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PRESERVICE TEACHERS' INSTRUCTIONAL BELIEFS AND EXAMINATION OF CONSISTENCY BETWEEN BELIEFS AND PRACTICES

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ABSTRACT. The purposes of this study were to determine preservice physics teachers' instructional beliefs and to investigate the relationship between their beliefs and practices. The theoretical framework was based on the combination Haney & McArthur's (*Science Education*, 86(6):783–802, 2002) research and Ford's (1992) motivation systems theory. A multicase study design was utilized for the research in order to focus on a belief–practice relationship within several examples. Semistructured interviews, observations, and preservice teachers' written documents were used to collect data. Results showed that most preservice teachers held instructional beliefs aligned with constructivist philosophy. Some of the preservice teachers' beliefs were consistent with their practices while some of them presented different practices from their beliefs in different placements.

KEYWORDS: classroom practice, constructivist teaching, instructional beliefs, pre-service science teachers, pre-service teacher education, teacher belief, traditional teaching

Introduction

Teachers' beliefs have been a focus of attention in a large amount of research conducted in various areas (Block & Hazelip, 1995; Fetters, Czerniak, & Fish, 2002; Hoban, 2003; Johnston & Whitenack, 1992; Kagan, 1990; McDiarmid, 1995; Pajares, 1992; Peterman, 1993; Richardson, 1996; Staub & Stern, 2002; Thompson, 1992; Tillema, 1998; Tsai, 2002; Woolley & Woolley, 1999). Similarly, researchers have investigated the relationship between teachers' beliefs and their practices (Aguirre & Speer, 2000; Beck, Czerniak, & Lumpe, 2000; Gales & Yan, 2001; Haney, Lumpe, & Czerniak, 2002; Olech, 1999; Simmons, Emory, Carter, Coker, Finnegan, et al., 1999; Tobin, Tippins, & Gallard, 1994). According to Thompson (1992), teacher educators should strive to help teachers uncover their beliefs and actions and any inconsistencies in them. If the purpose is to shape teachers' practices, their beliefs and the consistency between their beliefs and practices should be investigated at the earliest stages in teachers' professional development, especially during their preservice teacher education. Therefore, this study attempts

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to determine preservice physics teachers' instructional beliefs and to examine the relationship between their beliefs and practices.

Belief Systems and Teacher Belief

Beliefs, in terms of general meaning, are deeply personal, stable, rooted in vivid memories of past experiences, lie beyond individual control or knowledge, and are usually unaffected by persuasion (Nespor, 1987). Because of the complicated nature of beliefs, some researchers have talked about beliefs as a system (Block & Hazelip, 1995; Fishbein & Ajzen 1975; Green, 1971; Rokeach 1968; Thompson, 1992). Green (1971) identified three dimensions of belief systems. These dimensions have to do with the way in which they are related to one another within the system, rather than the content of the belief systems themselves. The first dimension is related to quasilogical structure of belief systems and categorizes beliefs as primary and derivative. Primary beliefs are derived from an individual's way of operating and independent from other beliefs. Derivative beliefs, on the other hand, are the consequence of primary beliefs. Green's second dimension has to do with psychological strength. Core beliefs are the ones that are most strongly held and are not easily amenable to change because they are generally fundamental to one's personality. On the contrary, peripheral beliefs are the ones that are held less strongly and are more susceptible to change. The third dimension is related to belief clusters. According to Green (1971), "beliefs are held in clusters, more or less in isolation of other clusters and protected from any relationship with other sets of beliefs" (p. 48).

There are various definitions that well synthesize what teacher belief is and the factors influencing teacher belief (Kagan, 1990; Richardson, 1996; Sigel, 1985). Kagan's (1990) definition of teacher belief is compatible with the scope of this study: "the highly personal ways in which a teacher understands classrooms, students, the nature of learning, the teacher's role in the classroom and the goals of education" (p. 423). Richardson (1996) provides three sources of teacher belief: (a) personal life experiences that shape a teacher's worldview, (b) experiences as a student with schooling and instruction, and (c) formal knowledge including pedagogical content knowledge.

Preservice Teachers' Beliefs

Students enter teacher education programs with preexisting beliefs based on their experiences as students in schools (Lortie, 1975) and their

personality. There is consensus that preservice teachers' beliefs serve to constrain their knowledge and in turn their pedagogical content knowledge (Johnston & Whitenack, 1992; Kane, Sandretto, & Heath, 2002). The need for teacher education programs to identify and target existing beliefs seems to be at the core of teacher educators' tasks (Johnston & Whitenack, 1992). However, turning preservice teachers' existing beliefs into the beliefs that reform requires is difficult. Meyer-Simith & Mitchell (1991) present some reasons for the difficulty in changing preservice teachers' beliefs, such as the short duration of course and program interventions, critical timing of field and university-based experiences, and disciplinary background of preservice teachers.

Relationship Between Beliefs and Practices

While some researchers (Skott, 2001; Stipek, Givven, Salmon, & MacGyvers, 2001) advocate that the influence is from belief to practice, some (Guskey, 1986; Ruthven, 1987) argue that belief is the result of practice rather than a main influence on it. According to Richardson (1996), "teachers' beliefs are interactive with their practices. Beliefs are thought to drive actions; however, experiences and reflection on action may lead to changes in and/or additions to beliefs" (p. 104). Thompson (1992) also states that the relationship between beliefs and practices is dialectic, not a simple cause–effect relationship, and suggests that studies should seek to elucidate the dialectic between teachers' beliefs and practices.

In this paper, the assumption is that preservice science teachers enter teacher education programs with existing instructional beliefs rooted in their personality and experiences as individuals and students. Their beliefs may be reshaped by pedagogical content knowledge and related instructional experiences.

