikle sınıfta bir tartışma ortamı oluşturuyoruz. Herkes kendi fikrini beyan etmeye tamamende o şeyi yapamıyoruz. Bazı işlerde müfredatta sıkıntı olur. Yani bazı konularda sınıfta bir tartışma ortamı oluşunca öğrenciler arasında iletişim örneğin birinin söylediği fikri başkası kabul de etmeyebiliyor eleştirebiliyor da. Öyle olunca öğrenciler arasında bir tartışma ortamı oluşturabiliriz fikir noktasında. Eee kimin haklı öğrenci mesela bir fikri ortaya atıyor bu fikrin dayandığı noktalar nedir. Kim bu fikri kabul edemiyor. Etmemesinin sebebi nedir. Böyle bir iletişim ortamı oluşuyor sınıfta. Bilişim noktasında da; az önce söylediğim gibi bazı şeyler ortaya atıyorum. Ortaya atınca öğrencinin merak duygusu uyanıyor. Böyle olunca öğrenci bilgiye ulaşma ihtiyacı duyuyor. Ulaşması içinde bilgisayarı kullanması gerekiyor. Bilgisayarı kullanabilmesi içinde gidip karıştırması öğrenmesi gerekiyor. Öyle olunca öğrenciyi bilişimi kullanmaya yönlendirebiliriz. Öğrenciyi mesela diyelim ödevler olsun şeyler olsun mesela öğrenciye diyorsunuz ki şu konu hakkında bir araştırma yapın. Şimdi öğrenci kendini mecbur hissettiği için onu öğrenme ihtiyacı duyuyor. Ondan dolayı bilgisayarı kullanmanın bir ihtiyaç olduğunu hissediyor. Ondan dolayı gidip bilgisayarı kullanabiliyor. Ondan sonra internetten araştırabiliyor. Bu noktada bu şekilde yardımcı olmaya çalışıyoruz.

CIRRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Kapucu, Serkan
Nationality: Turkish (TC)
Date and Place of Birth: 30 April 1983, Ankara
Maritial Status: Married
email: serkankapucu@yahoo.com

EDUCATION

Degree	Institution	Year of Graduation
MS	METU	2006
BS	METU	2006
High School	Atatürk Anatolian Teacher High Shool	2001

WORK EXPERIENCES

Year	Place	Enrollment
2009-2012	Ağrı İbrahim Çeçen University	Research Assistant

PUBLICATIONS

Ünal, İ., Okur, N. & **Kapucu, S.** (2010). The Effect of Using Animations on Pre-service Science Teachers' Science Achievement, World Conference on Educational Sciences (February 4-8, 2010), İstanbul

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