AN ANALYSIS OF EFFICACY BELIEFS, EPISTEMOLOGICAL BELIEFS AND ATTITUDES TOWARDS SCIENCE IN PRESERVICE ELEMENTARY SCIENCE TEACHERS AND SECONDARY SCIENCE TEACHERS

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ABSTRACT

AN ANALYSIS OF EFFICACY BELIEFS, EPISTEMOLOGICAL BELIEFS AND ATTITUDES TOWARDS SCIENCE IN PRESERVICE ELEMENTARY SCIENCE TEACHERS AND SECONDARY SCIENCE TEACHERS

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The purpose of the study was to analyze preservice science teachers at elementary science teaching and secondary science teaching with respect to their self efficacy beliefs, epistemological beliefs, and attitudes towards science teaching. Preservice elementary science teachers and preservice secondary science teachers who enrolled in Middle East Technical University in Ankara were the sample of this study.

Participants of this study were third grade of preservice elementary science teachers and preservice secondary science teachers. The instruments which are, efficacy beliefs, epistemological beliefs, and attitudes towards science, were utilized this study.

The analysis indicated that moderately positive self efficacy beliefs, epistemological beliefs and attitudes towards science teaching were expressed by most of the preservice elementary and secondary science teachers regarding science teaching. Moreover, preservice elementary and secondary science teachers believe that effective teaching can influence their teaching abilities and students' learning. Furthermore, many preservice elementary and secondary science teachers express a positive attitude toward science teaching.

The analysis indicated that there is a relationship between self efficacy beliefs and attitudes towards science teaching in preservice secondary science teachers, and there is another relationship between epistemological beliefs and attitudes towards science teaching in preservice elementary science teachers.

Keywords: Preservice Teacher, Self Efficacy, Self Attitude, Epistemology, Elementary preservice science teacher, Secondary preservice science teacher

And Scientific Epistemological View (SEV)

ÖZ

İLKÖĞRETİM FEN BİLGİSİ VE ORTA ÖĞRETİM FEN BRANŞLARINDAKİ ÖĞRETMEN ADAYLARININ ÖZ YETERLİLİK İNANÇLARININ, EPİSTEMOLOJİ KONUSUNDAKİ İNANÇLARININ VE FENE YÖNELİK TUTUMLARININ ÜZERİNE BİR ANALİZ

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Bu çalışmanın amacı, ilköğretim fen bilgisi ve orta öğrenim fen kolu öğretmen adaylarının öz yeterlilik inançlarının, epistemoloji konusundaki inançlarının ve fen bilimlerine yönelik tutumları üzerine bir analiz yapmaktır. Bu çalışmaya katılan ilköğretim fen bilgisi ve orta öğrenim fen kolu öğretmen adayları Orta Doğu Teknik Üniversitesi'nden seçilmiştir.

Bu çalışma Orta Doğu Teknik Üniversitesi'ndeki üçüncü sınıf ilköğretim fen bilgisi ve orta öğrenim fen kol öğretmen adayları ile icra edildi. Çalışmada kullanılan araçlar; bunlar öz yeterlilik inançları, epistemoloji konusundaki inançları ve bilime karşı olan tutumu belirleyen anketleridir. Bu anketler önceden kullanılmıştır ve geçerlidir. Üç anketin de oluşturulmasında önceki çalışmalardan faydalanılmıştır.

Verilerin analizleri ANOVA ve basit ikili ilişki analizi kullanılarak yapılmıştır. Analizler göstermiştir ki, ilköğretim ve orta öğretim fen bilgisi öğretmen adayları orta dereceli öz yeterlilik, epistemoloji inancı üzerinde pozitif görüşler görülmüştür. İlköğretim ve orta öğretim fen bilgisi öğretmen adayları etkili eğitimin kendi eğitim yeteneklerini ve öğrencilerin öğrenmelerini etkilediğine inanıyorlar. Ayrıca, öğretmen adaylarında fen eğitimine karşı da pozitif bir yönelim görülmüştür.

Ayrıca analizler göstermiştir ki, orta öğrenim fen bilgisi öğretmenleri arasında öz yeterlilik ile bilime karşı yönelim açısından bir ilişki vardır. Diğer bir ilişki ise epistemoloji inancı ve bilime karşı yönelim arasında ilköğretim fen bilgisi öğretmenleri arasında görülmüştür.

Anahtar Kelimeler: Öğretmen Adayı, Öz Yeterlilik İnancı, Öz Tutum, Epistemoloji, İlköğretim Fen Öğretmen Adayı, Orta Öğrenim Fen Branş Öğretmen Adayı ve Bilimsel Epistemolojik Görüş.

To my family

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LIST OF SYMBOLS

PSTE	: Personal Science Teaching Efficacy Beliefs
STOE	: Science Teaching Outcome Expectancy Beliefs
SEV	: Scientific Epistemological View
SEB	: Science Epistemology Belief
STAS	: Science Teaching Attitudes Scale
rSTAS	: revised Science Teaching Attitudes Scale
STEBI	: Science Teaching Efficacy Beliefs Instrument
LOC	: Locus of Control
CHED	: Chemistry Education Department
PHED	: Physics Education Department
ESE	: Elementary Science Education
CGPA	: Cumulative Grade Point Average

CHAPTER I

INTRODUCTION

Studies about the process of becoming a teacher have increased in recent years with an educational interest (Pintrich, 1990). According to the studies about preservice teachers, some researchers have been suggested that elementary teachers' graduate with generally low level of competency in terms of concepts, facts, and skills they acquired (Blosser & Howe, 1969; Victor, 1961). According to these researchers, the elementary teachers' in deficiency over science topics, and their lack of options to take effective science instructions lead to low level of background about science. Mechling et al. (1982) stated that, "Inadequate teacher preparation has often been blamed for the sorry state of science at the elementary level. Science for preservice elementary teachers needs to be improved" (p: 9). In the same way, Tekkaya, Çakıroğlu and Özkan (2004) in their research found that most of preservice science teachers in Turkey did not get an enough understanding of basic science concepts. Moreover, their results showed that many participants of the study have misconceptions about fundamental science concepts.

Current studies and reforms on education show the importance of teacher education and have focused on the need for improvement of preservice teacher training (APA, 1993; Blosser, 1989; Sivertsen, 1993, Wingfield & Ramsey, 1999). In addition, while improving the preservice trainings in universities, we should consider some parameters, such as; efficacy beliefs (Armor, Conroy, Cox, King McDonnell, Pascal, Pauly, Zellman, 1976), epistemological beliefs (Kardash, 2002; Wood & Kardash, 2002; Pomeroy, 1993), and attitudes towards science (Tabachnick & Zeichner, 1984).

These parameters have effect on teachers' behavior and success in classroom. One of the important parameter is shown in many studies as teacher efficacy which is related to student achievement (Armor et.al, 1976), student motivation (Midgley, Feldlaufer & Eccles, 1989), teachers' adoption of innovation (Berman, Mc Laughlin, Bass, Pauly & Zellman, 1977; Guskey, 1988; Smylie, 1988), superintendents' ratings of teacher competence (Trentham, Silvern & Brogdon, 1985) and teachers' classroom management strategies (Ashton & Webb, 1986). Educators dealt with teacher efficacy and provided quite a number of definitions of teacher efficacy over the 25 years of the development of the construct (Wilson & Tan, 2004). For example, Berman (et al) (1977) defined the term as "the extent to which the teacher believes he or she has the capacity to affect student performance". Guskey & Passaro (1994) provided another definition as "teachers' belief or conviction that they can influence how well students learn, even those who may be difficult or unmotivated" or teachers' comprehension over efficacy as "their beliefs in their ability to have a positive effect on student learning". As a component of powerful professional knowledge, self efficacy is a concept to categorize with and is part of a larger theory to think with. Self efficacy is "a context specific assessment of competence to perform a specific task" (Pajares, 1997, p.15). Self efficacy beliefs are about the future, about what a person will be able to do in a particular situation, not what a teacher already accomplished, or why he/she accomplished it in the past.

Preservice teacher and their efficacy beliefs over science education make a shape on their professional life. Ritter (1999) claimed that the greater the personal self efficacy the greater the performance accomplished. The greater the self efficacy the more likely the participant is to persist in their effort until they succeed.

In research, it was shown that another parameter is epistemological beliefs related to science teaching. Certainly sophisticated epistemological beliefs, such as the view of knowledge as a process of construction, are not essential for survival. However, many argue that those beliefs should be considered as important for society, because the amount of sophistication of our epistemological beliefs is responsible for how we process information and what value we place on that knowledge (Hofer, 2002). Moreover studies indicated that Investigating students' scientific epistemologies has had a long tradition in science education research (e.g., Carey & Smith, 1993; Driver, Leach, Millar, & Scott, 1996; Lederman, 1992; Anderson & Rubba, 1978; Ryan & Aikenhead, 1992; Solomon, Scott, & Duveen, 1996), and epistemological beliefs become an increasingly important dimension of educational research. Students’ science epistemology views have been related to the extent, richness, and precision of their cognitive structure outcomes of science learning (Tsai, 1998b) and to level of performance on learning tasks requiring abstract problem solving (Novak, 1988).

Another parameter that has influence on science and science teaching is attitude beliefs of preservice teachers towards science teaching. There are some definitions about attitude, and one is mentioned by Fishbein and Ajzen (1975); “a learned disposition to respond in a consistently favorable or unfavorable manner with respect to a given object” (Young, 1998, p: 97). The other definition is stated by Oppenheim (1992); “an attitude is a state of readiness, a tendency to respond in a certain manner when confronted with certain stimuli” (Young, 1998, p: 97). Researches indicated that attitudes have effect on behavior and that positive attitudes among preservice teachers can lead to good learning and as following to good teaching in their teaching life. Although there have been wide range of definitions, there is a consensus among researchers that an attitude is the tendency to think, feel, or act positively or negatively toward objects in our environment (Eagly & Chaiken, 1993; Petty, 1995). And when look at studies about elementary school teachers, the teachers think their ability to teach science is low, and this leads to a dislike for science teaching, that is attitude towards science teaching (Koballa and Crawley, 1985).

Several studies showed that teachers’ attitude and interaction with other parameters that have effects on epistemology, efficacy….etc. are critical elements in the success of scientific literacy for all students. Elementary teachers have been known to have negative attitudes toward science

(Shrigley, 1974), do not care for science (Tilgner, 1990), and do not have confidence in their ability to teach science (DeTure, Gregory, & Ramsey, 1990; Sunal, 1980 as cited in Park, 1996). This in turn causes elementary teachers to avoid teaching science to children (Czerniak & Chiarelott, 1990; Westerback, 1982, 1984) or spend less time teaching science as compared to other subjects (Good & Tom, 1985; Weiss, 1987; Westerback, 1984). Czerniak & Chiarelott (1990) found that the negative attitudes of teachers can be correlated to students' negative attitudes about science.

Purpose of the Study

Purpose of the study was to analyze preservice elementary and secondary science teachers with respect to their self efficacy beliefs, epistemological beliefs, and attitudes towards science teaching. Specific questions generated for this study are, as following;

1. What are the preservice science teachers' (elementary and secondary grade) self efficacy beliefs regarding science teaching?

2. What are preservice science teachers' (elementary and secondary grade) epistemological beliefs regarding to science teaching?

3. What are preservice science teachers' (elementary and secondary grade) attitudes toward science teaching?

4. What are the relationships among preservice elementary and secondary science teachers' efficacy beliefs, epistemological beliefs and attitudes towards science teaching?

Definitions of Important Terms

Preservice Science Teacher

Candidates of science teacher profession who students in education faculties in universities.

Elementary preservice science teacher

Prospective teachers in elementary science education department in education faculties are called as preservice elementary science teacher in this study

Secondary preservice science teacher

Prospective teachers in secondary science education department in education faculties are called as preservice secondary science teacher in this study

Personal Science Teaching Efficacy Beliefs (PSTE): A teacher's belief in his/her ability to perform science teaching.

Science Teaching Outcome Expectancy Beliefs (STOE): A teacher's beliefs in students' ability to learn.

Scientific Epistemological View (SEV)

In the study, scientific epistemological view is described as preservice teachers' epistemological beliefs towards science, and Tsai and Liu (2005), examined that five dimensions of scientific epistemological view which are; the role of social negotiation on science, the invented and creative reality of science, the theory-laden exploration of science, the cultural impacts on science, and the changing features of science.

Significance of the Study

Sarıkaya (2004) stated in her study, "teaching characteristics developed during preservice programs, will effect a permanent change in teachers' attitudes" (p.5). Similarly, according to Manning et al. (1982) there are very clear relationships between teachers' preparation, their practice and attitude toward science. Beyond these relationships, there is another relationship between teacher self-efficacy beliefs and numerous aspects of behavior, teaching techniques, effort and discipline strategies (Sarıkaya, 2004). From these studies, it is understood that preservice program is the place for developing teaching characteristics, efficacy beliefs and attitudes toward science. Therefore, teacher educators have been examined the change in preservice teachers' self-efficacy, epistemological beliefs, and attitudes toward science.

Fewer studies about self efficacy and epistemological beliefs exist in Turkey. Therefore, early detection of if any relationship exists between science knowledge, teachers' self efficacy, and epistemological beliefs might be valuable in providing specific activities for preservice teachers when planning and implementing science courses. According to Ministry of National Education (1998), the duration of compulsory basic education was extended from five to eight years and put into practice at the beginning of the 1997-1998 school year, throughout the country with a view to ensure organic unity and continuity in the educational program (Tekkaya, Cakıroglu, Ozkan, 2004). And education of the teachers is the most important step in improvement on education system in Turkey and all over the world. As a common expression, education faculties are the home of education, and preservice teachers are children of these homes. Preservice teachers preparing to their possible education life, moreover as Atatürk said future of country is vestige of today's teachers.

To sum up, in the study, I would mention that what science teacher educations is, and would analyze preservice elementary and secondary science teachers in three important parameters, these are efficacy beliefs, epistemological beliefs, and finally attitudes towards science education. There would be some differences between two education departments and results gave us how we make science education more effective, and good for preservice science teachers.

CHAPTER II

REVIEW OF THE LITERATURE

In this chapter, conceptual definitions, teachers' efficacy beliefs, epistemological beliefs and attitudes towards science are covered. In the following, there are reviews of literature, subtitled as preservice science teachers' efficacy beliefs, epistemological beliefs, and attitudes towards science teaching with their analysis and evaluation.