Teachers' Beliefs and Practices in Science Education Research

Over the past several years, educational researchers have highlighted the influence of science teachers' beliefs on their actions and the relationship between them. Luft, Roehrig, & Patterson (2003) found a relation between beliefs and practices but the relation remained undefined. Cronin-Jones (1991) tried to identify types of teacher beliefs influencing curriculum implementation and to determine how these beliefs specifically influence the implementation process. Her findings indicated that in addition to beliefs

regarding a teacher's role in the classroom, beliefs about how students learned and which student outcomes were most important also had significant influences on the curriculum implementation process. Brown & Melear (2006) analyzed links between the teachers' conveyed beliefs and observed practice regarding the teachers' actions and students' actions. They found inconsistencies between interview and observational data due to the physical environment and administrative duties. King, Shumow, & Lietz (2001) examined teachers' beliefs about their classrooms and their students. The researchers indicated that there was a disconnection between what the teachers said they did versus what observers saw them doing in the classroom. The teachers in their research perceived the following barriers that prevented them from being the best possible science teachers: need for additional classroom materials, need for extra adult help in the classroom during "hands-on" investigations, and behavior problems with students. Similarly, Kang & Wallace (2005) worked with three experienced secondary science teachers and revealed that a teacher's sophisticated epistemological beliefs were not always clearly connected to the practice. On the other hand, some research presented coherency between beliefs and practices. Verjovsky & Waldegg (2005), for instance, explored the beliefs and practices of a high school biology teacher. Although some difficulties of incorporating innovations existed due to institutional constraints, the data demonstrated a notable degree of consistency between many of her beliefs and practices. A review of the research literature indicates that external factors, such as physical environment, administrative duties, institutional constraints, and the behavior problems of students, keep science teachers from putting their beliefs into practices.

Theoretical Framework

The theoretical framework of this study was based on the combination of Haney & McArthur's (2002) research and Ford's (1992) motivation systems theory. In the literature, teachers' beliefs related to instruction are categorized mainly as traditional and constructivist. Haney & McArthur (2002) categorize constructivist beliefs as core beliefs, which are both stated and enacted (e.g., stating that students should solve problems together while working in groups followed by an action depicting student negotiation and problem solving), and peripheral beliefs, which are stated, but are not put into practice. If an individual cannot put their beliefs into practice because of some circumstances, this may cause disappointment and demotivation in time. At the end, they may reflect on their beliefs

and/or change them even if they are strongly held beliefs. In the meantime, there may be inconsistencies between the individual's beliefs and their practices, which can be defined as peripheral beliefs. Haney and McArthur present a further categorization of core beliefs as being constructivist core, conflict core, and emerging core beliefs. Constructivist core beliefs are the constructivist beliefs that are put into practice. On the other hand, conflict core beliefs are those beliefs that are enacted, but are in opposition to constructivist theory (e.g., believing in hands-on student inquiry but relying on heavy lecturing). Emerging core beliefs are the ones that are both stated and put into practice, but are not directly related to the constructivist practice (e.g., believing that good teachers are caring).

The theoretical framework of this study focused on general traditional and constructivist beliefs and their relation to practices. Traditional belief is "based on a theory of learning that suggests that students learn facts and concepts and they understand by absorbing the content of their teacher's explanations or by reading an explanation from a text and answering related questions" (Ravitz, Becker, & Wong, 2000, p. 1). Constructivist belief, in contrast, is "based on a theory of learning that suggests that understanding arises only through prolonged engagement of the learner in relating new ideas and explanations to the learner's prior knowledge" (Ravitz et al., 2000, p. 1). In constructivist belief, knowledge is seen as created rather than received, mediated by discourse rather than transferred by teacher talk, and explored and transformed rather than remembered as a uniform set of positivistic ideas (Holt-Reynolds, 2000).

In terms of practice, traditional practice is rooted in the behaviorist theory where knowledge is viewed as a commodity to be transferred to students whose responsibility is to learn it in a way that is faithful (Gallagher, 1993). Therefore, traditional practice is defined as teacher-centered instruction where teachers plan lessons along with a sequence of content while beliefs about how students learn or the resources needed become a secondary concern (Hoban, 2003). Conversely, constructivist practice, which is identified as student-centered instruction, primarily focuses on how students learn; thus, students' prior knowledge is taken into account and social interactions with peers and the teacher are structured (Hoban, 2003). In constructivist practice, teachers are engaged in thinking about their students' understanding of the subject matter, and they think about new practices, such as group work and writing to learn to examine their own teaching and their students' learning (Gallagher, 1993).

One more category, i.e., transitional, was also defined as applying to beliefs and practices to imply a movement from being traditional to constructivist. Hence, this study investigated beliefs in three categories:

traditional, transitional, and constructivist. Like Haney & McArthur's (2002) framework, it further investigated each belief category to the extent that beliefs are put into practice: core, peripheral, conflict, and emerging. Furthermore, Haney and McArthur's framework was expanded with Ford's (1992) motivation systems theory to be able to explain the sources of inconsistencies between belief and practice in cases of peripheral and conflict beliefs. In this theory, personal agency beliefs play a particularly crucial role in situations that involve challenging but attainable goals (Ford, 1992). Ford identifies two types of personal agency beliefs that are critical for an individual's effective functioning: context and capability. "Context beliefs are evaluations of whether one has the responsive environment needed to support effective functioning, and capability beliefs are evaluations of whether one has the personal skill needed to function effectively" (Ford, 1992, p. 124). Accordingly, the belief categories can be defined as follows based on the theoretical framework of this particular study: First, core beliefs are the beliefs that are both stated and put into practice. Second, peripheral beliefs are those beliefs that are stated, but are not enacted due to context beliefs. Context beliefs depend on the functional elements that are needed to have an optimally responsive environment. According to Ford, the responsive environment is congruent with an individual's personal goals and their biological, transactional, and cognitive capabilities. Additionally, the responsive environment has the material and informational resources and provides an emotional climate (Ford, 1992). Third, conflict beliefs are those beliefs that are stated, but are not put into practice due to capability beliefs.

