EARLY CHILDHOOD TEACHERS' SCIENCE TEACHING INTENTIONS AND BEHAVIOURS: AN APPLICATION OF THE THEORY OF PLANNED BEHAVIOUR

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ABSTRACT

EARLY CHILDHOOD TEACHERS' SCIENCE TEACHING INTENTIONS AND BEHAVIOURS: AN APPLICATION OF THE THEORY OF PLANNED BEHAVIOUR

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The purpose of the present study was to examine the factors influencing early childhood teachers' intentions and behaviours regarding science teaching in the light of Theory of Planned Behaviour (TPB). In addition to the original TPB constructs (i. e. behavioural beliefs, normative beliefs, control beliefs, attitude toward behaviour, subjective norms, perceived behavioural control, behavioural intention, and behaviour), four variables (i.e. personal norms, self-efficacy beliefs, science content knowledge, and epistemological beliefs) were added into the TPB model in this study. Data were collected from 893 early childhood teachers working in public pre-schools in Turkey. Early Childhood Teachers' Science Teaching Intention and

Behaviour Questionnaire was prepared in accordance with the TPB and previous science education literature. A model was developed to describe the relationships among study variables and tested in a complex correlational technique, Partial Least Square - Structural Equation Modelling (PLS- SEM). Results indicated that early childhood teachers' science teaching intentions were significantly related to their attitude, subjective and personal norms, perceived behavioural control, and self-efficacy beliefs. In addition, teachers' science teaching intentions and their self-efficacy beliefs were significantly associated with the frequency of science instruction in the classroom. Attitude towards science teaching was the strongest predictor of teachers' science teaching intentions and perceived behavioural control over science teaching was the weakest predictor of teachers' science teaching intentions. Moreover, science content knowledge of teachers did not directly predict teachers' intention, and epistemological beliefs did not provide any contribution to the model. Overall, the model explained 41.2 % of variance in intention to teach science, and 13.5 % of the variance in self-report science teaching behaviour. The findings implied that an extended model of the TPB was beneficial to investigate teachers' science teaching intentions and behaviours.

Keywords: Early Childhood Teachers, Theory of Planned Behaviour, Self-efficacy Beliefs, Science Content Knowledge, Epistemological Beliefs

ÖZ

OKUL ÖNCESİ ÖĞRETMENLERİNİN FEN ÖĞRETİMİNE YÖNELİK NİYET VE DAVRANIŞLARININ PLANLANMIŞ DAVRANIŞ TEORİSİ İLE AÇIKLANMASI

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Bu çalışmada okul öncesi öğretmenlerinin fen öğretimine yer verme niyet ve davranışları birçok değişken yardımıyla açıklanmaya çalışılmıştır. Bu değişkenler planlanmış davranış teorisi özgün yapıları (davranış inançları, davranışa karşı tutum, normatif inançlar, öznel normlar, kontrol inançları, algılanan davranış kontrolü) ve ilgili diğer yapılardan (öz-yeterlik inancı, kişisel normlar, bilimsel epistemolojik inançlar ve fen kavram bilgisi) oluşmaktadır. Bu çalışmaya Türkiye genelinden, devlet okullarında çalışan 893 okul öncesi öğretmeni katılmıştır. Çalışma verileri, “Okul Öncesi Öğretmenlerinin Fen Öğretme Niyeti ve Davranışı Anketi” ve “Demografik Bilgi Anketi” aracılığıyla toplanmıştır. Bu çalışmada ölçüm ve yapısal model analizleri *Kısmi En Küçük Kareler Yapısal Eşitlik Modellemesi* kullanılarak yapılmıştır. Yapısal model analizi; davranış inançları, normatif inançlar ve kontrol inançları ile sırasıyla tutum, öznel normlar ve algılanan davranış kontrolü arasında güçlü bir ilişki olduğunu göstermiştir. Okul öncesi öğretmenlerinin fen öğretim açısından davranış inançları fen öğretimine karşı tutumunu önemli bir şekilde belirlediği tespit edilmiştir. Ek olarak, çalışmaya katılan okul öncesi öğretmenlerinin fen öğretme niyetleri; fen öğretimine karşı tutum, öznel ve kişisel normlar, algılanan davranış kontrolü ve öz yeterlik inançları ile açıklanmıştır. Bu değişkenler öğretmenlerin fen öğretme niyetlerinin % 41.2 oranında varyansını açıklamışlardır. Ayrıca modele sonradan eklenen kişisel normlar ve öz-yeterlik inançları da önemli ölçüde modele katkı sağlamışlardır. Diğer taraftan, öğretmenlerin fen öğretim davranışını doğrudan ölçen üç değişkenden sadece ikisi (öz yeterlik inançları ve fen öğretme niyeti) anlamlı bulunmuş olup, öğretmenlerin fen öğretimine yer verme davranışlarının % 13.5 oranında varyansını açıklamıştır. Bulgular, genişletilmiş planlanmış davranış teorisinin öğretmenlerin fen öğretme niyet ve davranışlarını açıklamak için faydalı olduğunu göstermiştir.

Anahtar kelimeler: Okul Öncesi Öğretmenleri, Planlanmış Davranış Teorisi, Öz-yeterlik İnancı, Fen Kavram Bilgisi, Epistemolojik İnançlar

To my parents,
for their endless love and patience.

&

To my wonderful husband,
for his love and encouragement.

&

To my unborn baby,
you are my precious gift.