Self Efficacy Beliefs

a. Definitions of Efficacy Beliefs

In website-dictionary Wikipedia, "Self-efficacy is an impression that one is capable of performing in a certain manner or attaining certain goals. It is a belief that one has the capabilities to execute the courses of actions required to manage prospective situations. Unlike efficacy, which is the power to produce an effect (in essence, competence), self-efficacy is the belief (whether or not accurate) that one has the power to produce that effect."

The role of efficacy beliefs in teaching and learning is taken attention by the researchers and educators. Teachers' efficacy beliefs and their abilities on teaching were searched almost 30 years ago in the study. That study was performed as effects of teachers' characteristics on students' achievement by RAND Corporation (Armor, Conroy, Cox, King McDonnell, Pascal, Pauly & Zellman, 1976).

The other definition was given by Tschannen-Moran, Woolfolk Hoy, and Hoy (1998). Accordingly, teacher efficacy is the teachers' self belief on their own capability to organize and execute courses (that are lectures) of action required to successfully accomplishing their goals on the specific teaching duty in a particular substance. There is a model that includes sources of efficacy, cognitive processing, judgments of personal competence, and an analysis of the teaching events. Self perception of teaching competence and beliefs about the task requirements in a particular teaching situation contribute to efficacy judgments and to the consequences that follow including effort, persistence, and the setting of challenging goals. These consequences create new mastery experiences, which then become the basis for future efficacy judgments.

When looked at the theoretical background of self efficacy and teaching, it can be easily recognized that Bandura was the first to deal with this issue more than 30 years ago. Bandura has developed social learning theory and self efficacy beliefs on psychological construct originated from this theory. According to Bandura, self efficacy is "judgments of how well are can execute courses of action required to deal with prospective situations" (1982, p.122). In other words, although effective functioning will require skills and self-efficacy, level of skill is less important than what one believes about their achievement under the circumstances. Bandura mentions about the behavior which is based on two factors; outcome expectancy and self efficacy. Firstly, outcome expectancy is defined as a generalized expectancy about action outcome possibilities based on life experiences. Secondly, self efficacy is defined as people's developing specific beliefs about their own ability. Hence, those with strong efficacy beliefs are approaching difficult tasks as challenges to be overcome by setting goals and persisting with efforts to achieve them.

Furthermore, Bandura's self-efficacy theory is based on a relationship existing between personal self-efficacy and behaviors of the participants in his study. Bandura mentions that "self efficacy beliefs influence the course of action people choose to pursue, how much effort they put forth in given endeavors, how long they would persevere in the face of obstacles and failures, their resilience to adversity, whether their thought patterns are self hindering or self aiding, how much stress and depression they experience in coping with taxing environmental demands, and the level of accomplishment they realize" (1995, p3).

b. Studies about Self Efficacy

The examination of self efficacy and outcome expectancy in relation to teaching has been the focus of study by several researchers (e.g., Gibson & Dembo, 1984; Ashton & Webb, 1986; Guskey, 1988; Enochs & Riggs, 1990; Woolfolk & Hoy, 1990). According to Tschannen-Moran et al. (1998), two strands of research can be identified. The first is grounded in Rotter's social learning theory of internal versus external control (Rotter, 1966). In other words, teachers who believe that they are efficient to teach difficult or unmotivated students were considered to have internal control. On the other hand, teachers who believe that the environment has more effect on student learning than their own teaching abilities were considered to have external control. In the past two decades, researchers have found links between student achievement and three kinds of efficacy; the self-efficacy of students, the sense of efficacy of teachers, and the collective efficacy of schools (Goddard, Hoy & Woolfolk Hoy, 2000; Pajares, 1997; Ross, 1992a, 1994, 1998; Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Teachers' sense of efficacy is the focus of this investigation (cited in Sarıkaya, 2004).

Bandura mentioned in his study, "Beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" is known as perceived self-efficacy (1997, p. 3). Although, effective functioning will have need of skills and self-efficacy, its level of skill is less important than what one believes he or she can accomplish under the conditions. Moreover perceived self efficacy depends on context and will change as the context in which a task is to be performed changes (Bandura, 1997).

Self efficacy is an important construct in teaching and its importance has been proved by researchers. To illustrate, students learn more from teachers with high self efficacy than from those whose self efficacy is low (Ashton & Webb, 1986). Actually, teachers' beliefs in their instructional efficacy are a very strong interpreter of academic achievement in young children (Michayluk, Randhawa & Saklofske, 1988). Teachers who believe in their instructional efficacy demonstrate such positive teacher behaviors as being convince, rather than authoritarian, and supporting students to become self-directed learners who follow their own academic interests (Bandura, 1997). On the contrary, teachers with low self efficacy have more undesirable characteristics, such as a weak commitment to the profession (Evans & Tribble, 1986), custodial behavior in the classroom (Hoy & Woolfolk, 1990), and a tendency to spend less total time on academic matters than other teachers do (Dembo & Gibson, 1984).

According to Bandura (1997), sense of efficacy about teachers is not necessarily uniform across different subjects, and teachers have been shown to spend less time on subject areas where their supposed self efficacy is low, like science (Enochs & Riggs, 1990; Riggs, 1991). It was mentioned in the study, teachers allocate little time for science is a particular concern, and this can lead to the increasing importance of scientific literacy and capability in the technological changes occurring in society (Bandura, 1997). According to Czerniak and Schriver's study (1994), it was mentioned that when the high self efficacy is seen in teachers, it is linked to other positive teacher behaviors in elementary science, for example, be wanting children to be independent learners, and be selecting teaching strategies accordingly. On the other hand, teachers with low efficacy in the same study were concerned about children's behavior, blamed others for failures, and then chose topics and strategies for their entertainment value.

Teachers' efficacy beliefs change with preservice science courses as with changing beliefs and attitudes generally. In preservice science education, accessing to high quality subjects for example; such experiences as microteaching, cooperative learning, good role models, supportive learning environment, experiential learning. When teaching children is not involved, computer using is effective in positively changing self-efficacy (Ramey-Gassert & Shroyer, 1992; Scharmann & Hampton, 1995; Watters & Ginns, 1995; Huinker & Madison, 1997). On the contrary, such factors for example; gender bias, lack of practical work, and emphasis on examinations can prevent those changes from occurring changes in efficacy beliefs (Ginns &, Watters 1995).

Another change on efficacy beliefs comes with actual experience of teaching science to students, and it is also very important in bringing about appropriate change. For building self efficacy, experience of success in science teaching is particularly important in development (Ginns & Watters, 1995). Extend practicum placements in elementary science teaching have been shown to be beneficial (Cannon, 1999), as have taking science methods subjects before teaching science in field placement (Crowther & Cannon, 1998), positioning field experience early in a teacher education program, and having preservice teachers plan and teach science lessons cooperatively (Cannon & Scharmann, 1996) and combining field experience with peer teaching and self evaluation of microteaching (Enochs & Riggs, 1990).

c. Source of Information for Self Efficacy Beliefs

Bandura (1997) suggested that there are four sources of efficacy expectations: mastery experiences, physiological and emotional states, vicarious experiences, and social persuasion. Over these expectations, the mastery experiences are the most powerful source of efficacy information. The perception that a performance has been successful raises efficacy beliefs, contributing to the expectation that performance will be proficient in the future. Moreover, one’s performance has been a failure lowers efficacy beliefs, contributing to the expectation that future performance will also be inept (Tschannen-Moran, Hoy & Hoy, 1998). In addition to mastery experiences and vicarious experiences which involve the modeling of desired performance influence efficacy beliefs. Self-efficacy is usually increased if one compares well and decreased if one compares less favorable with people in similar situations.

The fundamental precepts of self-efficacy beliefs are based on the social learning theory and are the product of a complex process of self-persuasion that is dependent on cognitive processing of different sources of efficacy information. These beliefs include performance achievements, explicit experience, verbal persuasion and emotional and physiological excitement. Performance achievements or mastery experiences are regarded as the most important sources of information for affecting self efficacy beliefs because they are based on authentic experience in which the participant performance in the action (Adams, Bandura, & Beyer, 1977, Bandura, 1981). Achievement in mastery experiences is dependent on the participants preconceptions of their abilities, the degree of difficulty of the activity, the effort that they used up, their physical and emotional circumstances, and the degree of external support they receive (Bandura, 1995). How much teachers have greater the personal self-efficacy, that efficacy beliefs give greater performance achievements. In addition, how teacher have greater the self efficacy then the more likely the participant is to persist in their effort until they succeed. Therefore, teachers having greater self efficacy belief, and it leads to having greater the influence on the behavior. If the achievement in mastery experiences give an increasing in efficacy assessments while repeated failures will have lower self-efficacy beliefs. This is especially true if the failures come before success and does not reflect a short of effort on the part of the participant. Explicit experiences are actions that participants' watch others performance by having the desired behavior modeled in a successful manner the participants will be able to repeat the action and also be successful.

According to Brown and Inouye study (1978) the affects on explicit experiences and they found that “observers who believed themselves to be superior to a failing model maintained high efficacy expectations and did not at all slacken their efforts despite repeated failure. In contrast, modeled failure had a devastating effect on observers’ self-judged efficacy when they perceived themselves of comparable ability to the model” (Bandura, 1997 p. 207). As an example, when a prospective teacher recognizes with another prospective teacher in ability and who represents a performance and fails, it has a highly influence on their own self-efficacy beliefs. Similarly, when a prospective teacher identifies in ability with another prospective teacher who represents a performance and is successful this action have positively affect on their self-efficacy beliefs. Therefore, the person, who represents the performance the more influential the successes and failures, has identification in ability with. Participants convince themselves, that if others can do it, they should be able to achieve at least some improvement in performance.

Other source of information for self-efficacy beliefs is verbal persuasion. In this methodology, the participants are verbally told that they possess the capabilities to successfully perform the action. According to Chambliss and Murray (1979a, 1979b), “although social (verbal) persuasion alone may be limited in its power to create enduring increases in self efficacy, it can contribute to successful performance if the heightened appraisal is within realistic bounds”. And the persuasive efficacy influences, thus, have their greatest impact on people who have some reason to believe that they can produce effects though their actions (Bandura, 1982, p. 127). The verbal persuasion is widely used; and the reason is its expediency and accessibility. The success of verbal persuasion is also dependent on the reliability of those who are giving the verbal persuasion. If the participants see them as credible, when problems arise, they are more likely to exert greater effort and maintain it longer than those who place self-doubts and stay on their deficiencies (Litt, 1988 Schunk, 1989, Bandura, 1995).

Another source of information for self-efficacy beliefs is physiological and emotional states. This source of self-knowledge enlightens people about their state of concerned the amount of stress or vulnerability regarding their capabilities for a certain action to be achieved successfully. Individuals with a high sense of self-efficacy can find a heightened sense of stimulation like motivating, while those with a lower sense of self-efficacy may experience fear or anxiety that avoids them from attempting the performance. Up to now, talked about four sources of information for self-efficacy beliefs described above are environmental events, on the other hand, it is the cognitive realization of these events that must be internalized, processed and transformed to create a persons sense of self efficacy. The processes that standardize the formation of persons beliefs are: cognitive, motivational, affective and selection process (Bandura, 1977, 1982, 1986, 1995, 1997). These processes work in association together in the development of the persons self efficacy beliefs.

Epistemological Beliefs

In this section, the term epistemology, importance on education, ways to assess the epistemological beliefs were covered.

a. Definition of Epistemology

There are several definitions of epistemology. For example the definition in website dictionary Wikipedia, "Epistemology or theory of knowledge is the branch of philosophy that studies the nature and scope of knowledge and belief. The term "epistemology" is based on the Greek words " *επιστήμη or episteme*" (knowledge or science) and " *λόγος or logos*" (account/explanation); it was introduced into English by the Scottish philosopher James Frederick Ferrier (1808-1864). Much of the discussion in this field has focused on analyzing the nature of knowledge and how it relates to similar notions such as truth, belief, and justification. It also deals with the means of production of knowledge, as well as skepticism about different knowledge claims. In other words, epistemology primarily addresses the following questions: "What is knowledge?", "How is knowledge acquired?", and "What do people know?" There are many different topics, stances, and arguments in the field of epistemology. Recent studies have dramatically challenged centuries-old assumptions, and the discipline therefore carries on being vibrant and dynamic. “.

The term of epistemology, that is nature and justification of human knowledge has long been of interest to philosophers, by the way, interest of psychologist is relatively new. Main study of Piaget (1950) was about individual development of conceptions of knowledge and knowing and has grown in recent years. Ideas related with individuals’ knowledge and knowing have been the target of research programs. And the names of these programs are such as; epistemological beliefs (Jehng, 1993; Kardash and Howell, 2000; Kardash and Scholes, 1996; Qian and Alvermann, 1995, 2000; Schommer, 1990,1998; Schommer, et.al. 1992), then reflective judgment (King and Kitchener, 1994; Kitchener, 1986; Kitchener and King, 1981; Kitchener, 1983), then ways of knowing (Belenky et. al., 1986; Clinchy, 1995), epistemological reflection (Baxter Magolda, 1992,1999; Baxter Magolda and Porterfield, 1985), and epistemological theories (Hofer and Pintrich, 1997), then epistemic beliefs (Bendixen, 1998), and epistemological resources (Hammer and Elby, 2002).

The researchers Kuhn (1991) and King, Kitchener (1994) showed us important thing in epistemology thinking is, having a relation not only to school learning, but also is a critical element of life long learning in and out of school. The studies about epistemological understanding give us information related with understand how individuals resolve competing knowledge claims, evaluate new information, and make fundamental decisions that have effect on lives. According to King (1992), when we have higher order thinking and the ability to make reasoned judgments, then we have long been the hallmarks of liberal education, and knowing more about the role of epistemological thinking as a part of intellectual development can help us chart a path toward these important educational goals. The researcher considered the increasing about attention in both theory building and empirical investigations in the realm of personal epistemology. However, this study has not reached that may deserve, and component of either educational psychology or cognitive development have been accepted, and is not part of a teacher preparation curriculum, despite of its importance. The reason comes from we are still struggling with some conceptual issues that need resolution and other reason we are not yet clear about the educational implications of this work (Hofer, 2001).