> Capability beliefs can reflect confidence or doubts about any of a number of personal strengths or weaknesses: perceptual, motor, or communicative skills; memory or information-processing capabilities; self-control or self-regulatory skills; capabilities for dealing with stressful circumstances; or one's capacity for selective or sustained attentional or activity arousal (Ford, 1992, p. 128).

And fourth, emerging beliefs are the ones that are both stated and enacted, but are not directly related to constructivist and traditional beliefs.

Purposes of the Study

The Turkish Education System has been engaged in a reform movement to implement constructivist philosophy at all levels of instruction since 1997. Educators and researchers agree that teachers play a key role in making educational reforms successful (Dori & Herscovitz, 2005; van Driel,

Beijaard, & Verloop, 2001). Teachers possess beliefs regarding professional practice and these beliefs may impact their actions (Beck et al., 2000): Therefore, "the reform movement might be hindered by teachers' beliefs, if they are not supportive of the newly recommended style of instruction" (Jacops, Yoshida, Stigler, & Fernandez, 1997, p. 7). Consequently, the purposes of this study were to determine Turkish preservice physics teachers' instructional beliefs and to examine their beliefs in relation to their practices. In agreement with Green (1971), beliefs are in clusters, which might be isolated from each other. Hence, four clusters were determined for instructional beliefs by reviewing the related literature (Chen, Taylor, & Aldridge, 1997; Gales & Yan, 2001; Kagan, 1990; Kane et al., 2002; McGinnis, Kramer, Roth-McDuffie, & Watanabe, 1998; Nagy, Collins, Duschl, & Erduran, 1999; Ravitz et al., 2000; Woolley, Woolley, & Hosey, 1999). These clusters are classroom environment (CE), teaching activities and assessment (TAA), teacher's role (TR), and instructional goals (IG).

The following research questions were addressed in this study:

1. What are the Turkish preservice physics teachers' instructional beliefs in the CE, TAA, TR, and IG clusters?
2. How are the preservice teachers' instructional beliefs congruent or incongruent with their subsequent classroom practices?

Methodology

A multicase study design was utilized for the research in order to focus on a belief–practice relationship within several examples. A case study is a detailed examination of one setting, or a single subject, a single depository of documents, or one particular event (Bogdan & Biklen, 1998, p. 54). When two or more subjects, settings, or depositories of data are studied, it is called a multicase study (Bogdan & Biklen, 1998).

Thompson (1992) emphasized that inconsistencies between professed beliefs and observed practice could also be explained in part by the way teachers' beliefs were measured. In order to prevent any inconsistency between beliefs and practices because of the measurement, there was an attempt to use data from different sources to develop a detailed composite description of the preservice teachers' beliefs and practices. The data were collected by using various sources, i.e., semistructured interviews, observations, and preservice teachers' written documents such as lesson plans and self-assessment reports of their lessons. In order to achieve triangulation, multiple data sources were used and the data were analyzed

by two coders (Maxwell, 1996). Triangulation was emphasized in order to present meaningful propositions and to reduce the bias inherent in qualitative research (Mathison, 1988).

Participants and Setting

It might be useful to give some information about the physics teacher education program in Turkey where this study was situated. The program has two phases. In the first phase, preservice teachers complete undergraduate physics courses that last for 3.5 years. In the second phase, they undertake teacher education courses and do some practicums in schools. The aim of the second phase is to help preservice teachers develop their general pedagogical knowledge and pedagogical content knowledge. The content of the second phase is based on the constructivist philosophy.

Six preservice teachers (three females and three males) were randomly selected from among Turkish preservice physics teachers attending the physics teacher education program. All the selected preservice teachers were willing to participate in the study. They were in the same section so that their course instructors were the same. Their ages ranged from 20 to 23. In order to provide anonymity, the participants' names were changed to become Fatma, Selma, Tarkan, Mehmet, Defne, and Ali. All of them came from different home towns for their university education. Fatma and Tarkan were giving private lessons; Mehmet was a tutor in a private high school institution; Selma, Defne, and Ali did not have any teaching experience.

The participants were observed during their practicums in the "Instructional Methods in Physics" and "School Practice" courses. Instructional Methods in Physics is one of the main courses in the second phase, where preservice teachers meet four hours a week and have opportunities to build theories of physics teaching and learning, do teaching activities, examine their own teaching, observe and examine peer teaching, and experience different teaching and learning approaches. In the School Practice course, on the other hand, preservice teachers have public school placements where they spend four hours a week. They have opportunities to work with a mentor under the supervision of their professor and do some teaching activities in real school settings. They get feedback from both their mentors and professors.

Data Collection

Interviews. Three semistructured interviews were conducted with each participant throughout the research. The purpose of the first interview was to determine the participants' instructional beliefs. The Preservice Teachers' Instructional Beliefs (PTIB) instrument was used for the first

interview (see "Appendix"). The questions in this instrument were related to classroom environment, teaching activities and assessment, teachers' roles, and instructional goals. The second and third interviews were related to the participants' instructional practices in the methods course and the school settings. These interviews included stimulated-recall questions. The intention of the second and third interviews was to reveal the participants' preparation for their lessons and to evaluate their practices. The questions for the interviews were prepared by the first author and two authors made some revisions of the questions together to achieve content validity. The interviews were done by one of the authors in her office at the university and tape-recorded. Each interview lasted 30 to 45 min. Because the instructor of the methods course was the interviewer, the interviews were conducted in the following semester when the participants had no involvement in the course. The participants were assured that their responses would only be used for the stated purpose of the study.

Observations and Written Documents. In order to examine the participants' instructional practices, they were observed by the authors during their teaching in the methods course and in the school placements. Each teaching practice lasted 45 min. Descriptive field notes were taken throughout the observations. Besides, a modified version of the Constructivist Teaching Inventory (CTI) developed by Greer, Hudson, & Wiersma (1999) was used. As mentioned in the theoretical framework of the study, traditional practice is characterized as teacher-centered instruction while constructivist practice is characterized as student-centered instruction. The CTI is compatible with this framework. The subscales of the CTI are matched well with the clusters identified for the instructional beliefs. Furthermore, the items in most of the teaching and learning inventories are stated from a participant's point of view. The items in the CTI, on the other hand, are stated from an observer's point of view. The CTI is a reliable and valid instrument for measuring instructional practices (Greer et al., 1999) and composed of 44 items distributed under the following four subscales: Community of Learners, Teaching Strategies, Learning Activities, and Curriculum-Assessment. Each subscale has 11 items based on the seven-point Likert scale (0–6).