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BB	Behavioural Beliefs
NB	Normative Beliefs
CB	Control Beliefs
ATT	Attitude
SN	Subjective Norm
PBC	Perceived Behavioural Control
PN	Personal Norm
INT	Intention
SE	Self-Efficacy Beliefs
B	Behaviour
SCK	Science Content Knowledge
J	Justification of Knowledge
S-C	Source-Certainty of Knowledge
D	Development of Knowledge
TPB	Theory of Planned Behaviour
MoNE	Ministry of National Education
PLS-SEM	Partial Least Square-Structural Equation Modelling

CHAPTER I

INTRODUCTION

Recognition of the power of early thinking and learning of young children makes science an important part of early childhood education due to the fact that science provides children with a constructive scientific understanding, enables them to develop fundamental process skills and so, children have opportunity to increase the use of brain capacity at maximum level for learning (Bredekamp & Copple, 1997; Worth, 2010). National Research Council (NRC, 2014) asserted that children can understand science conceptually and use reasoning and inquiry skills to investigate how the world works. The Committee on Science Education K-12 of the Centre for Science, Mathematics, and Engineering Education (NRC, 1998, 2014) emphasized that children should learn critical thinking, synthesizing information correctly, and solving problems creatively commencing in kindergarten in order to cope with a more scientifically and technologically equipped world. Similar to international disposition, the expectation of early childhood education has been advancing in Turkey and it is suggested that science should be integrated throughout everyday curriculum to make it relevant and meaningful to children (Akman, Ustun, & Guler, 2003; Akman, Uyanik-Balat, & Guler, 2011; Aktas-Arnas, 2002; Erden & Sonmez, 2011, Usakli, 2010; Kefi, Celikoz, & Erisen, 2013; Ministry of National Education [MoNE], 2013)

The National Science Teachers Association (NSTA, 2014) emphasized that educators in early childhood settings should be aware of the significance of raising children's curiosity about science, which is a part of daily life and should provide opportunities for children to become involved in a well-planned scientific explorations by employing basic science process skills in a safely designed learning environment. Researchers asserted that young children should be learned science through active involvement, or investigative activities (Inan, 2007; Lind, 1999; Zeece, 1999). However, science education has a limited part in the preschool context (e.g. Chaille & Britain, 2003; Ginsburg & Golbeck, 2004; Sackes, Trundle, Bell, &

O'Connell, 2011) and early childhood teachers thought that science education is counterintuitive, formal, theoretical, and abstract for young children (Johnson, 1999) in spite of the its significance (Brenneman & Louro, 2008; Kallery, Psillos, & Tselfes, 2009; Tsunghui, 2006; Yoon & Onchwari, 2006). The reason of that situation is explained by Sackes, Trundle, and Bell (2013) as that only a small number of early childhood teachers have necessary subject matter and pedagogical content knowledge to be able to introduce science concepts and skills to young children.

Hsu (2002) stated that early childhood teachers are crucial for the qualified teaching process and teachers' professions are noteworthy for enhancing children's learning and attitude development. Nevertheless, teachers are influenced various kind of factors during their teaching service due to that fact that teaching is a complicated process in which teachers' individual philosophy, beliefs (e.g. Levitt, 2001; Pajares, 1992) and exterior agents are penetrated into this process. In other words, lots of internal (e.g. self-efficacy, attitudes, or beliefs) and external factors (e.g. curriculum standards, teaching guides, school climate, available resources, number of student, facilities, lack of resources or money, or lack of time) influence teachers' teaching behaviours (e.g. Appleton & Kindt, 1999; Gauthier, 1994; Karamustafaoglu & Kandaz, 2006; Sackes, 2014). One of the most important factors influencing teachers' science teaching is their attitudes toward science and science teaching. McDevitt (1993) asserted that attitudes determine teachers' length of science teaching and the choice of teaching methods. The more teacher held positive attitudes toward science, the more time is allocated inquiry based activities concerning science (Supovitz & Turner, 2000). Similarly, according to Cho, Kim and Choi (2003), teachers' attitudes toward science is a critical factor in science education for young children since teachers' attitudes toward science influence both teachers' practices in the classroom and their science understandings. Regrettably, many research studies (e.g. Pedersen & McCurdy, 1992; Cain & Evans, 1990; Harlan & Rivkin, 1996) revealed that in general, teachers hold negative attitudes toward science teaching at elementary and primary level. For this reason, researchers suggested that exploring teachers' attitudes toward science teaching is crucial to find the ways of developing favourable attitudes (Gauthies, 1994; Stefanich & Kelsey, 1989). Conezio and French (2002) also reported that early childhood teachers' unfavourable science education experiences make them anxious about teaching science in their classroom.

Teacher' attitudes and perceptions about science teaching may differ regarding their personal experiences and situational factors (Shrigley, 1983). According to Appleton and Kindt (1999) collegial support, self-confidence, and available resources are the other main determinants affecting the range of science instruction in early childhood classrooms. Teacher's self-efficacy belief in the science domain is concrete determinant of the science education quality of that classroom. Bandura (1991) stated that self-efficacy beliefs have an impact on human's activity choice and preparation of that activity in addition to putting in effort during performance. Early childhood teachers usually feel lack of confidence in preparing and teaching science activities for young children (e.g. Appleton & Kindt, 1999; Garbett, 2003; Alisinanoglu, Inan, Ozbey, & Usak, 2012). Teachers who are worried about their science content knowledge often teach less science, or only teach topics in which they feel comfortable by depending on the text and kits directly, or by expository teaching with less or no discussion (Czerniak, 1989; Harlen, 1997; Harlen & Holroyd, 1995) since teachers need broad content knowledge to ask appropriate and expressive questions to young learners (Garbet, 2003). In addition, Enochs and Riggs (1990) found that teachers with limited science background avoid teaching science and allocate less time for science teaching. In relation to science content knowledge, scientific epistemological beliefs also influence teaching practice of teachers (e.g. Pajares, 1992; Yang, Chang, & Hsu, 2008; Richardson, 1996; Jones & Carter, 2007; Cain, 2012). Epistemological beliefs filter all knowledge and beliefs (Schommer- Aikins, 2004) and by this way influence teachers' beliefs about classroom practices in particular contexts and learning (Brownlee, Purdie, & Boulton-Lewis 2002, Crawford, 2007). For instance, Crawford (2007) reported that scientific epistemological beliefs of prospective teachers are the most vital factor influencing their ability and intentions to teach science as inquiry. Also, Yang et al. (2008) found a significant relationship between earth science teachers' personal epistemology and their choice of instruction. Therefore, epistemological beliefs should be considered as a factor penetrating teachers' science teaching practice.