According to Hofer (2001), during students' educational experiences, students meet with new information and interpret them. Also, studied affective processes include a range of issues similar to educational psychologists. Students' basic beliefs about knowledge and knowing are the part of learning process, also effects of these beliefs over knowledge-acquisition and knowledge-construction process are interests of educational and instructional psychologists. There are two main epistemological approaches in education; these are personal epistemology and constructive epistemology.

b. Personal Epistemology and Related Studies

Personal epistemology is the ideas of individuals hold knowledge and knowing. Moreover, these two terms such as; knowledge, and knowing, was the aim of the research studies with different names, such as epistemological beliefs, reflective judgment, ways of knowing, and epistemological reflection. Another definition by Lundeberg & Scheurman (1997) that personal epistemology is beliefs about learning, dispositions toward thinking, and assumptions about knowledge itself.

We can easily recognize epistemological perspectives in numerous academic experiences but not only in encounters with new information, as suggested by research on the relation between one's epistemological beliefs and learning, and results of studies indicated that relations with learning style in various ways. In addition, having influence on reasoning and judgment throughout our lives, and have implications for teaching. Yet this work has remained outside the mainstream of educational psychology and cognitive development. In these studies for example, beliefs about the nature of knowledge may influence strategy use, cognitive processing, and conceptual change learning (Quian and Alvermann, 2000; Schommer, Crouse, Rhodes, 1992; Kardash and Howell, 2000) (cited in Hofer, 2001).

When we look at personal epistemology view again, there is any consensus in terminology, students' thinking and beliefs about knowledge and knowing have addresses the following elements such as; beliefs about the definition of knowledge, how knowledge is constructed, how knowledge is evaluated, where knowledge resides, and how knowing occurs. Even though the term "personal epistemology" has own limitations, place to individual conceptions of knowledge and knowing. When we look at the various approaches to the study of personal epistemology, it suggests that there are several central ways in which epistemological relations about individual thinking has conceptualized. One of the significant directions of work has been developmental for one's idea about knowledge and knowing. A second position is that personal epistemology is a system of more or less independent beliefs. Each bunches of research is reviewed in turn, followed by alternative views of how we might conceptualized this field, and how personal epistemology might be situated within larger psychological traditions. These conceptions of the model inform our thinking about what the educational implications might be.

In the personal-epistemology research, different results have gotten, and as indicated earlier, most studies of the personal epistemology, domain generality is started from the assumption. The researchers King and Kitchener (1994) developed their theory of reflective judgment based on interviews about discrepant knowledge claims in science, history, and world affairs. Although not primarily testing for domain differences, they did not find any. Schommer and Walker (1995) also did not find differences in epistemological beliefs when they asked students to consider knowledge in two fields (social sciences and mathematics). Those who have found domain-specific, discipline-related epistemic understandings have found them as students become more expert in academic domains in the undergraduate years (Hofer, 2000; Paulsen & Wells, 1998) and graduate education (King & Kitchener, 2002; Wineburg, 1991). These are also the levels of education that correspond with the higher levels of sophistication in personal epistemological understanding (King & Kitchener, 1994; Kuhn et al., 2000; Weinstock & Cronin, 2003). Particular significance of the current study, Hofer (2000) found some differences in first-year college students' understandings of psychology and science. Where knowledge was less certain, while science was considered a discipline with a stronger potential to reveal truths about the world, psychology was considered a softer domain.

c. Constructive epistemology and Related Studies

The possible relations between students' science epistemology belief (SEB) and their learning environment understandings could also be illustrated during exploring the constructivist epistemology. Constructivism is a relatively new model for education, philosophy and psychology. In addition, the constructivist epistemology could be applied to both the basic worth of contemporary philosophy of science and those of learning psychology. The epistemology gives a similarity as the developmental mechanism of scientific theories is similar to an individual's knowledge construction since one's childhood that known by public (Cleminson, 1990; Duschl, 1990; Nussbaum, 1983; Louden & Wandersee, 1992). This analogy does not state that the content of students' conceptual development summarizes with important point of those ideas presented in the history of science (though, in some cases, this really happens: see e.g. Eckstein and Kozhevnikov, 1997). Relatively, both scientists and learners' the conditions, the explanations and the processes of conceptual growth are quite similar. As like with what

Duschl (1990) has stated that in his study “learning as it occurs within individuals is guided by the same basic sets of principles that guide the growth of knowledge in science” (p. 12). The researcher Tsai (1998c) summarizes eight statements of the constructivist epistemology by showing many cases from the history of science and philosophy of science, and from educational studies concerning students’ science learning (cited in Tsai, 2000)

All the statements talked about before with full of theory and conceptual change qualities of scientific knowledge acquisition, and more illustrate how our knowledge in science should be viewed as a made up reality, which is also constructed through social negotiations and through contextual and cultural deep effects. The constructivist epistemology’s interaction between the philosophy of science and students’ science learning means that there may be a similar interaction between students’ philosophical views of science that is SEB and their learning assumptions or orientations. In this study, students’ scores gathered from a SEB survey represented students’ views of science. Students’ judgments of constructivist learning environments, which have evaluation on exploring students’ views about what ideal and actual instructional environments look like. In addition, they were used as an indicator to make known their learning assumptions or orientations. Presently, the science educators highly advocated practice of constructivism (Tobin and Tippins, 1993; Tsai, 1998c; Yager, 1995), and it is widely applied to various disciplines (Brooks and Brooks, 1993; Fosnot, 1996). For the most part of the studies, many science teachers showed importance of the conception of constructivist learning environments for students. According to Roth and Lucas (1997), students’ scientific epistemological beliefs have been recognized as an important part of science learning environments. When we look at the practice on constructivism in science education may not be successful without considering student SEB variations all times. During the analyzing of Taiwanese tenth-graders’ questionnaire responses in this study, and they examined the possible relationships between student SEB and perceptions of constructivist learning environments, with applications of the improvement of science teaching and learning.

Science education researchers have interest on personal epistemologies' brunch from their effects on students' learning of science. Students having higher level of epistemological knowledge have a tendency to learn more enthusiastically and need a better conceptual understanding (Linn and Songer, 1993; Schommer, Crouse, and Rhodes, 1992; May and Etkina, 2002; Hammer, 1994). Classroom involvements meant at giving address to students' epistemologies can guide to improved leaning (Carey and Smith, 1993; Linn and His, 2000; Smith, Maelin, Houghton and Hennessey, 2000). The researchers King and Kitchener (2004) view epistemologies as developmental stages (cited in Elby, Hammer, Louca and Kagey, 2004).

Students' epistemology has no unified term for education, and many researchers loosen different dimensions (Hofer and Pintirch, 1997), such as structure of knowledge, certainty of knowledge and source of knowledge. Views of Students assumed dimensions and each consists of semi-independent beliefs. As an example, a student could have interest on complicated views about the structure of physics knowledge, seeing it as a hierarchy of concepts rather than as a bunch of questions, while also having unique beliefs about the certainty of that knowledge, viewing new theories as fixed and absolute. Some researchers like Schommer (1990) has a view of epistemological beliefs as moderately global, while others have examined how epistemological beliefs differ by discipline, for example, in chemistry course versus psychology (Hofer, 2002a). Although all scientists agree on epistemological beliefs and students relations, epistemologies compose the most comparatively stable, strong cognitive structures equivalent to clearly understandable, declarative knowledge. “These beliefs are taken to be the units, that is, the cognitive “atoms” of epistemologies” (Elby, Hammer, Kagey, Louca, 2004) (p: 57).

In methodology, as like Schommer's surveys (1990), the researchers can investigate students' epistemological beliefs by using clinical interviews in less depth and more breadth, and also by clinical interviews, in less depth but more breadth. In the same time as, researchers can investigate a child with ice cream predilections by simply asking child favorite flavors rather than by observing the child's behavior in an ice cream parlor actually, you can investigate epistemological beliefs of student's simply by asking. In the cognitive units with beliefs, encouraging students' epistemological development is mainly a matter of changing their beliefs. As Hofer (2001) noted on this approach and with the reference of the researchers Posner, Strike, Hewson and Gertzog (1982), the first step was to destabilize naïve beliefs, equivalent to extracting and confronting misconceptions in science as a first step towards conceptual change.

Table 2.1: The constructivist epistemology: the interplay between the philosophy of science and students' learning psychology in science (adapted from Tsai, 2000)

	Construct Philosophy of Science	Students' Learning Psychology in Science
1	Observation are theory-laden	Students' existing conceptions play an important role for new knowledge acquisition
2	Theories will be retained even when encountering apparent anomalies	Students' alternative conceptions are resistant to change by conventional teaching strategies
3	Science grows through a series of revolutions	Students should experience a series of conceptual changes when learning science
4	The scientific theories between two (or more) paradigms are incommensurable	Students' ideas and those of teachers may be incommensurable; teacher should understand students' learning and thinking from their perspectives.
5	Science does not represent the reality while scientists are producers of the reality, not the reproducers of the reality; scientific knowledge comes from human imagination	Students are knowledge producers, not knowledge reproducers; learning is an active process of knowledge construction, not a passive process of knowledge reproduction; learning science requires students' creativity
6	Scientific knowledge comes from a series of criticism, validation consensus and social negotiation in the scientific community	Students learn effectively and meaningfully in a favorable environment where their ideas are explored, compared, criticized and reinforced through talking and listening to others
7	There is no certain "scientific method" and there is not only one way to interpret the same natural phenomena	Students learn by various methods; teachers should encourage students' multiple ways of researching, questioning and problem solving
8	Scientific knowledge is the product of a complex social, historical, cultural and psychological activity	Students' knowledge acquisition occurs in a complex social, historical, cultural and psychological context

d. The Relationship between Personal and Scientific Epistemology

According to Lederman (1992), most of the elementary school and high school students view scientific knowledge as corresponding objective facts about nature. The students suppose this knowledge to stay stable. In addition, some changes about scientific knowledge are assigned more to error than to the subjective nature of knowledge and the adoption of new theoretical frameworks. Therefore, generally, elementary school students do not comprehend science as provisionary or theory loaded (Carey et al., 1989; Carey & Smith, 1993; Lederman, 1992; Solomon et al., 1996). Even though, students in these age groups can have relationship between personal and scientific epistemologies keep advanced nature of science's views, including an understanding of its provisionary and theory loaded nature in the context of purposely reflective and often literal instruction (Khishfe Abd-El-Khalick, 2002; Smith et al., 2000).

When concerning the prevailing ideas of students, the nature of scientific knowledge is similar to the more primitive stages of epistemological development defined through the personal epistemology research. A number of different models of the development of epistemological understanding have been suggested, describing from six to nine stages (King & Kitchener, 1994; Leadbeater & Kuhn, 1989; Perry, 1970). The stages of epistemological understanding have been condensed into three levels (Hofer & Pintrich, 1997; Kuhn, Cheney, & Weinstock, 2000; Martin, Silva, Newman, & Thayer, 1994). Firstly, absolutist stage that the conception of knowledge and knowing as objective and absolute. Secondly, multiplist stage that regarding all knowledge as subjective and relative and, therefore, indeterminate because of multiple points of view. Finally evaluativist stage is the acceptance and integration of subjective and objective aspects of knowledge that would allow a degree of evaluation and judgment of knowledge claims.

According to Hofer and Pintrich's (1997) researches about the relationship between personal and scientific epistemologies is not enough. Furthermore, any related empirical studies have produced different and confusing results. Some research, both science-specific studies and personal epistemology studies, which suggesting unity or consistency and interacting over different ideas, which shows the way us to guess a positive correlation between personal and scientific epistemologies. On the other hand, another research suggests that individuals sustain differentiated and even conflicting ideas, which means that patterns in personal and scientific epistemology no need to be related.

In science education, two corresponding areas of research that discuss interactions between different aspects of knowledge are examining students' conceptual ecologies (e.g., Demastes et al., 1995; Strike & Posner, 1992). Moreover, those that examines students' world-views (e.g., Cobern, 1996, 1997; Cobern, Ellington, & Schores, 1990). These approaches in science education suggest that different aspects of knowledge interact and influence how we recognize, and construct new knowledge.

According to Cobern (1996, 1997) and Kearney (1975), the research with logico-structural approach that retains that, the basic organization of an individual's mind develops around a group of common culturally dependents. As an example; self, non-self, or causality establish a set of assumptions, which shapes ways of beliefs with he or she understands, cooperates with and responds to the world around them. For instance, worldview of people can set out them to view nature aesthetically, to view nature as pleasurable and comprehensive. In addition, Cobern (1996) mentioned that if a conflicting worldview presents scientific concepts, then the individual might find it difficult to differentiate and adopt these concepts. In other words, objective measurement represents a view of nature with an order and understandable, because worldviews be likely consistent and strive toward maximum logical and structural unity (Cobern, 1997; Kearney, 1975).

Students behave like keeping disconnected and even conflicting views of different topics, even though, various scientific topics shows students' conceptions is the rich body of research (diSessa, 1988; Linn, 1992; Mintzes, Trowbridge, & Arnaudin, 1991; Roth & Roychoudhury, 1994; Sandoval & Morrison, 2003; Vosniadou & Brewer, 1992). With respect to particular conceptions of natural phenomenon and knowledge in terms of students' ideas, make ideas fit to all perspective. As an example, the researchers Roth and Roychoudhury (1994) have a study on high school physics students, and concluded that epistemological beliefs of students is related with context of inquiry-based learning. A number of studies suggest that college students are more likely to view knowledge in the social sciences as subjective and in the sciences as objective (Thoermer and Sodian, 2002). For that reason, it is quite possible that students will keep different views about the nature of knowledge in general and the nature of scientific knowledge.

Since Perry's work, most of the researches have been directed, by the way, exactly few of them still are known about personal epistemologies and how they develop over time. By the way, researchers realize that something does happen within a university setting that has the possibility of developing the complexity of epistemological beliefs; it is not clear just what happens to produce this change. In addition, Moore (2002) suggested that the experience of college is responsible, because, students' experiences with a diversity of classes and curricula (cited in Hulling, 2005). From the time when the aim of a moderated arts education is to help students learn to think for themselves, maybe this is what is responsible for the development; however, this is still unclear. Current efforts to restructure teaching methods now favor a more constructivist teaching approach that is meant at helping students begin to understand the constructed nature of knowledge and knowing (NRC, 1996). Although definitely these reforms on education have not enjoyed a common acceptance and were not employed in the time Perry was doing his work. As a result, it should be clear that, while epistemological development has captured the attention and efforts of educational psychologists for a number of years, much remains to be known.