Some changes were made before using the CTI. The Curriculum-Assessment subscale in the inventory focuses on curriculum consisting of the content and processes taught, as well as their organization. Additionally, the subscale focuses on assessment involving the means of measuring student performance, the reasons for doing so, and the use of the results (Greer et al., 1999). The assessment items were moved from

the Curriculum-Assessment subscale to the Learning Activities subscale and the name of the Curriculum subscale was changed to IG. The Learning Activities subscale focuses on what the teacher has students do to be intellectually active (Greer et al., 1999). The name of the Learning Activities subscale, which also included the assessment items, was changed to TAA. The Community of Learners subscale focuses on the verbal interaction within the classroom community as well as the nature and quality of discourse (Greer et al., 1999). The name of the Community of Learners subscale was changed to CE. The Teaching Strategies subscale focuses on concepts such as teacher's perception of their primary role and its influence on their instructional decisions (Greer et al., 1999). Finally, the name of the Teaching Strategies subscale was changed to TR. After the changes were completed, there were 11 items in the CE subscale, 17 items in the TAA subscale, 11 items in the TR subscale, and five items in the IG subscale of the modified CTI. The change in procedure was only a matter of a different naming of categories. The purpose of the changes was to use the same terminology for the data gathered from the interviews and observations. Some examples from the items of the modified CTI are given in Table 1.

In order to address the issue of content validity for the modified CTI, the inventory was sent to 11 experts in the fields of science education and mathematics education to examine and rate each item on its representativeness and relevance with respect to the given subscale according to a five-point Likert scale (1—definitely not related, 2—not related, 3—somehow related, 4—related, 5—definitely related) and on its clarity and conciseness. Written responses were obtained from seven reviewers. The reviewers were all agreed on the clarity and conciseness of the items. In terms of representativeness and relevance, seven items (two items in the CE subscale, two items in the TR subscale, two items in the TAA subscale, and one item in the IG subscale) were rated as a "2" by one reviewer. However, these items were rated as a "4" or "5" by other reviewers and their mean values were high (between 4.0 and 4.6). Therefore, they were not dropped from the inventory. Additionally, 25 items rated as a "3" were retained because their mean values were also high (between 3.9 and 4.7). The modified CTI was used in a preservice teacher education program where the language of instruction was English. As one preservice teacher was teaching a science subject in the method course, her 32 peers observed and rated her teaching by using the modified CTI. The reliability of the modified CTI was established by examining the internal consistency (Cronbach alpha reliability coefficient) of the full scale and the four subscales of the inventory. The alpha

TABLE 1

Sample items from the modified CTI

Clusters	*Sample items from the CTI*
Classroom environment	Both teachers and students initiate and answer questions
	Climate of the classroom is primarily challenging (consistently pushing understanding)
Teaching activities and assessment	Activities require students to be self-directed
	Most activities cannot be solved through the routine application of previously learned knowledge. Most activities require the use of knowledge and skills in new ways
Teacher's role	Teacher intentionally provides students with opportunities for cognitive disequilibrium appropriate for cognitive understanding
	Teacher's primary role is to facilitate critical student inquiry, not to provide knowledge, skills, and answers
Instructional goals	Selection of content for teaching is frequently based on students' interests, prior knowledge, and/or particular learning needs
	Teacher does not depend on the district textbook to present the lesson. Teacher and student adapt or develop content and materials for their needs

coefficient for the full scale was 0.85. For each individual subscale, the alpha coefficients ranged from 0.75 to 0.87 (0.83 for the CE subscale, 0.75 for the TR subscale, 0.87 for the TAA subscale, and 0.81 for the IG subscale). These findings suggest that the subscales and total scale of the modified CTI have high reliability.

Six preservice teachers' lesson plans and self-assessment reports of their lessons that they had taught in the methods course and school settings were examined to determine any inconsistency between the data from the interviews, written documents, and observations. The whole procedure for data collection is demonstrated in Figure 1. Except for the PTIB that was used once, the data collection procedure was repeated twice for the participants' practices in both the methods course and school settings.

Data Analysis

All data were analyzed after the participants had completed the courses. Two authors analyzed the verbatim transcripts of the tapes as well as their

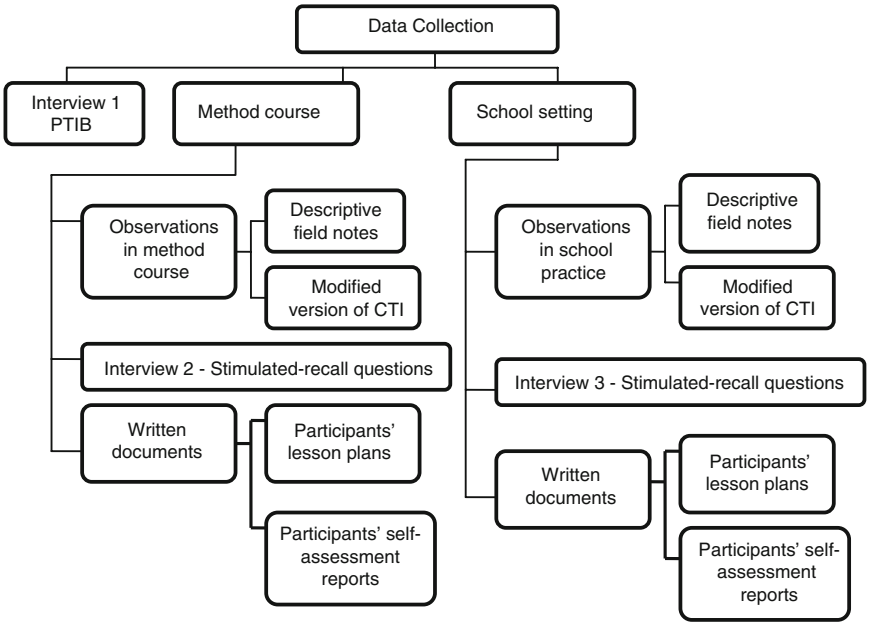

Figure 1. Data sources and the research procedure

field notes and identified themes separately in order to avoid interviewer bias. The participants' instructional beliefs and their practices were mainly coded as constructivist, transitional, and traditional.