In addition to lack of science content knowledge, self-efficacy beliefs, unsophisticated epistemological beliefs, and unfavourable attitudes towards science, teachers pay regard to people who are important for their profession. Marcinkiewicz and Regstad (1996) reported that endorsement and encouragement of other peoples in the school environments such as administrators, students, or colleagues were significant promoters to get used to new educational practices. In the context of early childhood education, some studies reported that reluctance of parents or school administration about science teaching may result in teachers' avoiding to teach science activities (e.g. Karamustafaoglu & Kandaz, 2006; Ozturk-Yılmaztekin & Tantekin-Erden, 2011; Olgan, 2015). For instance, Ozturk-Yılmaztekin and Tantekin-Erden (2011) revealed that according to teachers, parents did not think that science learning of their children were as important as their children's reading, writing, and mathematic learning. Besides, Appleton and Kindt (1999) reported that parents’ inexpectations regarding science learning may limit the number of science activities in early childhood classrooms. These findings implied that early childhood teachers' science teaching practices are also influenced from social factors.

As well as personal and social factors, contextual factors such as availability of resources, teacher training programs or classroom/school conditions are also significant impacts on teachers' classroom behaviours. Research studies regarding early childhood science education mostly repeated the problem of resources, materials, and science/nature corners needed for effective science teaching (e.g. Appleton & Kindt, 1999; Erden & Sonmez, 2011; Sigirtmac & Ozbek, 2011). In addition, many researchers concluded that the more teachers have science-related instructional materials, the more they conduct science activities and also teach inquiry skills in kindergarten classrooms (Inan, Trundle, & Kantor, 2010; Sackes et al. 2011; Tu, 2006). For instance, Erden and Sonmez (2011) reported that the teachers worked in private schools showed more positive attitude towards science teaching. The reason of this result discussed due to the fact that private schools had more opportunities (e.g. activity materials, or equipment) to carry out science activities than public schools. Similarly, in a study of Sigirtmac and Ozbek (2011), it was revealed that public school teachers did not have adequate materials and science corners to conduct science activities which in turn resulted in delimitation of science activities. Therefore, availability and usability of the resources and materials are under issue for effective science teaching in early childhood classrooms.

Considering aforementioned research studies, it is clear that early childhood teachers usually avoid teaching science due to various reasons. It is, therefore, essential to understand factors that influence teachers' science teaching behaviours to investigate the ways for favourable science teaching conditions in early childhood classrooms. In the present study, the Theory of Planned Behaviour (TPB; Ajzen, 1985, 1991, 2006), a frequently used theory to explain human intention and behaviour in a specific context, was utilized as a theoretical framework. Studying under the umbrella of the TPB gives chance to in depth understanding of factors influencing teachers' science teaching intentions and behaviours in early childhood classrooms. The TPB and its constructs are explained in detailed following section.

1.1 Theories that explain teachers' classroom behaviour

Theories used to examine teachers' classroom practices are commonly based on teacher beliefs. So that, this part starts a brief description of teacher beliefs and its relationships with teacher classroom practices. Then, specifically presents the social cognitive theory and self-efficacy theory. The theory of planned behaviour explained in section 1.1.4 as a theoretical framework of the study.

1.1.1 Teacher beliefs

Teacher beliefs have been differently defined by the researchers with respect to the point of the view (Mansour, 2009). Richardson (1996) specified that teachers' personal experience, schooling and instructional experience, and formal knowledge experience are three sources of teacher beliefs. Pajares (1992) notes beliefs as a "messy construct" due to its difficulty in empirical examination. In addition, Pajares makes distinction between beliefs and knowledge to clarify the meaning of beliefs. Beliefs include evaluation and judgement with its static nature whilst knowledge includes objective facts with its dynamic nature. For instance, Nespor (1987) stated that teachers teach differently in spite of having similar scientific knowledge. It is due to the fact that teachers have different beliefs about teaching and beliefs are more influential than their knowledge. Pajares (1992, p. 326) reflected on a research on teacher beliefs by suggesting "a strong relationship between teachers' educational beliefs and their planning, instructional decisions, and classroom practices". However, the relationship between teacher beliefs and classroom practices are still under question (Mansour, 2009). A substantial body of research has concentrated on personal beliefs of teachers in order to explore teacher classroom behaviour (Cain, 2012; Jones & Carter, 2007; Pajares, 1992; Richardson, 1996; Yang et al., 2008). Some research studies found that teacher beliefs directly influence teacher classroom implementations (see Cain, 2012; Haney, Czerniak, & Lumpe, 1996; Nespor, 1985; Pajares, 1992). Although earlier research on the relationship between teacher beliefs and classroom applications had proposed a simple, linear, and causal relationship by using mostly quantitative methods, recent studies are seeking for more interactive and dynamic relationships between beliefs and applications (Cain, 2012).