Attitude Beliefs toward Science

Attitudes and beliefs cannot be directly observed, and this becomes problematic in terms of this study because they must be ascertained by what the teacher in this particular study says and does. Clark and Peterson (1986) define the perspectives of teachers as, "a combination of beliefs, intentions, interpretations, and behavior that interact continually" (p. 287). Attitudes and beliefs are not standing because there is a constant interplay between reflection and interpretation as new experiences are added to the teacher's life. Then, there is also the question of the meaning and intentions teachers assign to their actions determining how they enact their own classroom practice. This behavior is based not only on their philosophy of teaching, but in this case their thinking in relation to the expectations set by their particular contextual reality. Their attitudes and beliefs define their role in the classroom and even their expectations of student learning that may or may not be gender related. According to Tabachnick and Zeichner (1984), a teacher's attitudes and beliefs are an essential foundation for what happens in the classroom. The implication is that what a teacher believes and the manner in which she carries out her practice are dependent on more than just her attitudes and beliefs but also on the contextual reality of the environment in which she carries out her practice. It is important to understand how the teacher perceives that contextual reality and how much of this perception guides her practice.

The latest studies about attitudes towards science, science teaching and learning, has directed the interest to this area. There is an important point about this manner, this is attitude toward science should not be confused with scientific attitude, which may be appropriately labeled as scientific attributes, as an example, postponed judgment and critical thinking. The expressions like “I like science”, “I hate science” and “Science is horrible!” are regarded as to be statements of attitudes toward science, the reason is they represent a general positive or negative feeling toward the formal study of science or science as an area of research (Koballa & Crawley, 1985).According to our comprehension the world, our acceptations of the world around us change with. It is based on our beliefs, and these beliefs are defined by our experiences. Researches about the attitudes have focused on attitudes in relation to science significantly, but it still remains broad. Most researchers agree that the key aspect of attitudes is the evaluative property toward a specific object (Weinburgh & Engelhard, 1994) and they define attitude as a mental concept that depicts favorable or unfavorable feelings toward an object (Koballa, 1988; Olarewaju, 1988; Shrigley, Koballa, & Simpson, 1988; Simpson, Koballa, Oliver, & Crawley, 1994; Weinburgh & Engelhard, 1994). And there are four major attitude attributes are important in this area of research. The researchers Koballa (1988) identified and studied three of them, and Koballa suggested at the end of the studies that the purposes for examining attitude research in each study should be evaluated by using the following three attributes: firstly, attitudes are tenacious over time (Hill, Atwater, & Wiggins, 1995; Koballa, 1988), then attitudes are learned (Koballa, 1988), and finally attitudes and behavior are correlates (Koballa, 1988; Shrigley, 1990, 1983). And finally, fourth attribute is attitude is a function of personal beliefs (Ajzen, 1988; Fishbein & Ajzen, 1975; Zint, 2002). Fishbein and Ajzen (1975) argued that an individual's attitude toward any object is a function of the individual's beliefs about the object as well as the implicit evaluative responses associated with those beliefs. According to them, attitudes are affected by beliefs, and then these attitudes affect our aim and behaviors. (cited in Sarıkaya, 2004) And the researcher Ajzen, (1988) examined that intentions are determined by attitude toward the behavior, subjective norms, and perceived behavioral control. Changes on attitude studies have become an important concept for a number of reasons. One of the reasons for attitudes toward science is taught to accomplish basic psychological needs, like as knowledge and succession information. Another reason for attitudes toward science is taught to have an effect on future behaviors, like as interest in working on a science project and scientific activities. Additionally, Turkish students' attitudes toward science courses significantly decreased from Grade 5 through Grade 11, because the results of nationwide assessments of attitude toward science indicate. (Baykul, 1990)

a. Attitudes Research Studies

Students' attitude toward science is affected by teachers' attitude toward science; according to Shrigley (1972) it is related with the condition of the attitude of preservice elementary teachers toward science. In Shrigley's study some variables were tested such as; first one is the effect of gender as sex difference, then looked at the effect of male elementary teachers, another variable is the effect of organized and incidental elementary science programs, and finally the effect the number of high school science courses had on the science attitude of preservice teachers is examined as a variables. Then getting results and they indicated that: firstly, there is no sex difference in science attitude of preservice teachers, secondly, sex difference would not have a more positive effect on the science attitude of their students, and finally, an organized elementary science program affects the science attitude of preservice teachers positively (Sarıkaya, 2004). Correspondingly, the researchers Türkmen and Bonnstetter (1999) have a study about Turkish preservice science teachers and their attitudes toward science and science teaching. And they used Turkish version of Science Teaching Attitudes Scale (STAS II) to measure their attitudes, the scale was developed by Moore and Foy (1997). According to results of this study, preservice Turkish science teachers have positive attitudes toward science and science teaching was indicated. Researchers Fishbein and Ajzen (1975) were indicated that the relationship between beliefs, attitudes and behaviors that is intended or actual. Any change on attitudes also is required to manage belief change and behavior change. As an example, if someone's attitude toward science changes, the change in beliefs on science and science related behavior as same as his/her change on attitudes belief about science.

According to many teachers in education system that insufficient background in science and methods for teaching is the crucial reason for their prevention from performing science teaching. By the way, when the teachers have strong self efficacy beliefs to teach science as a their ability, they should find the subject less worrying and will apply more effort in teaching it effectively in classroom, may be it is simple ,and the reason is teachers feel strongly that they can be successfully in subjects. Another suggestion shows that low personal self efficacy may underlie science anxiety, poor attitudes toward science and consequentially unwillingness to spend sufficient time and resources teaching science.

With the help of this information, Gassert, Shroyen and Staver (1996) suggests and given attention to the factors which have effect on personal science teaching efficacy and science teaching outcome expectancy in elementary teachers. Their study was done over elementary teachers who in a project to enhance science, mathematics, and technology education. And in the light of data, variables identified as related to science teaching self efficacy were collected and composed from three self-reporting instruments, as an example, the Science Teaching Efficacy Beliefs Instrument, in service version (STEBI-A) and interview questions. Gassert, Shroyen and Staver found that personal science teaching efficacy beliefs was positively correlated with the variables such as attitude toward science, educational degree level, choosing to teach science, and self-rated effectiveness in science teaching. Moreover, attitude toward science, choosing to teach science and self-rated effectiveness all reflect an interest in science and science teaching as well as an acquaintance or comfort with science. The relation between PSTE and educational degree level is linked with teachers' beliefs that continuing to learn science with the purpose of instruct children science effectively. STOE was positively and significantly correlated with number of college science courses that taken and choosing to teach science. The numbers of science course, which taken in college, may be related to STOE, that make teachers were comfortable and interested.

As an addition, the researchers Manning et al. (1982) suggested that "Highly significant relationships exist between teachers' preparation and their practice and attitude toward science" (p.41). This suggestion was based on responses of survey from elementary teachers, which showed that it took relatively few undergraduate science content courses. If teachers have low level of preparation, limited knowledge, negative beliefs towards personal science with regarding to teaching competency, and lack of assurance, the researcher Shymanski and Green (1982) concluded that elementary teachers are simply unwillingly to teach science for students. There is an explanation for this relationship between low science knowledge and an unwillingness to teach science was presented by Victor (1961), who found teachers' fear about losing of classroom status when providing science instruction in classroom. Haury (1984) indicated that in his thesis as; “Many elementary teachers may perceive themselves as having little personal instrumentality or control in a classroom situation involving science instruction” (p.6) which has agreement with Rotter’s study (1966) “locus of control” (LOC) construct. The real meaning of the LOC model is to show that the power of subjective belief can be held by an individual applies greater control on person’s behavior than the objective fact of control. As an addition, Haury (1984) suggested that an internal “locus of control” LOC concluded with positive attitudes toward teaching science. As a summary, based on adequate preparation, we can translate it into positive attitudes toward teaching science as in previous statements.

Another study was performed by Lucas and Pooley (1982) which also showed that completion of introductory science units like as astronomy and physical science by preservice teachers, it is resulted as “very significant improvement in student teachers’ attitudes toward science teaching” (p.809). as an addition to Lucas and Pooley study, Feistritzer and Boyer (1983) found that no relationships existed between the number of college level science courses completed and teachers’ subsequent attitude toward teaching science was somewhat surprising. Feistritzer and Boyer’s also indicated that an insignificant relationship between the number of college science courses taken and teachers’ assurance relating to teach science (1983).

When we look at another study, Wenner (1993) suggests that the relationship between preservice teachers’ attitudes towards science concerning their ability to affect science learning among elementary students and their level of science knowledge. And Wenner, in his study, administered an instrument, and it was composed of three parts: first one was survey information regarding high school and college science coursework, secondly general science knowledge as measured by the General Science Test, and lastly it was about beliefs about science instruction measured by a slightly modified version of the Science Teaching Efficacy Belief Instrument (Riggs & Enochs, 1990). Wenner (1995) suggests that in his study, a relatively low level of science knowledge among preservice elementary teachers give a negative relationship between science knowledge and attitude toward teaching science as like as findings of Victor (1961) and Blosser and Howe (1969). Furthermore, after some serial studies, Wenner (1995) found that there is no increase in science content knowledge but he identified positive changes in efficacy beliefs.

Stevens and Wenner (1996) were reported that measurement of both content knowledge and beliefs are important consideration in reformation programs designed to improve teacher capability in mathematics and science education. The researchers examined relationships that might exist between the beliefs held by prospective teachers regarding their ability to affect science and mathematics learning among elementary students and their personal level of science and mathematics knowledge. They developed a three part instrument for measuring of attitudes and students who enrolled a program like methods for teaching elementary science and mathematics served in their study. First part of the instrument's purpose is protecting information regarding general content knowledge in science and mathematics. The second part of instrument has a Likert type scale to measure students' personal beliefs regarding science and mathematics instruction. When we look at the last part, it composed of four questions regarding the number of science and mathematics courses taken in high school and college. Their study was resulted with the preservice teachers have weak knowledge base in science and mathematics; also they showed that negative relationship between beliefs and knowledge. They noticed that preservice elementary teachers need further background in mathematics and science to represent themselves in science and mathematics content when they enter a career in education.

In another study, Tekkaya, Çakıroğlu and Özkan (2002) examined that understanding of science concepts, attitude toward science teaching and their efficacy beliefs regarding science teaching over Turkish preservice science teachers. Instruments on the study were Science Concept Test, The Science Teaching Efficacy Belief Instrument, The Science Teaching Attitude Scale, Biology/Physics/Chemistry Attitude Scales, and open ended questions on 85 preservice science teachers. Results of the study showed that most of the participants had misconceptions about fundamental science concepts, and also results were showed that they generally had positive attitudes toward science teaching and three different science types like biology, physics, and chemistry. As an addition, slightly positive self-efficacy beliefs were found among the most of the participants regarding science teaching, although they have misconceptions.

b. Attitudes and Beliefs in Relation to Teaching and Learning

Attitudes and beliefs about teaching and learning, about science, about gender, and about teachers in relation to all pedagogical practice are not limited to classroom or professional practice but are also implicit in the manner in which these teachers view themselves personally and socially. They serve as the filter and foundation of their knowledge about teaching and learning as well as what it means to be a female and its implications in relation to science. Their attitudes and beliefs hold perceptions of their own fit as females in a patriarchal society and how gender enacts itself in said society whether they are conscious of the patriarchal structure or not.

Nespor (1987) attempted to unearth the source of teacher beliefs, and argues that these are the product of previous events and experiences. The images of past events and how they are perceived act as a filter for new information. Bryan (2003) focused on attitudes and beliefs of a prospective elementary teacher from a constructivist perspective, examining her belief system about science teaching and learning as she developed professional knowledge. Findings revealed contradictions between beliefs framed by experience and those acquired as new experiences are added to one’s schema of life. New experiences serve to have us re-examine the past. The findings accentuated the complexity of teachers' belief systems and underscoring the significance of identifying teachers' beliefs. I agree with this and in terms of female teachers consider that the experiences they bring with them and the constraints and limitations they have endured as part of a patriarchal structure certainly affect what Blake (2002) describes as *self-efficacy*. Self–efficacy based on Pajares' work (1992) refers to human agency and ones perceived capability of oneself. Pajares (1992) also writes about self-efficacy and his writings have also been influential to me in terms of theorizing how a sense of self-efficacy may clearly impact the behavior of females and, in particular, pedagogical practice. This notion of self-efficacy is a significant factor in terms of this study because female experiences differ from those of males, framing perceptions of who they are capable of becoming and what course of action is available to them as females. These perceptions are defined by a societal structure that sets as favorable and expected very gender-specific behaviors for females (Blake, 2002). Defined in relation to Bandura (1977, 1986), self-efficacy is "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of outcomes" (p. 26) (cited in Zapata, 2005)

CHAPTER III

METHODOLOGY

In this chapter, information including a brief description of research design and procedure, the statement of the research problem, research questions and related sub-problems and statistical hypotheses associated with sub-problems will be presented. Following these, a brief description of population and sample selection, data collection instruments, analysis of data, and assumptions and limitations are given.

Research Design and Procedure

This study was going to explore preservice science teachers at elementary science teaching and secondary science teaching with respect to preservice science teachers' efficacy beliefs, epistemological beliefs, and attitudes towards science teaching. The present study was conducted at the middle of the spring semester of 2006 - 2007 academic year. The subjects in the sample were third grade elementary science and secondary science teachers. In order to accomplish the purpose of the study, data were collected and analyzed by utilizing survey research techniques. The subjects answered the three questionnaires.

The Statement of the Research Problem of the Present Study

The main problem of this study was;

"What are beliefs that preservice elementary' and secondary science teachers hold about efficacy, epistemology, and attitudes that hold about science teaching?"

Research questions of this study were;

1. What are preservice elementary and secondary science teachers' efficacy beliefs regarding to science teaching?
2. What are preservice elementary and secondary science teachers' epistemological beliefs regarding to science teaching?
3. What are preservice elementary and secondary science teachers' attitudes towards science teaching?
4. Is there a relationship between preservice elementary science teachers' efficacy beliefs and epistemological beliefs?
5. Is there a relationship between preservice elementary science teachers' efficacy beliefs and attitudes towards science teaching?
6. Is there a relationship between preservice elementary science teachers' epistemological beliefs and attitudes towards science teaching?
7. Is there a relationship between preservice secondary science teachers' efficacy beliefs and epistemological beliefs?
8. Is there a relationship between preservice elementary science teachers' efficacy beliefs and attitudes towards science teaching?
9. Is there a relationship between preservice elementary science teachers' epistemological beliefs and attitudes towards science teaching?