The codes for the preservice teachers' instructional beliefs and their practices were given based on the learning theories and the definitions mentioned in the theoretical framework of the study. What is considered as constructivist, transitional, and traditional in four clusters of beliefs and practices (CE, TAA, TR, and IG) can be described as follows: a classroom environment where both teachers and students initiated and answered questions and students interacted with each other, worked collaboratively, were given opportunities by the teacher to think aloud, and were intellectually active was considered as constructivist. Teaching activities such as providing nonroutine applications of previously learned knowledge and accommodating individual students' interests, needs, and abilities were considered as constructivist. Assessment techniques such as journal writing, open-ended problems, projects, etc. were also considered as constructivist. In the TR cluster, teachers who saw their roles as providing knowledge, skills, and answers, and assigning specific tasks to students were considered as traditional. In contrast, facilitating critical student inquiry, providing students with opportunities for cognitive

disequilibrium, and questioning to help students to think through an issue for themselves were considered as constructivist in the TR cluster. For the IG cluster, selecting content for teaching based on students' interests, prior knowledge, and particular learning needs, and organizing knowledge and skills in such a way that relationships between them were obvious were considered as constructivist while a more curriculum-centered teaching was considered as traditional. A cluster where both traditional and constructivist themes equally existed was considered as transitional. Two descriptors emerged during the data analysis: close to constructivist and close to traditional. A cluster where constructivist themes were in the majority, but there were some traditional themes, was coded as close to constructivist. In opposition, a cluster where traditional themes were in majority, but there were some constructivist themes, was coded as close to traditional.

Observational data, which were gathered by using the modified CTI, were analyzed by calculating the mean values for each cluster. This procedure was repeated by the authors separately for each participant. In order to use consistent terminology among the data from interviews, field notes, and the inventory, the mean values were categorized according to a scale that was divided into five. Therefore, if the mean value was between 0 and 1.2, it was coded as traditional; if the mean value was between 1.21 and 2.4, it was coded as close to traditional; if the mean value was between 2.41 and 3.6, it was coded as transitional; if the mean value was between 3.61 and 4.8, it was coded as close to constructivist; and if the mean value was between 4.81 and 6.0, it was coded as constructivist. The codes derived from the numerical analyses of the inventory were compatible with the codes assigned based on the qualitative analyses of the field notes.

Each participant's overall belief was determined by calculating the average of four beliefs given to the clusters. The same procedure was repeated to determine each participant's overall practice.

The codes assigned by the authors for the participants' beliefs and practices were compared and interrater reliabilities were calculated. The interrater reliability values were high (92% for the beliefs and 96% for the practices). No inconsistency was found among the stimulated-recall interviews, written documents, and observational data.

The participants' beliefs in relation to their practices were determined with regard to the theoretical framework of the study. Categories of beliefs in relation to practices in the method course and school setting were determined by comparing the participants' beliefs and their practices performed in the methods and school practice courses. For instance, Tarkan held constructivist beliefs in the TR cluster and performed constructivist practice in this cluster in the methods course. Consequently,

he was considered as having constructivist core beliefs in the TR cluster meaning that he was constructivist in the TR cluster and he put his constructivist beliefs into practice in the methods course.

Results

The preservice physics teachers' instructional beliefs and their practices both in the methods course and school settings are presented in Table 2. The mean values in Table 2 were calculated by averaging the mean values derived from the observations of two authors. Table 2 also shows the participants' instructional beliefs in relation to their practices according to the clusters. Four preservice teachers held constructivist instructional beliefs while one preservice teacher held transitional beliefs and the other preservice teacher held traditional beliefs. Whereas four preservice teachers' instructional practices in the method course aligned with their overall beliefs, two of them changed their practices in their school settings and performed in such a way as to have an inconsistent belief–practice relationship. Detailed results for each preservice teacher are given below.

Fatma's overall instructional belief was determined as constructivist. When data from the interview were analyzed, Fatma was considered as close to constructivist in the CE cluster. She said that:

> I want my students to have personal interests in physics, show effort and feel comfortable in their behaviors, but they must be respectful…. Students can ask questions that I cannot answer….. Interactivity in the classroom is very important (Fatma).

She saw her role as a teacher who enjoyed teaching and whose students enjoyed learning. She was constructivist in the TAA cluster. She expressed that:

> I decide on my teaching activities according to my students' levels and interests. I use daily life questions and concept maps. I engage students with hands on activities and videotapes that enable them to visualize things (Fatma).

She determined her instructional goals as to balance student learning and the curriculum. Her overall instructional practice in the methods course was constructivist. Fatma used many demonstrations, asked daily life questions, and provided opportunities for her peer group working on the subject of pressure. Thus, her belief in relation to practice was considered as constructivist core in the method course. However, Fatma's overall practice in the school was close to traditional as she taught a curriculum-centered lesson and asked multiple-choice questions about the

subject of density. She criticized herself in her self-assessment report. While she was evaluating her lesson in the interview, she said that:

> My mentor told me to prepare questions for my lesson. Since she found the textbook questions inadequate to prepare students for the university entrance examination, I chose the questions from the books written for university entrance examination…. In order to solve as many problems as I can, I could not give students opportunities to discuss…. If it was my own class, I would care for students' interests and give real life examples (Fatma).