Epistemological beliefs are regarded as a filter of all knowledge and beliefs (Schommer- Aikins, 2004) and also by this way influence teachers' beliefs about classroom practices in particular contexts and learning (Brownlee, Purdie, & Boulton-Lewis 2002). Epistemological beliefs are defined as the beliefs about nature of knowledge and knowing (Schraw & Olafson, 2002; Conley, Pintrich, Vekiri, & Harrison, 2004). The researchers (e.g. Perry, 1970; Schommer, 1990; Hofer &Pintrich, 1997) developed theories about individuals' epistemological beliefs and labelled them differently. Schommer (1990) determined five independent beliefs under headings of *Certain Knowledge*, *Simple Knowledge*, *Innate Ability*, *Quick Learning, and Omniscient Authority*. According to Hofer and Pintrich (1997), Fixed Ability and Quick Learning are more related to beliefs about intelligence rather than epistemological beliefs. In addition, Hofer and Pintrich (1997) asserted that epistemological beliefs had four dimensions which are *Certainty of Knowledge*, *Simplicity of Knowledge*, *Source of Knowledge* and *Justification for Knowing* (see Figure 1.1). These four dimensions classified under two general areas: Beliefs about the nature of knowledge and beliefs about the nature of knowing. Certainty of Knowledge and Simplicity of Knowledge reflect beliefs about nature of knowledge, and Source of Knowledge and Justification for Knowing reflect beliefs about nature of knowing.

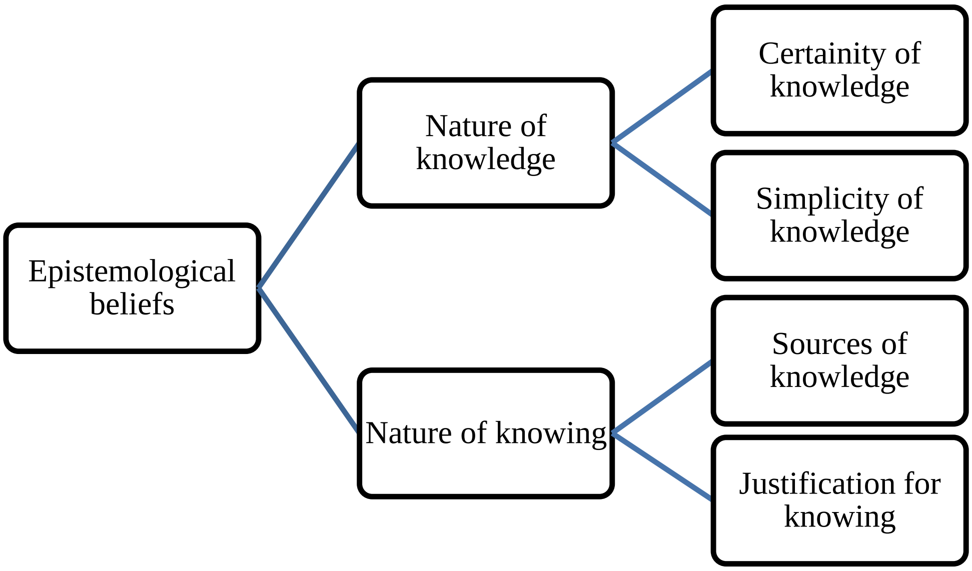


Figure 1.1 Components of epistemological beliefs (Hofer & Pintrict, 1997)

Regarding nature of knowledge, less sophisticated beliefs included thoughts that knowledge is fixed and certain (certainty of knowledge); and knowledge is composed of concrete and discrete facts (simplicity of knowledge). On the other hand, individuals having more sophisticated beliefs think that knowledge is tentative and evolving (certainty of knowledge); and knowledge is complex and composed of highly interrelated concepts (simplicity of knowledge). From the point of nature of knowing, people having less sophisticated beliefs think that external authorities construct knowledge (source of knowledge), and knowledge does not need to be justification (justification for knowing). However, people with more sophisticated beliefs think that knowledge is constructed by knower in an interaction with others (source of knowledge), and knowledge can be evaluated and justified with further evidences (justification for knowing) (Hofer & Pintrict, 1997).

Epistemological beliefs research area has been open to grow since the researchers seek for association of these beliefs with other psychological constructs. Researchers have been interested in the relationship between epistemological beliefs and other variables such as gender (e.g. Baxter Magolda, 1992; Bendixen, Schraw, & Dunkle, 1998), culture (e.g. Chan & Elliot, 2000; Youn, 2000), age (e.g. Schommer, 1998), subject domain (e.g. Hofer, 2000), instructional method (e.g. Brownlee, Purdie, & Boulton-Lewis, 2001; Tsai, 1999), academic performance (e.g. Conley et al., 2004; Hofer, 2000; Ryan, 1984; Schommer, Calvert, Gariglietti, & Bajaj, 1997), and teaching practices (e.g. Pajares, 1992; Yang, Chang, & Hsu, 2008). For that reasons, epistemological beliefs have been investigated in educational research in diverse settings.

1.1.2 Social Cognitive Theory

Social Cognitive Theory (SCT; Bandura, 1986, 1989) proposes a model of causation that shows interplay of three constructs: behaviour, environmental factors and personal factors (see Figure 1.2). According to this model, the reciprocal causation between personal factors and behaviour figures out the interaction between action, thought, and affect. That is, people behaviour is influenced from their thoughts, beliefs, and feelings, and in turn, their behaviours influence these aspects. Next, the reciprocal causation between environmental factors and personal factors reflects the interaction between human beliefs, affects, expectations and cognitive competencies and social influences. Then, the reciprocal causation between environmental factors and behaviour indicates the relationship between human behaviour and their social environment (Bandura, 1989).