Population and Sample Selection

In this study, the target population is the third grade preservice elementary and secondary science teachers enrolled in science education programs of Middle East Technical University (METU) in Ankara. The approximate total number of the third year preservice elementary and secondary science teachers at science education programs in METU is 124 students according to quota listed in METU web page. Table 3.1 describes distribution of the participants according to their departments.

For descriptive research, “the sample for a correlational study is selected using an acceptable sampling method, and 30 participants are generally considered to be a minimally acceptable sample size. There are, however some factors that influence the size of sample. The higher the validity and reliability of the variables to be correlated, the smaller the sample can be, but not less than 30” (Airasian & Gay, 2000, p: 322).

In the study convenience sampling was used. According to Airasian and Gay (2000), when nonrandom samples are used, it is not possible to specify what probability each member of a population has of being selected for the sample. In fact, it is usually difficult, if not impossible, to even describe the population from which a sample was drawn and to whom results can be generalized. Nonrandom sampling approaches include convenience sampling, which is the most used in educational research, and is therefore the major source of sampling bias in educational research studies. Convenience sampling, also referred to as accidental sampling and haphazard sampling, basically involves including in the sample whoever happens to be available at the time. (Ariasian, Gay, 2000)

Table 3.1: Distribution of Participants Preservice Teachers according to their departments.

Department	Number of Participant
CHED (Chemistry Education Department)	21
PHED (Physics Education Department)	15
ESE (Elementary Science Education Department)	32

Data Collection Instruments

In this study, data were collected through 3 instruments and these are;

1. The Science Teaching Efficacy Belief Instrument for preservice teachers (STEBI-B) developed by Enochs & Riggs (1990),

2. Epistemological Beliefs Survey developed by Kardash ; Wood & Kardash, (2002), and
3. Revised Science Attitude Scale for Preservice developed by Thompson & Shrigley, (1986).

a. The Science Teaching Efficacy Belief Instrument Form B (STEBI-B)

The Science Teaching Efficacy Belief Instrument Form B (STEBI-B) (Enochs & Riggs, 1990) was designed to measure self-efficacy beliefs of preservice elementary teachers regarding science teaching. The STEBI-B consists of 23 items in a five-point Likert type scale and response categories were accomplished by assigning a score of 5 to “strongly agree”, 4 to “agree”, 3 to “uncertain”, 2 to “disagree”, and 1 to “strongly disagree”. Negatively worded items must be reverse scored so that high scores on both subscales are indicative of positive efficacy beliefs towards science teaching. The STEBI-B is comprised of two sub-dimensions; the Personal Science Teaching Efficacy (PSTE) retained 13 items (Items 2, 3, 4, 6, 7, 12, 16-22) and the Science Teaching Outcome Expectancy (STOE) retained 10 items (Items 1, 5, 8, 9, 10, 11, 13, 14, 15, and 23). Appendix B displays the STEBI-B. Enochs and Riggs (1990) reported that the STEBI-B was a valid and reliable instrument with the alpha reliability coefficients of 0.90 and 0.76 for the PSTE, and STOE, respectively.

b. Epistemological Beliefs Survey

In order to test the students’ epistemological beliefs, I employed the Epistemological Beliefs Survey *(*Kardash, 2002; Wood and Kardash, 2002), which consists of 38 questions in a Likert type scale. The test was developed to measure 5 factors: Speed of Knowledge Acquisition, Structure of Knowledge, Knowledge Construction and Modification, Characteristics of Successful Students, and Attainability of Objective Truth. Epistemological Beliefs Survey gives researchers the ability to measure different epistemological beliefs as well as how they are related to such things as thinking, problem solving, and reasoning (Wood & Kardash, 2002). Even with the proven reliability of this measure, I used the information gained through this instrument to further probe students.

c. The revised Science Teaching Attitude Scale (rSTAS)

The Science Teaching Attitude Scale (Thompson & Shringley, 1986), an instrument designed this scale measure preservice elementary teacher' attitudes towards science teaching consist of 22 items in a five-point Likert scale format. Response categories were accomplished by assigning a score of 5 to "strongly agree", 4 to "agree", 3 to "uncertain", 2 to "disagree", and 1 to "strongly disagree". Out of 22 items, 13 were worded positively and 9 were worded negatively. The Science Teaching Attitude Scale has been stated to be a reliable, valid instrument useful in determining preservice science teachers' attitudes toward science teaching (Thompson & Shringley, 1986). Appendix D displays the revised Science Teaching Attitude Scale (rSTAS).

Data Analyses

In this study, data were analyzed utilizing descriptive and inferential statistics. With the purpose of answering the first, second and third research questions, descriptive, statistics were utilized. For the preservice students' scores (who are participants on this study) on the scales of the STEBI-B, Epistemology Belief Survey, and the revised Science Teaching Attitude Scale, individual item means and standard deviations on each subscale, as well as mean scores and, standard deviations for the subscales were calculated.

In the study when determining the fourth to ninth research question, Bivariate Correlation was performed to determine the relationships between efficacy beliefs and epistemological beliefs then efficacy beliefs and attitudes towards science teaching and finally epistemological beliefs and attitudes towards science teaching in preservice elementary and secondary science teachers. In addition, SPSS with version 15 was utilized the data of the study.

Assumptions and Limitations

In this section, assumptions and limitations of this study are presented.

a. The Assumptions of This Study

- The sample size represented the population.
- The instrument was administered under standard conditions.
- Data collectors were not biased during the application of the instrument.
- The participants completed the instrument accurately and truthfully.
- The participants from the same universities did not interact with each other to affect the results of the study.
- The implementation process of the study instrument was the same for all participants.

b. The Limitations of This Study

- Subjects of this study were limited to 68 third grade preservice elementary (32) and secondary science students (36) at Middle East Technical University in Ankara in Turkey during the 2006-2007 spring semesters. So, the results of this study can not be generalized to all preservice teachers. The results of the present study can be generalized to subjects having the same characteristics in the similar settings.

CHAPTER IV

RESULTS

Purpose of the study was to examine preservice science teachers at elementary science teaching and secondary science teaching with respect to preservice science teachers' efficacy beliefs, epistemological beliefs, and attitudes towards science teaching and in relation with each other. When the explaining the research questions, the results of the study are given in different subsections. The first subsection includes preservice teachers' efficacy beliefs regarding science teaching and giving discussion about the results. The second subsection includes preservice teachers' epistemological beliefs regarding science teaching and giving discussion about the results. The third subsection includes preservice elementary teachers' attitude toward science teaching and giving discussion about the results. Therefore, in this chapter, the findings are discussed under main headings.

a. Preservice Science Teacher's Efficacy Beliefs Regarding Science Teaching

In the study, the participants' scores on the STEBI-B were analyzed by utilizing descriptive statistics. There are some items, that were written negatively and they were shown with asterisks in Table 4.1 and Table 4.2. At the beginning of the statistical analysis, those questions were reversed at their scores to provide constant values between negatively and positively worded items. Because of two distinct dimensionality (i.e. positively and negatively scored questions), following analyses were conducted separately on each sub dimensions. Moreover, item scores of each sub dimensions were summed to create two separate scale scores for each participant. In the research, the higher mean scores on negatively written item show also positive teaching efficacy as an end result of their reversed scores. As a result, the efficacy scores for each subscale was computed by taking the mean of the responses to the items held on to each factor. Therefore Table 4.1 shows the means and standard deviations of participants' scores for each item on the PSTE subscale. As an addition, Table 4.2 represents the descriptive statistics for each item on the STOE subscale like Table 4.1. In the PSTE subscale the possible minimum score is 13 (least efficacious) and the maximum score is 65 (most efficacious) because it includes 13 items with a five category response scale (i.e. strongly agree to strongly disagree). For the STOE subscale the possible minimum score is 10 (least efficacious) and the maximum score is 50 (most efficacious) because it includes 10 items with a five category response scale.

The participants who preservice elementary and secondary science teachers indicated efficacy beliefs regarding the teaching of science on both dimensions. For the PSTE subscale, raw scores ranged from 17 to 65 with a mean score of 46.82 and a standard deviation of 10.96 for preservice secondary science teachers, also with a mean score of 35.36 and a standard deviation of 9.00 for preservice elementary science teachers, as like as, for the STOE subscale, raw scores range from 15 to 50 with a mean score of 35.34 and a standard deviation of 9.00 for preservice secondary science teachers, also with a mean score of 35.00 and a standard deviation of 8.71 for preservice elementary science teachers. Also, in the study, percentages for each item of responses were categorized into three groups: agreement, neutral, and disagreement, agreement points (strongly agree and agree) put the category agreement and disagreement points (strongly disagree and disagree) out the category disagreement. Moreover, PSTE and STOE results in tables display percentages of responses to each item that fell into three collapsed categories for Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (STOE) scale.

The preservice secondary science teachers had reasonable sense of self efficacy beliefs in teaching science (mean=46.82) that scores on the PSTE scale. Approximately 94.5% of the participants showed that they usually welcome students' science questions, and 88.8% of the participants showed that they can easily to answer students' science questions, and then 83.4% of the participants indicated that they understand well enough to teach elementary science, 80.5% of the participants claimed that they would continually find better ways to teach science. In addition, 61.1% of the participants claimed that they know the steps for teaching science effectively also 61.1% asserted that they would be able to explain to students why science experiments work. 58.4% indicated that they would be effective in monitoring science experiments, 55.5% thought that they knew how to help the student when a student had a difficulty to understand a science concept. 56.4% of the participants believed that with effort they would teach science as well as most subjects. However, 41.7% of the participants indicated that given a choice, they would invite the principal to evaluate their science teaching. In addition almost same percentage of participants (41.7%)

The preservice elementary teachers had reasonable sense of self efficacy beliefs in teaching science (mean=45.849) that scores on the PSTE scale. 87.5% of the participants claimed that they will find better methods to teach science continuously, and with the same percentage of participants asserted that receive students questions positively when teaching science. Moreover participants claimed that can be to answer students' science related questions (81.3%). Some of the participants (78.2%) thought that understand science concepts well enough to be effective in teaching elementary science, moreover, with same percentage of participants claimed that generally teach science effectively. 75.0% of the participants asserted that know how to turn students on to science. And participants claimed that very effective about monitoring science activities (71.9%). 65.6% of the participants claimed that they do not find explaining the reason of science experiments work. Participants thought that they can teach most subjects well (62.6%). Almost half of the participants (53.1%, 51.1%, and 50%) they welcome to principal for evaluating my science teaching, they know how to help students in science concepts when students have difficulties about understand the concepts, and finally participants claimed that know the necessary steps to teach science concepts efficiently.

Table 4.1 Scores on the PSTE Subscale of the Science Teaching Efficacy Beliefs Instrument for Preservice Secondary Science Teachers

Item no	Item description	Mean	SD	Agree	Neutral	Disagree
2	I will continually find better ways to teach science.	4.00	.717	80.5	16.7	2.8
3*	Even if I try very hard, I will not teach science as well as I will most subjects.	3.50	.941	13.9	30.6	55.5
5	I know the steps necessary to teach science concepts effectively.	3.61	.766	61.1	30.6	8.3
6*	I will not be very effective in monitoring science activities.	3.42	.874	16.7	25.0	58.4
8*	I will generally teach science ineffectively.	3.83	.941	5.6	19.4	75.0
12	I understand science concepts well enough to be effective in teaching elementary science.	3.94	.715	83.4	11.1	5.6
17*	I will find it difficult to explain to students why science experiments work.	3.50	.971	22.2	16.7	61.1
18	I will typically be able to answer students' science questions.	4.08	.554	88.8	11.1	
19*	I wonder if I will have the necessary skills to teacher science.	3.03	1.000	33.4	27.8	38.9
20*	Given a choice, I will not invite the principal to evaluate my science teaching.	3.02	1.027	41.7	22.2	36.1
21*	When a student has difficulty understanding a science concept, I will usually be at a loss as to how to help the student understand it better.	3.00	.926	41.7	16.7	41.7
22	When teaching science, I will usually welcome student questions.	4.22	.637	94.5	2.8	2.8
23*	I do not know what to do to turn students on to science.	3.67	.894	5.6	36.1	58.4
Total Scale (Min 13-Max 65)		46.8278	10.963			

Table 4.2 Scores on the PSTE Subscale of the Science Teaching Efficacy Beliefs Instrument for Preservice Elementary Science Teachers

Item no	**Item description**	**Mean**	**SD**	**Agree**	**Neutral**	**Disagree**
2	I will continually find better ways to teach science.	3.97	.595	87.5		12.5
3*	Even if I try very hard, I will not teach science as well as I will most subjects.	3.438	.981	21.9	15.6	62.6
5	I know the steps necessary to teach science concepts effectively.	3.34	.827	50.0	31.3	18.8
6*	I will not be very effective in monitoring science activities.	3.438	1.045	25.1	3.1	71.9
8*	I will generally teach science ineffectively.	3.75	1.047	18.7	3.1	78.2
12	I understand science concepts well enough to be effective in teaching elementary science.	3.94	.716	78.2		21.9
17*	I will find it difficult to explain to students why science experiments work.	3.625	.975	18.8	15.6	65.6
18	I will typically be able to answer students' science questions.	3.78	.751	81.3	12.5	6.2
19*	I wonder if I will have the necessary skills to teacher science.	3.00	.842	31.3	40.6	28.1
20*	Given a choice, I will not invite the principal to evaluate my science teaching.	2.688	.965	18.8	28.1	53.1
21*	When a student has difficulty understanding a science concept, I will usually be at a loss as to how to help the student understand it better.	3.161	1.128	34.4	12.5	51.1
22	When teaching science, I will usually welcome student questions.	4.00	.916	87.5	3.1	9.4
23*	I do not know what to do to turn students on to science.	3.719	.851	9.4	15.6	75.0
Total Scale (Min 10-Max 50)		45.849	11.641			

When we look at the scores on the STOE scale, preservice secondary science teachers (i.e. physics and chemistry preservice teachers) showed that they had reasonable sense of outcome expectancy beliefs in teaching science (mean= 35.36). About 84.4% of the participants claimed that extra attention improved low achievers, and 83.3% of the participants thought that they could increase students' achievement with effective teaching, 77.7% of the participants believed that the inadequacy of a student's science background could be overcome by good teaching. Also 72.3 % of the participants thought that when a student did better than usual in science, and it was often because the teacher exerted a little extra effort. About the same percentage of the participants (72.3%) believed that the teacher was generally responsible for the achievement of students in science. Moreover, 66.7% of the students' achievement in science was directly related to their teacher's effectiveness in science teaching, and more than half of the participants (58.3%) were in agreement that ineffective science teaching resulted in underachieving of students in science. Only half of the participants (50.0%) believed that their performance would enhance students' interest in science, as same percentage (50.0%) of participants asserted that increased effort in science teaching produced change in some students' science achievement. However, less than half of the participant claimed that low achievement of some students in science; it is not blamed of their teacher.