Fatma's mentor requested that she ask questions that could help students prepare for the university entrance examination. Due to the fact that questions in the university entrance examination are in a multiple-choice format, she preferred multiple-choice questions. Furthermore, she observed that her mentor could solve many problems in one lesson. Hence, as she explained, she wanted to solve as many problems as she could like her mentor and this resulted in almost no student participation. Because of her context beliefs depending on her mentor's desire and the time limitation, Fatma could not put her constructivist beliefs into practice. Therefore, her overall belief in relation to practice was considered as constructivist peripheral in the school setting.

Selma was determined as having constructivist beliefs in all the clusters. She said that:

> I prefer a classroom where all the students are active and rules are determined by me and my students….I try to motivate my students by emphasizing performance-based assessment….. In my opinion, students' meaningful learning is more important than covering the whole curriculum (Selma).

Her overall practice in the school setting was constructivist. She considered students' prior knowledge, gave opportunities for cognitive disequilibrium, and did various activities during her practice in the school. Similarly, her overall practice in the methods course was close to constructivist. However, Selma did not let her peers actively participate in the methods course lesson; thus, her belief in relation to practice was constructivist conflict in the CE cluster for the methods course. In the follow-up interview, she explained the reason for her behavior as follows:

> My subject was electromagnetic theory and there were some concepts where I was not certain about my knowledge. I was afraid that my peers would realize that; hence, I did not let them ask questions and add something to my explanations (Selma).

Her capability beliefs reflecting her doubts about her subject matter knowledge prevented Selma from putting her constructivist beliefs for the CE cluster into practice in the methods course.

TABLE 2

Comparison of participants' teaching beliefs and practices

		Belief	*Practice*			*Belief in relation to practice*		
Participants	*Clusters*		*Methods course means*	*Methods course*	*School setting means*	*School setting*	*Methods course*	*School setting*
Fatma	CE	Close to constructivist	4.4	Close to constructivist	2.7	Transitional	Constructivist core	Constructivist peripheral
	TR	Close to constructivist	5.4	Constructivist	3.1	Transitional	Constructivist core	Constructivist peripheral
	TAA	Constructivist	5.1	Constructivist	1.7	Close to traditional	Constructivist core	Constructivist peripheral
	IG	Constructivist	5.8	Constructivist	1.8	Close to traditional	Constructivist core	Constructivist peripheral
	Overall	Constructivist	5.2	Constructivist	2.3	Close to traditional	Constructivist core	Constructivist peripheral
Selma	CE	Constructivist	3.4	Transitional	5.8	Constructivist	Constructivist conflict	Constructivist core
	TR	Close to constructivist	4.4	Close to constructivist	5.4	Constructivist	Constructivist core	Constructivist core
	TAA	Constructivist	4.4	Close to constructivist	5.1	Constructivist	Constructivist core	Constructivist core
	IG	Constructivist	5.4	Constructivist	4.6	Close to constructivist	Constructivist core	Constructivist core
	Overall	Constructivist	4.4	Close to constructivist	5.2	Constructivist	Constructivist core	Constructivist core
Tarkan	CE	Constructivist	4.4	Close to constructivist	3.0	Transitional	Constructivist core	Constructivist peripheral
	TR	Constructivist	5.4	Constructivist	3.3	Transitional	Constructivist core	Constructivist peripheral
	TAA	Close to constructivist	5.0	Constructivist	2.1	Close to traditional	Constructivist core	Constructivist peripheral
	IG	Close to constructivist	6.0	Constructivist	1.0	Traditional	Constructivist core	Constructivist peripheral
	Overall	Constructivist	5.2	Constructivist	2.4	Close to traditional	Constructivist core	Constructivist peripheral
Mehmet	CE	Transitional	0.8	Traditional	1.1	Traditional	Transitional conflict	Transitional conflict
	TR	Transitional	1.4	Close to traditional	1.5	Close to traditional	Transitional conflict	Transitional conflict
	TAA	Traditional	0.8	Traditional	1.9	Close to traditional	Traditional core	Traditional core
	IG	Constructivist	1.8	Close to traditional	2.8	Transitional	Constructivist conflict	Constructivist conflict
	Overall	Transitional	1.2	Traditional	1.8	Close to traditional	Transitional conflict	Transitional conflict
Defne	CE	Constructivist	1.8	Close to traditional	1.6	Close to traditional	Constructivist conflict	Constructivist conflict
	TR	Constructivist	2.0	Close to traditional	2.3	Close to traditional	Constructivist conflict	Constructivist conflict
	TAA	Constructivist	3.8	Close to constructivist	4.2	Close to constructivist	Constructivist core	Constructivist core
	IG	Close to constructivist	5.8	Constructivist	4.6	Close to constructivist	Constructivist core	Constructivist core
	Overall	Constructivist	3.3	Transitional	3.2	Transitional	Constructivist conflict	Constructivist conflict
Ali	CE	Traditional	0.9	Traditional	0.3	Traditional	Traditional core	Traditional core
	TR	Traditional	1.2	Traditional	0.5	Traditional	Traditional core	Traditional core
	TAA	Traditional	1.2	Traditional	0.8	Traditional	Traditional core	Traditional core
	IG	Traditional	1.4	Close to traditional	1.2	Traditional	Traditional core	Traditional core
	Overall	Traditional	1.2	Traditional	0.7	Traditional	Traditional core	Traditional core

Tarkan's overall instructional belief was constructivist. He expressed that:

> Students should feel comfortable and behave in a friendly way in my classroom…. Teachers should provide an environment to increase students' interest…. Giving feedback and awareness of students' understanding are important (Tarkan).

He was considered as constructivist in the TR cluster because he saw his role as a consultant who helped students construct knowledge and who knew enough but could not understand everything in the physics discipline.