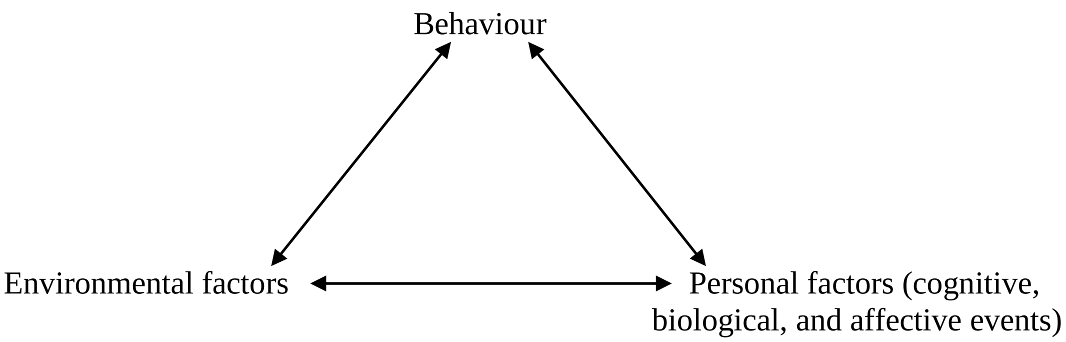


Figure 1.2 A model of social cognitive theory (Bandura, 1989, p.3)

Bandura (1986, 1989) emphasized that the triadic relationship among behaviour, environment, and personal factors do not have to exert equal reciprocal influence. In social cognitive theory, five human capabilities were specified in order to demonstrate the complexity of the human behaviour. These are symbolizing capabilities, forethought capabilities, vicarious capabilities, self-regulatory capabilities, and self-reflective capabilities.

1.1.3 Self-Efficacy Theory

Individual's belief about abilities to execute activities or any tasks is named as self-efficacy. Self-efficacy beliefs, as a psychological construct, motive on actions and willingness to pursue on an activity (Bandura, 1994). Bandura’s social cognitive theory (1986; 1994) provides a basis for self-efficacy theory. Bandura (1977) determined two dimensions of self-efficacy; namely, personal self-efficacy and outcome expectancy. Personal self-efficacy is defined as “belief in one’s capabilities to organize and execute the courses of action required to produce given attainments", and outcome expectancy is defined as "a judgment of the likely consequence such performances will produce” (Bandura, 1997, p. 3).

Bandura (1977) identified four sources of personal efficacy expectations: performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal. First, performance accomplishment depends on personal mastery experiences. While repeated successes increase the mastery expectations, failures decrease the mastery expectations. So, repeated successful practices on a specific task are seen as facilitative mechanism for cognitive and affective change. Second, observation of others' performance is a source of vicarious experience and resulted in efficacy judgements. If others can do it, observers think that they can also do it. Third, verbal persuasion refers to suggestions of leading people. People usually can achieve a task, if they are persuaded verbally or vice versa. However, the influence of verbal persuasion is smaller than the influence of performance accomplishment due to the fact that verbal persuasion does not include a real experience about task. Last, emotional arousal refers to physiological and psychological arousal. That is, stress, worry, fear, or anxiety can influence perceived self-efficacy in overcoming threatening cases.

Self-efficacy belief has emerged as a respectable construct in teacher education research over the past 30 years. Self-efficacy beliefs of teacher include his/her confidence in their own ability to teach (personal teaching efficacy), and expectancy of student learning occurring by virtue of his/her teaching (outcome expectancy) (Ramey-Gassert & Enchos, 1990). In the context of science instruction, Bandura (1994) states that high self-efficacy beliefs of teachers result in allocating long time for science teaching and providing better approaches to make students understand science conceptually. Therefore, educational researchers agreed that teachers' self-efficacy beliefs directly have an effect on what and how they teach in their classrooms. Many research studies provided empirical evidence that self-efficacy beliefs influences teachers’ classroom behaviours (Czerniak & Chiarelott, 1990;

Brickhouse, 1994; Czerniak & Shriver, 1994; Lumpe, Czerniak, Haney, & Beltyukova, 2004; Lumpe, Haney, & Czerniak, 2000), therefore; this situation specific construct (Bandura, 1981) can help to predict teachers' science teaching behaviours.

1.1.4 Theory of Planned Behaviour

The Theory of Planned Behaviour (Ajzen, 1985, 1991; Ajzen & Fishbein, 1980) is the theoretical framework of the present study. The TPB is one of the extensively studied forefront theory to explain human explicit behaviours (Perkins et al., 2007) and the TPB (Ajzen, 1991; Ajzen & Driver, 1991, Ajzen & Madden, 1986) has been empirically well-supported and broadly-used in psychological, social, behavioural, educational, and health sciences (e.g. Alt & Lieberman, 2010; de Bruijn, Kremers, Singh, Mathieson, 1991; van den Putte, & van Mechelen, 2009; Walker, Courneya, & Deng, 2006). The TPB is an extended version of previously developed theory of reasoned action (TRA; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). The TRA was proposed by Fishbein and Ajzen (1975, 1981) to predict human behaviour by means of intention to performing behaviour along with subjective norms and attitude toward behaviour. While behavioural beliefs are antecedents to attitude toward performing a behaviour, normative beliefs constitutes the person's subjective norms about performing a behaviour in both the TRA and the TPB. Ajzen (1985) added one more belief component to the TRA regarding the resources and opportunities for performing behaviour under issue. Madden, Ellen, and Ajzen (1992) stated that individual's perceived behavioural control over the behaviour can be higher if the requisite resources and opportunities are available and vice versa. Higher perceived behavioural control over the behaviour results in the likelihood of person's intention to performing the behaviour. Also, a direct effect from perceived behavioural control to behaviour is assumed to remark actual control on behaviour.

The TPB has been constituted to predict and explain human behaviour in specific contexts. The TPB assumes that the best predictor or motivator of behaviour is behavioural intention, and behavioural intention is predicted by attitude toward the behaviour, social normative perceptions of performing that behaviour, and perceived control over performing that behaviour. Accordingly, three kinds of beliefs shape the human action (see Ajzen, 1991, 2002):

1. *Behavioural beliefs:* Beliefs about the probable results of the behaviour and the analysis of these results. These beliefs are assumed to generate a favourable or unfavourable attitude toward the behaviour (Ajzen & Fishbein, 1975, Ajzen, 1991).
2. *Normative beliefs*: These beliefs are thought as normative suppositions of other people and motivation to comply with these suppositions. These beliefs come about perceived social pressure or subjective norm (Ajzen & Fishbein, 1975, Ajzen, 1991).
3. *Control beliefs:* These beliefs are evaluated as beliefs about the existence of agents that may facilitate or impede behaviour's performance and the perceived power of these agents. Control beliefs bring about perceived behavioural control (Ajzen, 1991).