When we look at the scores on the STOE scale, preservice elementary science teachers showed that they had reasonable sense of outcome expectancy beliefs in teaching science (mean= 35.00). %75.0 of the participants asserted that lack of knowledge about students' science background can be overcome with the help of good teaching. Also participants claimed that with the teachers' extra attention, low-achieving students go in to progress in science (71.9%). With the percentage of 71.4, the participants believed that teachers are responsible from the students' achievement on science topics. 68.8% of the participants asserted that if parents stated that their children showing more interest over science, it comes from teachers' performance. Almost same percentage of participants

(65.6% and 65.7%), participants claimed that the reason of underachievement on science teaching on students is in effective science teaching, moreover, if a student does better than usual in science, the reason is teacher's extra efforts on student. Almost half of the participants (53.1%) asserted that increasing on effort of science teaching leads to little change in some students' science achievement. Half of the participants agreed and disagreed that achievement of students in science directly related to their teachers' efficiency in science classes.

Table 4.3: Scores on the STOE Subscale of the Science Teaching Efficacy Beliefs Instrument for Preservice Secondary Science Teachers

Item no	Item description	Mean	SD	Agree	Neutral	Disagree
1	When a student does better than usual in science, it is often because the teacher exerted a little extra effort	3.72	.974	72.3	13.9	13.9
4	When the science grades of students improve, it is often due to their teacher having found a more effective teaching approach.	4.03	.774	83.3	11.1	5.6
7	If students are underachieving in science, it is most likely due to ineffective science teaching.	3.42	1.052	58.3	16.7	25.0
9	The inadequacy of a student's science background can be overcome by good teaching	3.69	.889	77.7	8.3	13.9
10*	The low science achievement of some students cannot generally be blamed on their teachers	2.89	1.008	41.7	25.0	33.4
12	When a low-achieving child progresses in science, it is usually due to extra attention given by the teacher.	3.94	.715	84.4	11.1	5.6
13*	Increased effort in science teaching produces little change in some students' science achievement.	2.86	1.046	50.0	16.7	33.4
14	The teacher is generally responsible for the achievement of students in science.	3.75	.937	72.3	16.7	11.1
15	Students' achievement in Science is directly related to their teacher's effectiveness in science teaching.	3.67	.894	66.7	19.4	13.9
16	If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child's teacher.	3.39	.766	50.0	36.1	13.9
Total Scale (Min 10-Max 50)		35.36	9.005			

Table 4.4: Scores on the STOE Subscale of the Science Teaching Efficacy Beliefs Instrument for Preservice Elementary Science Teachers

Item no	Item description	Mean	SD	Agree	Neutral	Disagree
1	When a student does better than usual in science, it is often because the teacher exerted a little extra effort	3.56	.840	65.7	18.8	15.6
4	When the science grades of students improve, it is often due to their teacher having found a more effective teaching approach.	3.75	.568	68.8		31.3
7	If students are underachieving in science, it is most likely due to ineffective science teaching.	3.47	.950	65.6	18.8	15.6
9	The inadequacy of a student's science background can be overcome by good teaching	3.78	.832	75.0	18.8	6.3
10*	The low science achievement of some students cannot generally be blamed on their teachers	3.00	.950	34.4	31.3	34.4
12	When a low-achieving child progresses in science, it is usually due to extra attention given by the teacher.	3.94	.716	71.9		28.1
13*	Increased effort in science teaching produces little change in some students' science achievement.	2.75	1.107	53.1	12.5	34.4
14	The teacher is generally responsible for the achievement of students in science.	3.69	.821	71.4		28.1
15	Students' achievement in Science is directly related to their teacher's effectiveness in science teaching.	3.47	.983	50.0		50.0
16	If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child's teacher.	3.59	.946	15.6	15.6	68.8
Total Scale (Min 10-Max 50)		35.00	8.7134			

b. Epistemological beliefs toward Science Teaching

The scores of the participants on the Epistemological Beliefs Survey were analyzed by utilizing descriptive statistics. The possible minimum score is 38 (for negative attitude) and the maximum score is 190 (for positive attitude) because it includes 38 items with five category scale; scores approaching the midpoint of 114 indicate neutral.

In this study, mean score of the Epistemological Beliefs Survey was 123.68 with a standard deviation of 36.096. Percentages for each item of responses were categorized into three groups: agreement, neutral, and disagreement. As an addition, percentages of responses for each item were given in the table.

According to the percentages on the Epistemological Beliefs Survey, the respondents showed positive epistemological beliefs toward science teaching on most of the items. 88.9% of the participants claimed that wisdom knowing how to find the answer but not knowing the answer, as same percentage of participants asserted that original thinking is the most important part of scientific work. Participants thought that preferring to make things simple when they learn something (86.1%). By the way, participants claimed that if you want to evaluate the textbook, you should familiar to topic with the percentage of 83.4%. According to 75% of the participants thought that the good way to understand a textbook is reorder the information based on own personal schemes. Participants disagree on item on survey “If I can’t understand something quickly, it usually means I will never understand it” with the percentage of 75%. On the other hand, 77.8% of participants claimed that understand something when it makes sense them first time. And participant asserted that advices given by experts should be questioned (69.5%). As an addition to results of survey, 72.2% of the participants asserted that information is learned in school not certain and can change.

When we look at the scores of preservice elementary science teacher in attitude test, and according to the percentages on the revised Science Teaching Attitude Scale, the respondents showed positive epistemological beliefs toward science teaching on most of the items. 93.7% of the participants claimed that most of the important part of scientific work comes from original ideas, as same percentage of participants believed that the term “wisdom” knowing how to find the answers, but it not knowing answers. Students also asserted that when leaning something, they prefer to make things as simple as possible (%), with same percentage students claimed that they have found some lecturer annoying when students were attending their lectures, the reason is lecturers not seeming believe themselves about what they give in classrooms. With percentage of 81.3% of students believed that they can understand later, if they don’t understand at first time, and also believed that when evaluating the accuracy of information in textbooks, you should be familiar with the topic. 78.2% of the participants claimed that they are pleased about well organized lectures to lecturers, and same percentage of students asserted that they try their best to combine information across chapters or even classes. With percentage of 75.1% of students thought that the experts’ advices should be questioned, and almost same percentage of students claimed that information that are given from schools, are not certain and unchanging (% 75.0). Participants claimed that memorizing a lot of facts does not make students successful (68.8%), and also same percentage of students asserted that good way to understand a textbook is reorganize the information according our own scheme.

Table 4.5: Scores on Epistemological Beliefs Test for Preservice Science Teachers

Item no	Items	Mean	SD	Agree	Neutral	Disagree
1	You can believe most things you read.	2.91	1.067	33.4	22.2	41.7
2	The only thing that is certain is uncertainty itself.	3.03	1.055	30.5	41.7	27.7
3	If something can be learned, it will be learned immediately.	3.06	1.170	47.2	8.3	44.5
4	I like information to be presented in a straightforward fashion; I don't like having to read between the lines.	3.58	.937	61.1	22.2	16.7
5	It is difficult to learn from a textbook unless you start at the beginning and master one section at a time.	3.39	.934	52.7	25.0	22.2
6	Forming your own ideas is more important than learning what the textbooks say.	3.69	1.037	61.1	22.2	16.7
7	Almost all the information you can understand from a textbook you will get during the first reading.	2.83	1.000	30.6	25.0	44.5
8	A really good way to understand a textbook is to reorganize the information according to your own personal scheme	3.83	.655	75.0	22.2	2.8
9	If scientists try hard enough, they can find the answer to almost every question	3.08	1.156	38.9	27.8	33.3
10	You should evaluate the accuracy of information in textbooks if you are familiar with the topic.	3.89	.854	83.4	8.3	8.4
11	You will just get confused if you try to integrate new ideas in a textbook with knowledge you already have about a topic.	3.11	.979	41.7	30.6	27.8
12	When I study, I look for specific facts.	3.39	.964	55.6	27.8	16.7
13	If professors would stick more to the facts and do less theorizing, one could get more out of college.	3.31	.889	52.8	22.2	25.0
14	Being a good student generally involves memorizing a lot of facts.	2.47	1.230	30.6	8.3	61.1
15	Wisdom is not knowing the answers, but knowing how to find the answers.	4.31	.668	88.9		11.1
16	Working on a difficult problem for an extended period of time only pays off for really smart students.	3.00	1.095	41.7	25.0	33.3
17	Some people are born good learners; others are just stuck with a limited ability.	3.03	1.276	38.9	16.7	44.4
18	Usually, if you are ever going to understand something, it will make sense to you the first time.	3.67	.676	77.8	11.1	11.1
19	Successful students understand things quickly.	3.19	1.009	55.6	13.9	30.6

20	Today's facts may be tomorrow's fiction.	3.58	.841	63.9	22.2	13.9
21	I really appreciate instructors who organize their lectures carefully and then stick to their plan.	3.75	.906	61.1	30.6	8.3
22	The most important part of scientific work is original thinking.	4.06	.532	88.9	11.1	
23	Even advice from experts should be questioned.	3.83	.655	69.5	30.6	
24	If I can't understand something quickly, it usually means I will never understand it.	2.00	1.095	8.4	16.7	75.0
25	I try my best to combine information across chapters or even across classes.	3.39	.871	58.4	19.4	22.2
26	I don't like movies that don't have a clear-cut ending.	2.47	1.183	19.4	19.4	61.1
27	Scientists can ultimately get to the truth.	2.97	1.082	27.8	36.1	36.2
28	It's a waste of time to work on problems that have no possibility of coming out with a clear-cut answer.	2.69	1.064	22.3	30.6	47.2
29	Understanding main ideas is easy for good students.	3.53	.845	63.9	19.4	16.7
30	It is annoying to listen to lecturers who cannot seem to make their mind up as to what they really believe.	3.50	.845	61.2	22.2	16.7
31	A good teacher's job is to keep students from wandering from the right track	3.64	.899	63.9	30.6	5.6
32	A sentence has little meaning unless you know the situation in which it was spoken.	3.56	.998	63.9	22.2	13.9
33	The best thing about science courses is that most problems have only one right answer.	3.14	1.018	47.2	22.2	30.6
34	Most words have one clear meaning.	2.75	.874	19.5	36.1	44.5
35	The really smart students don't have to work hard to do well in school.	2.83	1.028	33.4	19.4	47.3
36	When I learn, I prefer to make things as simple as possible.	3.83	.775	86.1	5.6	8.4
37	I find it is refreshing to think about issues that experts can't agree on.	3.28	.815	50.0	27.8	22.2
38	The information we learn in school is certain and unchanging.	2.11	1.116	19.4	8.3	72.2
Total Score: Min (38) max (190)		123.68	36.096			

Table 4.6: Scores on Epistemological Test for Preservice Elementary Science Teachers

Item no	Items	Mean	SD	Agree	Neutral	Disagree
1	You can believe most things you read.	2,84	1,167	37.5	21.9	40.6
2	The only thing that is certain is uncertainty itself.	3,63	0,907	53.1		46.9
3	If something can be learned, it will be learned immediately.	3,03	1,150	37.5	18.8	43.8
4	I like information to be presented in a straightforward fashion; I don't like having to read between the lines.	3,25	1,078	59.4	9.4	31.3
5	It is difficult to learn from a textbook unless you start at the beginning and master one section at a time.	3,53	0,915	62.5		37.5
6	Forming your own ideas is more important than learning what the textbooks say.	3,56	1,014	54.3	43.8	18.8
7	Almost all the information you can understand from a textbook you will get during the first reading.	2,66	1,125	25.1	21.9	53.1
8	A really good way to understand a textbook is to reorganize the information according to your own personal scheme	3,63	0,793	68.8	18.8	12.5
9	If scientists try hard enough, they can find the answer to almost every question	2,53	1,077	21.9	21.9	56.2
10	You should evaluate the accuracy of information in textbooks if you are familiar with the topic.	3,81	0,780	81.3	12.5	6.2
11	You will just get confused if you try to integrate new ideas in a textbook with knowledge you already have about a topic.	3,03	0,861	31.2	37.5	31.3
12	When I study, I look for specific facts.	3,50	0,916	53.1	31.3	15.6
13	If professors would stick more to the facts and do less theorizing, one could get more out of college.	3,22	0,870	43.7	31.3	25.0
14	Being a good student generally involves memorizing a lot of facts.	2,22	1,008	15.6	15.6	68.8
15	Wisdom is not knowing the answers, but knowing how to find the answers.	4,22	0,553	93.7		6.3
16	Working on a difficult problem for an extended period of time only pays off for really smart students.	2,78	0,941	28.1	28.1	43.8
17	Some people are born good learners; others are just stuck with a limited ability.	3,28	1,170	53.1	15.6	31.3
18	Usually, if you are ever going to understand something, it will make sense to you the first time.	3,38	0,871	50.0	31.2	18.8
19	Successful students understand things quickly.	3,50	0,950	62.5	15.6	21.9

20*	Today's facts may be tomorrow's fiction.	3,68	0,748	62.5	28.1	6.3
21	I really appreciate instructors who organize their lectures carefully and then stick to their plan.	3,84	0,920	78.2	12.5	9.4
22	The most important part of scientific work is original thinking.	4,25	0,568	93.7	6.3	
23	Even advice from experts should be questioned.	3,78	0,608	75.1	21.9	3.1
24	If I can't understand something quickly, it usually means I will never understand it.	1,94	1,045	6.3	12.5	81.3
25	I try my best to combine information across chapters or even across classes.	3,63	1,040	78.2	3.1	18.8
26	I don't like movies that don't have a clear-cut ending.	2,47	1,135	21.9	21.9	56.2
27	Scientists can ultimately get to the truth.	2,78	0,941	18.8	37.5	43.7
28*	It's a waste of time to work on problems that have no possibility of coming out with a clear-cut answer.	2,58	1,057	18.8	21.9	25.0
29	Understanding main ideas is easy for good students.	3,50	1,047	65.8	6.3	25.0
30	It is annoying to listen to lecturers who cannot seem to make their mind up as to what they really believe.	3,88	0,660	84.4	9.4	6.3
31*	A good teacher's job is to keep students from wandering from the right track	3,65	0,709	62.6	28.1	6.3
32	A sentence has little meaning unless you know the situation in which it was spoken.	3,66	0,787	65.7	25.0	9.4
33	The best thing about science courses is that most problems have only one right answer.	2,72	1,085	31.2	15.6	53.2
34	Most words have one clear meaning.	2,59	0,979	21.9	18.8	59.4
35	The really smart students don't have to work hard to do well in school.	3,06	1,190	46.9	18.8	34.4
36	When I learn, I prefer to make things as simple as possible.	4,00	0,842	84.4	6.3	9.4
37	I find it is refreshing to think about issues that experts can't agree on.	3,72	0,772	65.6	28.1	6.3
38	The information we learn in school is certain and unchanging.	2,16	1,081	15.6	9.4	75.0
Total Score: Min (38) max (190)		123.49	35.36			

c. Attitude towards Science teaching

The participants' score on the revised Science Teaching Attitude Scale were analyzed by utilizing descriptive statistics. The possible minimum score is 22 (for negative attitude) and the maximum score is 110 (for positive attitude) because it includes 22 items with five category scale.