Tarkan enacted his constructivist beliefs while he was teaching in the methods course where he designed and constructed a small electric motor to explain the concept of electric potential. However, his instructional practice was not constructivist in the school; therefore, his belief in relation to practice was categorized as constructivist peripheral. Although he believed in implementation of teaching activities that enhanced learning, Tarkan could not implement any of them in a constructivist way because of his context beliefs depending on his mentor's expectations and the school's condition. In the interview and his self-assessment report, he revealed that:

> My mentor wanted me to cover a lot of topics in a short time; consequently, I couldn't let students lead the class….. In the university, student-centered teaching is encouraged. However, the conditions are different in the schools. There are not enough resources, especially laboratory materials, to perform student-centered instruction in the schools. I can only demonstrate an experiment. How can students understand without doing the experiment by themselves? (Tarkan).

Mehmet's overall instructional belief was considered as transitional. Nevertheless, he did not hold the same belief for every cluster. His CE belief was transitional because he held constructivist themes as well as traditional themes. He desired a classroom environment where students had discipline and listened what he said. He also wanted students to have an interest in learning physics and to be active during the lesson. His TR belief was also transitional because he believed that he had to have a leading role in spite of students' active participation. He said that:

> I see my teaching role as a leading role in a theatre who adds some script into a play….. The teacher is the center of the classroom and the students receive what is given by the teacher. Thus, the teacher must always tell the truth (Mehmet).

The reason behind his transitional beliefs in CE and TR clusters was his primary belief about having total control over the class. During the interview, Mehmet explained one of his memories. While he was teaching at an institution that he worked in, he heard that the students made fun of

him and had given him a bad nickname. He stated that he got very angry and he did not want it to happen to him again. His beliefs about the classroom environment and teacher's role were derived from his fundamental belief about having total control.

Meanwhile, Mehmet was considered as traditional in the TAA cluster since he stated that he prepared his lessons based on the sequence of content and he generally preferred a focus on lecturing. On the other hand, he highlighted the importance of establishing relationships between the physics concepts and also emphasized student learning despite the time pressure to cover the whole curriculum. Moreover, he underlined the importance of prior knowledge and organization of knowledge and skills where relationships between them were obvious. For these reasons, Mehmet was considered as having constructivist belief in the IG cluster.

When his beliefs were compared to his practices, it was found that his instructional practices were traditional in the methods course and close to traditional in the school setting. His subject was waves in the methods course and it was density in the school. Although both subjects could be taught by doing easily prepared demonstrations and experiments, he mainly focused on lecturing. He assumed that his peers in the methods course and the students in the school understood everything he said. Mehmet did not allow any social interaction in the lessons. Therefore, his beliefs in relation to practices were categorized as transitional conflict in both the methods course and school setting. The reason for the inconsistency between his beliefs and practices might be his primary belief about having total control over the class. This primary belief might be related to his capability beliefs. Although he believed that students should be active in the class, this primary belief he had might prevent him from allowing his students to participate.

Defne held constructivist beliefs in all the clusters. She expressed that:

> I prefer a classroom where students are curious and share what they have found outside the classroom with their peers…I see my role as a facilitator, but not as a teacher who transfers the knowledge…. My students can ask me the questions, which I don't know the answers (Defne).

Regarding the mean values and field notes, her instructional practices in the methods course and in the school setting fit into constructivist and close to constructivist categories for the TAA and IG clusters. Defne assessed prior knowledge at the beginning of the lessons and got students' attention by daily life examples. Thus, her beliefs in relation to practices were considered as being constructivist core for these two clusters. However, she did not give enough time and opportunities to her peers (in the method course) and the students (in school practice) to construct their knowledge while she was presenting simulations, experiments, and demonstrations. Her lack of

experience and skills might have prevented her from enacting her constructivist beliefs. Hence, her beliefs in relation to practices were categorized as constructivist conflict for the CE and TR clusters.

Ali held traditional beliefs in all the clusters. He said that:

> I may consider doing some experiments provided that these experiments do not take much time….. I prepare my lessons according to the textbook, which should be written appropriately for the students' level…. Students should be interested in physics. I cannot do anything by myself……My role is to teach (Ali).

There was not any inconsistency between his beliefs and practices. That is, he was also traditional in his instructional practices both in the methods course and school setting. In the methods course, Ali lectured Bernoulli equations without explaining what these equations are for. He just gave the formulas and did not relate the concepts and the laws to daily life examples. Similarly, he lectured on density and asked factual questions in his school placement. When the students asked interesting questions, he discouraged their curiosity. As a result, his beliefs in relation to practices were categorized as traditional core for the four clusters.

Discussion and Suggestions

The results of the current study illustrate that four preservice teachers (Fatma, Selma, Tarkan, and Defne) out of six randomly selected preservice teachers had constructivist beliefs in all the clusters. This result is compatible with the result presented by Levitt (2001) who explained that teachers espoused certain nontraditional beliefs about the teaching and learning of science and these nontraditional beliefs accorded with the philosophy of current science education reform. One preservice teacher (Ali), in contrast, held traditional beliefs in all the clusters. This result leads us to make the suggestion that the content of teacher education programs needs to be designed to provide preservice teachers with opportunities to turn their traditional instructional beliefs into constructivist beliefs.

The results also reveal that one preservice teacher may hold different beliefs in different clusters (as happened in Mehmet's case). In other words, beliefs are not consistent from cluster to cluster and a particular preservice teacher may have traditional belief for the teaching activities and assessment cluster as well as constructivist belief for the instructional goals cluster. This finding supports Mewborn (2002)'s view that "it is possible for an individual to hold conflicting beliefs, but as long as they are held in isolated clusters and never placed side-by-side s/he does not

feel any conflict" (p. 5). As teacher educators, we recommend challenging preservice teachers' awareness of their conflicting beliefs in different clusters so that they can move to a more coherent set of beliefs.