The theory of planned behaviour proposed that if the attitude toward behaviour, subjective norm and the perceived control is more desirable; in turn, the person will show willingness to try behaviour. In addition, if the actual control over the behaviour is adequate, and the opportunity serves, people will probably perform their intentions. Intention is the most powerful motivator of the behaviour. However, in performing behaviour, a person may face some difficulties. For this reason, in addition to intention, the TPB takes into account perceived behavioural control to predict human behaviour (Ajzen, 1991). Figure 1.3 illustrates the constructs in the theory of planned behaviour.

In addition to aforementioned belief components (i.e. behavioural, normative, and control beliefs), attitude toward behaviour, subjective norm, perceived behavioural control, behavioural intention and behaviour are main constructs of the TPB.

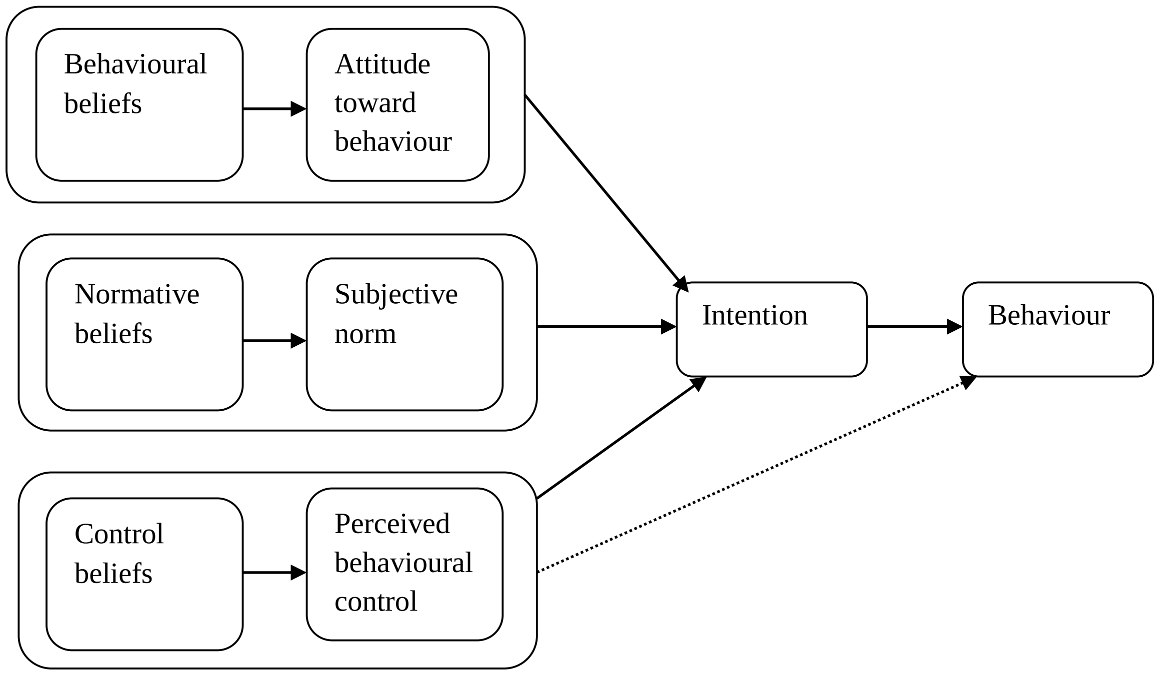


Figure 1.3 Constructs in the Theory of Planned Behaviour (Retrieved from http://people.umass.edu/aizen/tpb.diag.html)

Ajzen (1991) defined three different conceptual constructs as predictive factors of behavioural intention. These constructs are attitude toward the behaviour, subjective norm, and perceived behavioural control.

Attitude toward the Behaviour: Ajzen (1988, p. 4) defined attitude as "a disposition to respond favourably or unfavourably to an object, person, institution, or an event" or "a person’s evaluation of any psychological object" (Fishbein & Ajzen, 1975, p.27). According to the expectancy- value model (Fishbein, 1970) and theory of planned behaviour, attitude toward a behaviour is determined by a set of behavioural beliefs and evaluation of these beliefs. Specifically, each behavioural belief strength (b) is multiplied by the outcome evaluation (e) of the corresponding belief, and the products are summed, as shown in the following equation (1).

$$A \propto \sum b_i e_i \qquad (1)$$

Subjective Norms: Subjective norm is defined as “a person’s perceived social pressure to perform or not to perform a behaviour” (Ajzen, 1991, p.188). It has two components; one of them is, if other people who are crucial for their life approve their behaviour, or not (normative belief strength). The other one is the outcome evaluations of a behaviour. Specifically, the strength of each normative belief (n) is multiplied by motivation to comply (m) with the corresponding belief, and the products are added up, as in Equation (2) (see Ajzen, 1988, 1991).

$$SN \propto \sum n_i m_i \qquad (2)$$

Perceived Behavioural Control: In the TPB, perceived behavioural control was defined as “the perceived ease or difficulty of performing the behaviour” (Ajzen, 1991, p.188). It has two components: the degree of a person’s power of control on a behaviour, and a person’s confidence for the ability of carrying out or not carrying out a behaviour. Particularly, the strength of each control belief (c) is multiplied by the perceived power (p) of the corresponding control factor, and the products are added up, as seen in the Equation 3 (see Ajzen, 1991).

$$PBC \propto \sum c_i p_i \qquad (3)$$

Intention: Intention is the indicator of a personal motivation to try or to plan a behaviour. A linear relationship was assumed between intention and performing a given behaviour (Ajzen, 1991). Ajzen proposed that intention is the most influential motivator of performing a behaviour. According to the theory, intention depends on the attitude toward the behaviour, subjective norm, and perceived behavioural control, with each indicator weighted for its significance in relation to the behaviour and population of interest.