In this study, mean score of the revised Science Teaching Attitude Scale was 79.4972 with a standard deviation of 20.42806. Percentages for each item of responses were categorized into three groups: agreement, neutral, and disagreement. As an addition, percentages of responses for each item were given in the table.

According to the percentages on the revised Science Teaching Attitude Scale, the respondents indicated positive attitude toward science teaching on most of the items. They were in agreement that the teaching of science process is important in the elementary classroom (86.1%). 83.4% of the participants claimed that science is important as the term 3 R's (reading, relating and responding). Also, 83.3% of the participant thought that get students' excite toward science. Participants asserted that they have no fear about to show science events on classroom (77.8%), as same percentage of participants claimed that like to help student when constructing experiment equipment. As an addition, 66.7% of the participants asserted that like to spend their time to set up experiment equipments and manipulating the science equipment. It is very important that 77.8 of the participant claimed that they had no fear about science. On the contrary, they were low attitude toward science teaching on about science concepts items. For example, most of them afraid that students would ask them questions that they could not answer and they had a difficult time understanding science (30.6%). Although participants asserted that integrating the science to in to other areas of lives (69.5%), almost half of the participants thought that teaching science takes too much time (47.2%).

When we look at the scores of preservice elementary science teacher in attitude test, and according to the percentages on the revised Science Teaching Attitude Scale, the respondents indicated positive attitude toward science teaching on most of the items. All students like to construct science equipments. 93.7% of the participants claimed that teaching of science process is important in classroom, and most of the students asserted that they can excite students about science subjects (90.6%). 87.6% of the participants claimed that they can show science phenomena in classrooms. Some students like to influence over science equipments (84.4%). And with ratio of 81.3% and 81.2% of participants claimed that I not fear from science, and feel comfortable when teaching science, also they asserted that science is important as three basic terms in education (reading, relating and responding), then students like to spend time with lab equipments. Moreover, 75.1% of the participants like lab periods, and about same percentage of the participants claimed that planning to integrate science into other areas of life. On the other hand, 78.1% of the participants thought that science teaching takes too much effort. And 71.9% of the participants asserted that interested in working with an experimental science curriculum, and same percentage of participants thought that elementary school curriculum and its science content is good for them.

Table 4.7: scores on attitude test for preservice secondary science teachers

Item No	Item	Mean	SD	Agree	Neutral	Disagree
1*	I will feel uncomfortable teaching science	3.542	1.196	27.8	8.3	61.1
2	The teaching of science processes is important in the elementary classroom	4.06	.539	86.1	11.1	-
3*	I fear that I will be unable to teach science adequately	3.542	1.146	22.2	19.4	55.5
4*	Teaching science takes too much time	3.400	1.034	22.2	22.2	52.8
5	I will enjoy the lab period in science courses that I teach	3.83	.539	13.9	13.9	69.4
6*	I have a difficult time understanding science	3.714	.925	11.1	16.7	69.5
7	I feel comfortable with the science content in the elementary school curriculum	3.63	.877	63.9	19.4	13.9
8	I would be interested in working an experimental science curriculum	3.74	.919	69.5	13.9	13.9
9*	I dread teaching science	4.085	1.010	8.4	11.1	77.8
10	I am not afraid to demonstrate science phenomena in the classroom	3.80	.964	77.8	5.6	13.9
11*	I am not looking forward to teaching science in my elementary classroom	3.542	1.010	13.9	13.9	69.5
12	I will enjoy helping students construct science equipment	3.97	1.014	77.8	8.3	11.1
13	I am willing to spend time setting up equipment for a lab	3.83	1.098	66.7	16.7	13.9
14	I am afraid that students will ask me questions that I cannot answer	3.400	1.090	30.6	11.1	55.6
15	Science is as important as the 3 R's	3.89	.530	83.4	11.1	2.8
16	I enjoy manipulating science equipment	2.86	.845	72.2	16.7	8.3
17*	In the classroom, I fear science experiments won't turn out as expected	3.257	.918	22.2	27.8	47.2
18	Science would be one of my preferred subjects to teach if given a choice	3.71	.926	72.2	16.7	8.4
19	I hope to be able excite my students about science	4.03	.822	83.3.	5.6	8.3
20*	Teaching science takes too much effort	2.771	.942	47.2	25.0	25.0
21	Children are not curious about scientific matters	3.000	1.028	38.9	22.2	36.2
22	I plan to integrate science into other areas	3.89	1.051	69.5	16.7	11.1
Total score (min 22 max 1103.89)		79,497	20.428			

* Scoring Reversed For These Items

Table 4.8: Scores on Attitude test for preservice elementary science teachers

Item No	Item	Mean	SD	Agree	Neutral	Disagree
1*	I will feel uncomfortable teaching science	3.938	1.1622	15.6	3.1	81.3
2	The teaching of science processes is important in the elementary classroom	4.160	.767	93.7		6.3
3*	I fear that I will be unable to teach science adequately	3.719	1..0234	12.5	21.9	65.7
4*	Teaching science takes too much time	2.875	1.395	46.9	21.9	31.3
5	I will enjoy the lab period in science courses that I teach	3.840	.847	75.1	15.6	9.4
6*	I have a difficult time understanding science	3.406	.9791	62.6	9.4	28.1
7	I feel comfortable with the science content in the elementary school curriculum	3.560	.801	71.9	15.4	12.5
8	I would be interested in working an experimental science curriculum	3.880	.660	71.9		28.1
9*	I dread teaching science	4.000	.7184	3.1	15.6	81.3
10	I am not afraid to demonstrate science phenomena in the classroom	4.000	.718	87.6	6.3	6.3
11*	I am not looking forward to teaching science in my elementary classroom	3.531	.9153	9.4	28.1	62.6
12	I will enjoy helping students construct science equipment	4.220	.420	100		
13	I am willing to spend time setting up equipment for a lab	4.000	.950	81.2		18.8
14	I am afraid that students will ask me questions that I cannot answer	3.594	1.0115	21.9	12.5	65.6
15	Science is as important as the 3 R's	3.780	.751	81.3	12.5	6.2
16	I enjoy manipulating science equipment	3.940	.716	84.4	9.4	6.3
17*	In the classroom, I fear science experiments won't turn out as expected	3.129	.9413	28.1	28.1	43.8
18	Science would be one of my preferred subjects to teach if given a choice	3.530	1.047	59.4	21.9	18.8
19	I hope to be able excite my students about science	4.190	.592	90.6		9.4
20*	Teaching science takes too much effort	2.313	.998	78.1	12.5	9.4
21	Children are not curious about scientific matters	3.094	1.0883	37.5	21.9	40.7
22	I plan to integrate science into other areas	3.910	.963	75.0		25.0
Total score (min 22 max 110)		80.60	19.109			

* Scoring Reversed For These Items

d. Relationships between Preservice Elementary Science Teachers' Self Efficacy Beliefs Scores and Epistemological Beliefs Scores

In the study, when understanding relationships between preservice elementary science teachers' efficacy beliefs scores and epistemological beliefs scores, "Pearsons' R" value has calculated. And as a result, there is no significant relationship between preservice elementary science teachers' self efficacy beliefs and epistemological beliefs (r: .096 and p: .620). Moreover, "r value" is bigger than .03 so that no relation between them, and also same result was seen in "sig." value; p value is bigger than .05.

e. Relationships between Preservice Elementary Science Teachers' Self Efficacy Beliefs Scores and Attitudes Questionnaire Scores

In the study, when understanding relationships between preservice elementary science teachers' efficacy beliefs scores and attitudes questionnaire scores, "Pearsons' R" value has calculated. And as a result, there is no significant relationship between preservice elementary science teachers' self efficacy beliefs and attitudes towards science teaching (r: .180 and p: .334). Moreover, "r value" is bigger than .03 so that no relation between them, and also same result was seen in "sig." value; p value is bigger than .05.

f. Relationships between Preservice Elementary Science Teachers' Epistemological Beliefs Scores and Attitudes Questionnaire Scores

In the study, when understanding relationships between preservice elementary science teachers' epistemological beliefs scores and attitudes questionnaire scores, "Pearsons' R" value has calculated. And as a result, there is significant relationship between preservice elementary science teachers' epistemological beliefs and attitudes towards science teaching (r: .368 and p: .05). Moreover, p value equals to .05 so that it is accepted.

g. Relationships between Preservice Secondary Science Teachers' Self Efficacy Beliefs Scores and Epistemological Beliefs Scores

In the study, when understanding relationships between preservice secondary science teachers' efficacy beliefs scores and epistemological beliefs scores, "Pearsons' R" value has calculated. And as a result, there is no significant relationship between preservice secondary science teachers' self efficacy beliefs and epistemological beliefs (r: .061 and p: .728). Moreover, "r value" is bigger than .03 so that no relation between them, and also same result was seen in "sig." value; p value is bigger than .05.

h. Relationships between Preservice Secondary Science Teachers' Self Efficacy Beliefs Scores and Attitudes Questionnaire Scores

In the study, when understanding relationships between preservice secondary science teachers' efficacy beliefs scores and attitudes questionnaire scores, "Pearsons' R" value has calculated. And as a result, there is a significant relationship between preservice secondary science teachers' self efficacy beliefs and attitudes towards science teaching (r: .801 and p: 0). When looked at the "sig. value" p: 0 so it is smaller than p: .05, it means that there is a correlation between self efficacy and attitudes towards science teaching in secondary science teachers.

i. Relationships between Preservice Secondary Science Teachers' Self Epistemological Beliefs Scores and Attitudes Questionnaire Scores

In the study, when understanding relationship between preservice secondary science teachers' epistemological beliefs scores and attitudes questionnaire scores, "Pearsons' R" value has calculated. And as a result, there is no significant relationship between preservice secondary science teachers' self efficacy beliefs and epistemological beliefs (r: .083 and p: .639). Moreover, "r value" is bigger than .03 so that no relation between them, and also same result was seen in "sig." value; p value is bigger than .05.

CHAPTER V

DISCUSSION

This study was going to explore preservice science teachers at elementary science teaching and secondary science teaching with respect to preservice science teachers' efficacy beliefs, epistemological beliefs, and attitudes towards science teaching with some independent variables and in relation with each other. The results of the study were presented in the previous part of the chapter. And in these parts, results (i.e. findings) were discussed under main topics that were given in the previous chapters.

a. Preservice Science Teacher's Efficacy Beliefs Regarding Science Teaching

Because of the effects of teachers' beliefs over teachers actions, behavior in classroom; so, many of the educational studies were performed about teachers' behavior. Especially efficacy beliefs have important place in these studies, and many of these studies put emphasis on teacher efficacy is related to effectiveness and student achievement, and attitude of teacher (Anderson, Greene & Loewen, 1988; Ashton & Webb, 1986; Woolfolk, Rosoff, & Hoy, 1990; Ross, 1992b; Tschannen-Moran et al., 1998; Ramsey & Wingfield, 1999; Ritter, 1999; Wilson & Tan, 2004).

There is a strong relationship between efficacy beliefs and science teaching, for this reason; teacher education programs should give importance to self-efficacy beliefs on preservice teacher in education faculties, so that teaching programs give permanent changes in students' (preservice teachers) attitudes and beliefs about science teaching. According to the result of this study, the preservice elementary teachers indicated reasonably positive efficacy beliefs regarding science teaching on personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE). Personal science teaching efficacy shows that the preservice elementary teachers' beliefs about ability to carry out science teaching, and science teaching outcome expectancy show preservice teachers' ability to overcome the negative effects of environmental factors give result about student's positive learning outcomes. When looked at the PSTE subscale of efficacy survey, most of the participants declared that they welcome to students' science questions by the way they do not feel themselves enough to answer some questions of students. And overall, preservice science teachers look like optimistic about being effective in science teaching in the future. When looked at the STOE subscale, most of the participants believed that students' learning can be influenced by effective teaching and also they are in agreement that effective science teaching techniques can overcome the insufficient science background of students. Overall, preservice science teachers have positive efficacy beliefs toward science teaching.

b. Preservice Science Teachers' Epistemological beliefs toward Science Teaching

Epistemological beliefs also have important role in shaping preservice teachers view on education, and this make epistemological beliefs a hot topic to researchers (Anderson & Rubba, 1978; Carey & Smith, 1993; Driver, Leach, Millar & Scott, 1996; Lederman, 1992; Ryan & Aikenhead, 1992; Duveen, Scott and Solomon, 1996, Hofer, 2001) (cited in Tabak and Weinstock, 2005). Some researchers declared the importance of "meaningful learning" and many of the educators agree that "meaningful learning" for students could produces better cognitive outcomes, greater learning motivation. (Ausubel, 1968; Ausubel, Novak & Hanesian, 1978; Novak, 1977; Anderson, 1987; Minstrell, 1989; Novak & Gowin, 1984) (cited in Tsai, 1997).