This study shows some differences between preservice physics teachers' instructional beliefs and their practices. The results are in line with the results of several researchers (Aguirre & Speer, 2000; Brown & Melear, 2006; Haney et al., 2002; Kang & Wallace, 2005; King et al., 2001; Lee, Luykx, Buxton & Shaver, 2007; Simmons et al., 1999; Tsai, 2002) that beliefs affect practice in complex ways and what teachers profess to believe and what they actually do in the classroom may or may not be consistent. A teacher cannot act according to his or her belief because of practical or logistical circumstances (King et al., 2001; Wilson & Cooney, 2002). This study identified various constraints, which were related to capability and context, on the enactment of belief. First, as Selma experienced, lack of subject matter knowledge may be a barrier for preservice teachers to put their constructivist beliefs into practices. For that reason, it is agreed that one of the purposes of teacher education programs should be to raise preservice teachers' own knowledge and understanding of scientific phenomena. Second, mentors' expectations may have influence on preservice teachers' practices. For example, Fatma and Tarkan, whose school settings were different, could not teach in accordance with their constructivist beliefs in the school settings because of their mentors' expectations such as solving multiple-choice questions and covering too many topics in one lesson. Unfortunately, teachers do not take any training to be mentors in Turkey. School coordinators assign mentoring positions to teachers. Furthermore, science teachers' participation in in-service education programs is quite low (Ogan-Bekiroglu, 2007). Thus, mentors do not have much chance to follow constructivist recommendations. This study proposes that mentors need to be trained and they need to cooperate with universities to be able to encourage preservice teachers to perform constructivist practices. Third, as Tarkan experienced, school conditions may have a negative impact on teachers' instructional practices. The situation of inadequate laboratory equipment in the schools has been reported in the research (Ogan-Bekiroglu, 2007). It is important that schools have materials and resources to provide a responsive environment so that teachers can put their constructivist beliefs into actions. Fourth, primary beliefs possibly prevent preservice teachers from enacting their beliefs and create conflict, as might be the case for Mehmet. Further studies are needed to support this conclusion, and last, as in Defne's situation, lack of enough experience of and skills for constructivist practices, such as providing opportunities for students to help them construct their knowledge, may also act as a barrier and prevent preservice teachers from acting upon

their beliefs. Teacher education programs should facilitate these kinds of experiences. Moreover, not only should teacher educators teach constructivist philosophy but they also should behave in a constructivist mode. Inconsistencies between teacher educators' beliefs and practices may create conflict and cause preservice teachers to fail in the internalization of constructivist teaching.

The findings emphasize how beliefs about capability may result in a lack of compatibility between beliefs and practices. Deficiencies in preservice teachers' abilities should be detected and eliminated in the earlier stages of their professional development. Otherwise, gaining experience in teaching while having these deficiencies through a period of time brings about strong conflicting beliefs. Additionally, this study substantiates some researchers' (Ernest, 1991; Hoyles, 1992; Lerman, 1994; Simmons et al., 1999) argument that differences between beliefs and practices should be interpreted by considering the role of context on beliefs since any human activity is contextualized and situations are coproducers of beliefs. Understanding the context in which the teacher operates is of critical importance (King et al., 2001) because teachers negotiate differently in their commitment to their beliefs with their perceived teaching contexts (Kang & Wallace, 2005). Four preservice teachers (Fatma, Selma, Tarkan, and Ali) put their beliefs into practice so that their beliefs in relation to practice were classified as core beliefs in the methods course. Nevertheless, only two (Selma and Ali) presented core beliefs in the school settings. Simmons et al. (1999) explain that as teachers adapt to different educational environments, they construct subuniverses (teacher-centered, student-centered) organized from the perspective of self in relation to social context. They add that teachers construct these subuniverses as individuals within each of the social contexts in which they function. This result brings out the concern that if the context is not suitable for the teachers after they graduate from teacher education programs, they may not perform their constructivist beliefs in their profession and go back to their traditional beliefs after some time. According to Luft (2001), beginning science teachers should receive support and assistance for two or three years in order to reinforce reform-based beliefs and practices. Nevertheless, it is essential that this support and assistance should address teachers' capabilities as well as contextual factors.

This study also suggests that if the purpose of teacher education programs is to change preservice teachers' beliefs, not only teacher educators but also preservice teachers should be aware of the inconsistencies between their own beliefs and practices. When teachers experience a fundamental shift in their beliefs and are aware of this shift, then they have the potential to continue to grow and change as they encounter new situations (Mewborn, 2002).

Therefore, reflective thinking should be emphasized and helping preservice teachers reflect on problems of practice should be the key purpose of teacher education programs (Dewey, 1933). Richardson (1996) found that reflecting on one's practice directly influenced beliefs and practices and moved teachers towards more constructivist approaches.

Implications of the Study

Teacher beliefs matter and identifying, discussing, and reflecting upon the belief–practice relationship should be a component of every teacher education program (Haney et al., 2002). Preservice physics teachers' instructional beliefs were determined and consistencies between their beliefs and practices were examined in this research. The implications of this study derive from its theoretical framework, which elucidates the dialectic between teachers' beliefs and practices and can be used to understand the gap between beliefs and practices

The study has promising results in relation to preservice teachers' constructivist beliefs. However, changing preservice teachers' beliefs completely in an extensive year program is not easy. Sometimes, only subtle changes in these may occur. These slight changes can be detected by utilizing the theoretical framework of this study. Some of the categories in the framework that were not observed in this research (such as transitional core and traditional peripheral) were observed in another piece of research conducted by Akkoç & Ogan-Bekiroglu (2006).

Appendix—Preservice Teachers' Instructional Beliefs

1. Could you describe the environment you would desire in your classroom? (CE)
2. What would be your criteria when you decide on teaching activities for your lesson? (TAA)
3. In your opinion, what is the role of a teacher? (TR)
4. When you plan your instruction, which one would be your first preference: covering the whole curriculum or encouraging student learning? Why? (IG)
5. What kind of teaching activities would you use in your classroom? How often would you use these activities? (TAA)

6. What kind of assessment methods would you use to assess students' learning? Why? (TAA)
7. What would be your goals for your students in learning physics? (IG)

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