Ajzen (1991, p. 199) asserted that the TPB model is an open model if further important variables are identified:

> The theory of planned behaviour is, in principle, open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variance in intention or behaviour after the theory's current variables have been taken into account.

Conner and Armitage (1998) discussed the TPB in a study of meta-analysis and proposed some evidences for further extension of the TPB in various ways. Previous studies (e.g. Armitage & Conner, 1998; Rivis & Sheeran, 2003) provide theoretical and empirical evidence for additional variables in the TPB model. These variables are listed as past behaviour/habit, self-efficacy beliefs, moral or personal norms, self-identity, and affective beliefs. In guidance of that, additional predictor variables (self-efficacy beliefs, personal norms, scientific epistemological beliefs, and science content knowledge) which taught to be necessary were included in the TPB model for the present study.

Although Ajzen (1991) discussed that *self-efficacy* and *perceived behavioural control* are synonymous, many researchers stated that self-efficacy and perceived behavioural control are different in nature and so, should be evaluated separately (e.g. Armitage, 1997; Dzewaltowski, Noble, & Shaw, 1990; Terry & O'Leary, 1995; White, Terry, & Hogg, 1994). Even if these studies were carried out on different behaviours such as food choice, academic achievement, or physical exercise, the distinction between self-efficacy and PBC is robust. In this study, self-efficacy was herewith assessed as a separate construct in order to emphasize the importance of self-efficacy beliefs on teachers' actions.

Some researchers discussed that the subjective norms were the weakest predictor of behavioural intention in both the theory of reasoned action and theory of planned behaviour (see Godin & Kok, 1996; Sheppard et al., 1988; van den Putte; 1991); therefore, researchers highlighted the need of more normative influences on behaviour (Conner & Armitage, 1998). For instance, some researchers (e.g. Ajzen, 1991; Beck & Ajzen, 1991; Harrison, 1995; Manstead, 2000) proposed to add moral norms to the TPB model. However, it is not relevant to include moral norms in some situations. In these cases, personal norm which is individual's own values about the behaviour may be used (Cialdini, Kallgren, & Reno, 1990). There are lots of studies which found significant contribution of personal norms to prediction of intention (e.g. Schwatrtz & Tessler, 1972; Sparks, Shepherd, & Frewer, 1995; Vermette & Godin, 1996; Kurland, 1996). In Schwartz (1968, 1977) norm-activation theory, personal norms were defined as "the internalized self-expectations that are based on internalized values. Personal norms are experienced as feelings of personal obligation to engage in a certain behaviour". When one's behavioural choices influence the other people, personal norms are activated. In the present study, personal norms were used to predict early childhood teachers' science teaching intentions since teachers may think that their choices in the classroom would influence their students. Thus, in addition to what the others think, teachers' own views were included by means of personal norms.

In addition to personal norms and self-efficacy beliefs, science content knowledge was also included in the TPB model regarding its significance on teacher' science teaching. Many researchers (e.g. Harlen, 1997; Osborne & Simon, 1996; Tilgner, 1990; Appleton & Kindt, 1999) have suggested that elementary, beginning and pre-school teachers show tendency to avoid teaching science. The reason of avoiding teaching science was summarized by Appleton (2007) as lack of science subject matter knowledge, limited science pedagogical content knowledge, low self-efficacy beliefs in science and science teaching. As the previous studies concluded that the knowledge of teacher directly has an impact on teachers' classroom practice, in the present study, science content knowledge of early childhood teachers was taken into account as a predictor of science teaching intention. In addition to that, scientific epistemological beliefs were used as an underlying factor of teachers' science content knowledge.

Epistemological beliefs was also included in the research model as a predictor of science content knowledge level of teachers since it is thought that scientific epistemological beliefs of teachers might influence their science content knowledge at some level. Although studies investigating the relationship between epistemological beliefs and academic achievement mostly conducted with students, there is enough evidence that the more sophisticated epistemological beliefs individual had, the more academic achievement they had (see Ryan, 1984; Hofer, 2000; Schommer, 1990, 1993; Schommer, Crouse, & Rhodes, 1992). On the other hand, the potency of relationship between epistemological beliefs and academic achievement is still under question regarding sample and dimensions of the epistemological beliefs.

1.2 Research questions

The purpose of the present study was to examine the factors that could potentially predict early childhood teachers' science teaching intentions and behaviours in the framework of the TPB. In relation with the purpose of the study, the main problem was determined as "To what extent do the TPB components and related additional variables provide a basis for predicting and explaining early childhood teachers' science teaching intentions and behaviours in their classrooms?". In accordance with the main problem of the study, the research questions were generated as following:

1. What are early childhood teachers' attitude toward science teaching, subjective science teaching norms, perceived behavioural control, personal science teaching norms, self-efficacy beliefs regarding science teaching, science concept knowledge, science teaching intentions, science teaching behaviours?

2. In what ways early childhood teachers' behavioural beliefs, normative beliefs, control beliefs, and epistemological beliefs are related to attitudes, subjective norms, perceived behavioural control, and science content knowledge?
3. How well can early childhood teachers' science teaching intentions be explained by their attitude toward science teaching, subjective science teaching norms, perceived behavioural control, personal science teaching norms, self-efficacy beliefs regarding science teaching, and science concept knowledge?
4. How well can early childhood teachers' science teaching behaviours be explained by their perceived behavioural control, self-efficacy beliefs regarding science teaching, and science teaching intentions?