According to epistemology view survey, most of the participants have positive epistemological beliefs toward science teaching, participants claimed that wisdom, and knowledge is important to getting achievement with the high ratios like over %85 to %95 in both preservice elementary science teachers and preservice secondary science teachers. And their agreement showed that they are good students on exploring truth, and knowledge, it is a sight of being a good teacher in future.

c. Preservice Science Teachers' Attitude toward Science Teaching

A lack of interest in science is one of the barriers to effective elementary science teaching. Stollberg (1969) asserted that teachers with a neutral or negative attitude could either avoid the teaching of science or pass this negative attitude along to young students. Therefore relationship between attitude and behavior must be considered as schools of education that prepare future teachers (Tosun, 2000).

d. Preservice Elementary Science Teachers' and Secondary Science Teachers' Self Efficacy Beliefs and Epistemological Beliefs

Self efficacy beliefs have importance in shaping preservice teachers professional life (Anderson, Greene & Loewen, 1988; Ashton & Webb, 1986; Ross, 1992b; Tschannen-Moran et al., 1998; Ramsey & Wingfield, 1999; Ritter, 1999; Sarıkaya, 2004; Wilson & Tan, 2004) and epistemological beliefs give preservice teachers what is knowledge and search of knowledge (Ausubel, 1968; Ausubel, Novak & Hanesian, 1978; Anderson, 1987; Minstrell, 1989; Novak & Gowin, 1984; Tsai, 1997).

Although a positive relationship between self efficacy and epistemological beliefs were shown in literature, there is no significant relationship between preservice elementary science teachers' efficacy beliefs and epistemological beliefs. By the way, the preservice elementary science teachers have positive beliefs in efficacy and epistemology, so that courses and activities in university give them properly.

When looked at preservice secondary science teachers, same results were taken, that is, there is no significant relationship between self efficacy beliefs and epistemological beliefs. By the way, the preservice secondary science teachers have positive beliefs in efficacy and epistemology, so that courses and activities in university give them properly.

e. Preservice Elementary Science Teachers' and Secondary Science Teachers' Self Efficacy Beliefs and Attitudes towards Science Teaching

Self efficacy beliefs have importance in shaping preservice teachers professional life (Goddard, Hoy & Woolfolk Hoy, 2000; Pajares, 1997; Ross, 1992b, 1994, 1998; Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998) and attitudes show preservice teachers' ideas and feeling how they behave in professional life (Bitner, 1994; Young, 1998; Barton & Zacharia, 2003; Zacharia, 2003; Chin, 2005; Zapata, 2005).

Although a positive relationship between self efficacy beliefs and attitudes were shown in literature, there is no significant relationship between preservice elementary science teachers' efficacy beliefs and epistemological beliefs. By the way, the preservice elementary science teachers have positive beliefs in efficacy and epistemology, so that courses and activities in university give them properly.

When looked at preservice secondary science teachers, same results were taken, that is, there is no significant relationship between self efficacy beliefs and attitudes towards science teaching. By the way, the preservice secondary science teachers have positive beliefs in efficacy and attitudes, so that courses and activities in university give them properly.

f. Preservice Elementary Science Teachers' and Secondary Science Teachers' Epistemological Beliefs and Attitudes towards Science Teaching

Epistemological beliefs and attitudes have effects to each others and these factors are important in shaping preservice teachers professional life (Ausubel, 1968; Ausubel, Novak & Hanesian, 1978; Anderson, 1987; Minstrell, 1989; Novak & Gowin, 1984; Bitner, 1994; Tsai, 1997; Young, 1998; Barton & Zacharia, 2003; Zacharia, 2003; Chin, 2005; Zapata, 2005).

Although a positive relationship between epistemological beliefs and attitudes towards science teaching were shown in literature, there is significant relationship between preservice elementary science teachers' efficacy beliefs and epistemological beliefs. By the way, the preservice elementary science teachers have positive beliefs in epistemology and attitudes towards science teaching, so that courses and activities in university give them properly.

When looked at preservice secondary science teachers, same results were taken, that is, there is no significant relationship between epistemological beliefs and attitudes science teaching. By the way, the preservice secondary science teachers have positive beliefs in epistemology and attitudes, so that courses and activities in university give them properly.

CHAPTER VI

CONCLUSION AND RECOMMENDATIONS

In an effort to inform teacher education practices, this study explored the preservice elementary teachers' self-efficacy beliefs regarding science teaching, their science knowledge level and attitudes toward science teaching. Specifically, the study investigated the relationships between self-efficacy beliefs, epistemological beliefs and attitude toward science teaching and of preservice elementary teachers. In this chapter, the research findings are summarized and in the light of these findings some implications for practice and further research on the concern of teachers' efficacy, their science knowledge level and attitude toward science teaching are put forward.

Conclusions

Analysis of the self efficacy survey indicated moderately positive self efficacy beliefs expressed by the most of preservice elementary and secondary science teachers regarding science teaching. Moreover, preservice teachers believe that effective teaching (outcome expectancy beliefs) can influence their teaching abilities and students' learning. Furthermore, analysis of the science attitude scale indicated a positive attitude toward science teaching expressed by preservice elementary teachers. According to most of the preservice elementary and secondary science teachers, science was important in elementary class (From answer to the questionnaire).

Analysis of the relationships between self efficacy beliefs, epistemological beliefs and attitudes towards science teaching showed that same positive beliefs in participants. Relationship between self efficacy beliefs, epistemological beliefs and attitudes towards science teaching prove that university education was performed well on preservice science teachers. By this way, preservice science teachers have high self efficacy on being teachers. In addition, with epistemological beliefs, preservice science teachers search knowledge, try to understand nature of knowledge with their high attitudes towards science teaching. In conclusion, education faculties is the place for shaping preservice science teachers professional life, and they give to preservice teachers necessary knowledge, skills, and techniques for their professional life.

Recommendations

In this section, recommendations for further research are put forward.

- Qualitative and quantitative research techniques should be utilized to construct and measure preservice elementary and secondary science teachers' efficacy beliefs and epistemological beliefs more accurately.
- This study should be conducted with all grades of preservice elementary and secondary science teachers (from grade 1 to grade 4 or 5).
- The variation of efficacy beliefs should be followed across years.
- The variation of epistemological beliefs should be followed across years.
- Also achievement test should be added to these parameters and trying to understand effects of it.
- This study should be performed in education faculties of other universities in Turkey.
- Research should be performed with different demographic data, such as; number of education lesson taken, or participants' parents' jobs…etc.
- Research should investigate participants' beliefs about nature of science but it should be performed in long time period.

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APPENDIX A

Demographic Data sheet

Choose from below that fits you the best

1. **Department**

☐ CHED	☐ PHED	☐ ESE

2. **Gender**

☐ Female	☐ Male

3. **High school which you graduated from**

☐Normal Lyceé	☐Anatolian Lyceé	☐Science Lyceé
☐Teacher Education Lyceé	☐ Private Lyceé	☐Others

4. **cGPA** **…………………..**

5. **Is father working?**

☐ Yes	☐ No

6. **What is the education level of father?**

☐ Not Gone to School	☐ Primary School	☐ Secondary School
☐ High School (Lyceé)	☐ University	☐ Master or more (Graduate)

7. **Is mother working?**

☐ Yes	☐ No

8. **What is the education level of mother?**

☐ Not Gone to School	☐ Primary School	☐ Secondary School
☐ High School (Lyceé)	☐ University	☐ Master or more (Graduate)

This survey has 3 sections; efficacy beliefs, epistemological beliefs, attitudes towards science teaching.

For three surveys, we used below abbreviations for your responses.

SA = Strongly Agree	A = Agree	UN = Uncertain	D = Disagree	SD = Strongly Disagree

Please circle one of these options that represent your ideas.

APPENDIX B

Efficacy Beliefs Survey

The Science Teaching Efficacy Belief Instrument for preservice teachers (STEBI-B) by Enochs & Riggs

Please indicate the degree to which you agree or disagree with each statement below by circling the correct response.

1	When a student does better than usual in science, it is often because the teacher exerted a little extra effort	SA A UN D SD
2	I will continually find better ways to teach science.	SA A UN D SD
3	Even if I try very hard, I will not teach science as well as I will most subjects.	SA A UN D SD
4	When the science grades of students improve, it is often due to their teacher having found a more effective teaching approach.	SA A UN D SD
5	I know the steps necessary to teach science concepts effectively.	SA A UN D SD
6	I will not be very effective in monitoring science activities.	SA A UN D SD
7	If students are underachieving in science, it is most likely due to ineffective science teaching.	SA A UN D SD
8	I will generally teach science ineffectively.	SA A UN D SD
9	The inadequacy of a student's science background can be overcome by good teaching.	SA A UN D SD
10	The low science achievement of some students cannot generally be blamed on their teachers.	SA A UN D SD
11	When a low-achieving child progresses in science, it is usually due to extra attention given by the teacher.	SA A UN D SD
12	I understand science concepts well enough to be effective in teaching elementary science.	SA A UN D SD
13	Increased effort in science teaching produces little change in some students' science achievement.	SA A UN D SD
14	The teacher is generally responsible for the achievement of students in science.	SA A UN D SD
15	Students' achievement in Science is directly related to their teacher's effectiveness in science teaching.	SA A UN D SD
16	If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child's teacher.	SA A UN D SD
17	I will find it difficult to explain to students why science experiments work.	SA A UN D SD
18	I will typically be able to answer students' science questions.	SA A UN D SD
19	I wonder if I will have the necessary skills to teacher science.	SA A UN D SD
20	Given a choice, I will not invite the principal to evaluate my science teaching.	SA A UN D SD
21	When a student has difficulty understanding a science concept, I will usually be at a loss as to how to help the student understand it better.	SA A UN D SD
22	When teaching science, I will usually welcome student questions.	SA A UN D SD
23	I do not know what to do to turn students on to science.	SA A UN D SD

APPENDIX C

Epistemological Beliefs Survey

Epistemological Beliefs Survey by Kardash ; Wood & Kardash

Please indicate how strongly you agree or disagree with each of the statements listed below. Please circle the number that best corresponds to the strength of your belief.

1	You can believe most things you read.	SA	A	UN	D	SD
2	The only thing that is certain is uncertainty itself.	SA	A	UN	D	SD
3	If something can be learned, it will be learned immediately.	SA	A	UN	D	SD
4	I like information to be presented in a straightforward fashion; I don't like having to read between the lines.	SA	A	UN	D	SD
5	It is difficult to learn from a textbook unless you start at the beginning and master one section at a time.	SA	A	UN	D	SD
6	Forming your own ideas is more important than learning what the textbooks say.	SA	A	UN	D	SD
7	Almost all the information you can understand from a textbook you will get during the first reading.	SA	A	UN	D	SD
8	A really good way to understand a textbook is to reorganize the information according to your own personal scheme	SA	A	UN	D	SD
9	If scientists try hard enough, they can find the answer to almost every question	SA	A	UN	D	SD
10	You should evaluate the accuracy of information in textbooks if you are familiar with the topic.	SA	A	UN	D	SD
11	You will just get confused if you try to integrate new ideas in a textbook with knowledge you already have about a topic.	SA	A	UN	D	SD
12	When I study, I look for specific facts.	SA	A	UN	D	SD
13	If professors would stick more to the facts and do less theorizing, one could get more out of college.	SA	A	UN	D	SD
14	Being a good student generally involves memorizing a lot of facts.	SA	A	UN	D	SD
15	Wisdom is not knowing the answers, but knowing how to find the answers.	SA	A	UN	D	SD
16	Working on a difficult problem for an extended period of time only pays off for really smart students.	SA	A	UN	D	SD
17	Some people are born good learners; others are just stuck with a limited ability.	SA	A	UN	D	SD
18	Usually, if you are ever going to understand something, it will make sense to you the first time.	SA	A	UN	D	SD
19	Successful students understand things quickly.	SA	A	UN	D	SD

20	Today's facts may be tomorrow's fiction.	SA A UN D SD
21	I really appreciate instructors who organize their lectures carefully and then stick to their plan.	SA A UN D SD
22	The most important part of scientific work is original thinking.	SA A UN D SD
23	Even advice from experts should be questioned.	SA A UN D SD
24	If I cant understand something quickly, it usually means I will never understand it.	SA A UN D SD
25	I try my best to combine information across chapters or even across classes.	SA A UN D SD
26	I do not like movies that do not have a clear-cut ending.	SA A UN D SD
27	Scientists can ultimately get to the truth.	SA A UN D SD
28	It's a waste of time to work on problems that have no possibility of coming out with a clear-cut answer.	SA A UN D SD
29	Understanding main ideas is easy for good students.	SA A UN D SD
30	It is annoying to listen to lecturers who cannot seem to make their mind up as to what they really believe.	SA A UN D SD
31	A good teacher's job is to keep students from wandering from the right track	SA A UN D SD
32	A sentence has little meaning unless you know the situation in which it was spoken.	SA A UN D SD
33	The best thing about science courses is that most problems have only one right answer.	SA A UN D SD
34	Most words have one clear meaning.	SA A UN D SD
35	The really smart students don't have to work hard to do well in school.	SA A UN D SD
36	When I learn, I prefer to make things as simple as possible.	SA A UN D SD
37	I find it is refreshing to think about issues that experts cant agree on.	SA A UN D SD
38	The information we learn in school is certain and unchanging.	SA A UN D SD

*A*PPENDIX D

Attitude towards Science Teaching Survey

Revised Science Attitude Scale for Preservice by Thompson & Shrigley

Please indicate the degree to which you agree or disagree with each statement below by circling the correct response.

1	I will feel uncomfortable teaching science	SA A UN D SD
2	The teaching of science processes is important in the elementary classroom	SA A UN D SD
3	I fear that I will be unable to teach science adequately	SA A UN D SD
4	Teaching science takes too much time	SA A UN D SD
5	I will enjoy the lab period in science courses that I teach	SA A UN D SD
6	I have a difficult time understanding science	SA A UN D SD
7	I feel comfortable with the science content in the elementary school curriculum	SA A UN D SD
8	I would be interested in working an experimental science curriculum	SA A UN D SD
9	I dread teaching science	SA A UN D SD
10	I am not afraid to demonstrate science phenomena in the classroom	SA A UN D SD
11	I am not looking forward to teaching science in my elementary classroom	SA A UN D SD
12	I will enjoy helping students construct science equipment	SA A UN D SD
13	I am willing to spend time setting up equipment for a lab	SA A UN D SD
14	I am afraid that students will ask me questions that I cannot answer	SA A UN D SD
15	Science is as important as the 3 R's	SA A UN D SD
16	I enjoy manipulating science equipment	SA A UN D SD
17	In the classroom, I fear science experiments won't turn out as expected	SA A UN D SD
18	Science would be one of my preferred subjects to teach if given a choice	SA A UN D SD
19	I hope to be able excite my students about science	SA A UN D SD
20	Teaching science takes too much effort	SA A UN D SD
21	Children are not curious about scientific matters	SA A UN D SD
22	I plan to integrate science into other areas	SA A UN D SD