1.3 Overview of the proposed model

The present study indicated the applicability of the extended TPB model in predicting early childhood teachers' science teaching intentions and behaviours. The extended TPB model explicitly offers a model that allows the exploration of the impacts of diverse factors on teachers' classroom behaviours. In this model, in addition to original TPB predictor variables including behavioural, normative and control beliefs, attitude toward behaviour, subjective norm, and perceived behavioural control; additional variables (i.e. science content knowledge, personal norms, self-efficacy beliefs, and scientific epistemological beliefs) thought to have an impact on teachers' science teaching intentions and behaviours were utilized in the model. While science content knowledge and personal norms were included in the model as a direct predictor of teachers' science teaching intentions, self-efficacy beliefs were used both direct predictor of teachers' science teaching intentions and behaviours. In addition, epistemological beliefs were included in the model as a predictor of teachers' science content knowledge. Thus, relying on the extended TPB model, early childhood teachers' science teaching behaviours are indirectly determined by attitude, subjective norm, personal norm, and science content knowledge through their effects on intention. Moreover, self-efficacy beliefs and perceived behavioural control are both directly and indirectly have an influence on the teachers' science teaching behaviours. Figure 1.4 shows the proposed model to be tested in the analysis. In the model, original TPB variables were represented in blue colour and the additional variables were represented in pink colour.

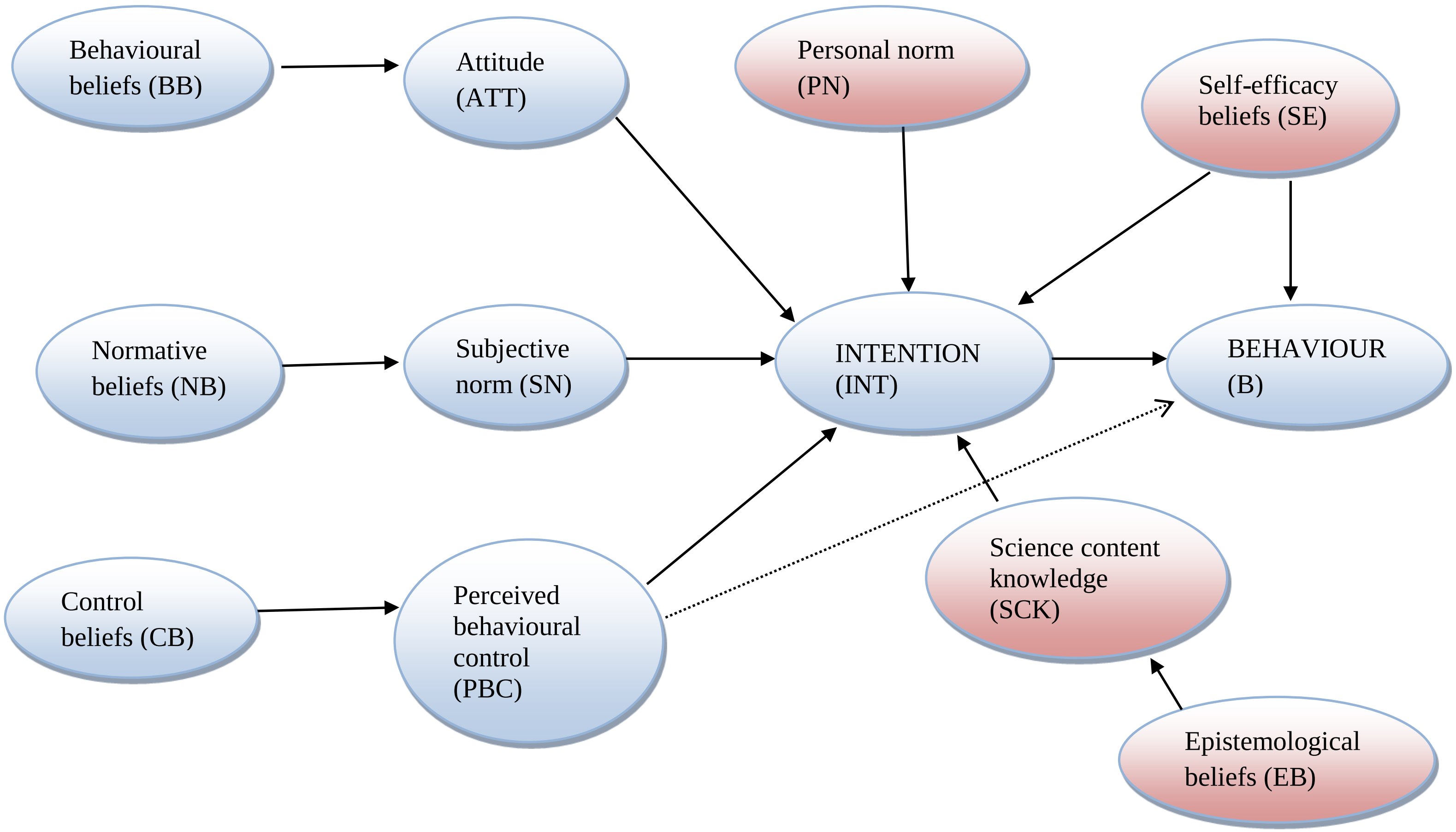


Figure 1.4 Hypothesised model of the study

1.4 Significance of the study

This study is significant in that it addresses several needs by its contribution and implications to the literature, its methodology, and its findings.

In the literature, the number of studies exploring early childhood teachers' opinions about science instruction is expanding (e.g. Olgan, 2015; Sigirtmac & Ozbek, 2011; Edwards & Loveridge, 2011). However, researchers emphasized that there is still requirement of studies examining early science practices of teachers (see Inan, Trundle, & Kantor, 2010; Tu, 2006; Olgan, Guner-Alpaslan, & Oztekin, 2014). In addition, several research papers and reports mentioned the importance of early childhood science education (Kallery, Psillos, & Tselfes, 2009; Yoon & Onchwari, 2006; Tsunghui, 2006; Brenneman & Louro, 2008) whilst there is currently a big gap between what the researchers say about teaching science at early ages and what the teachers do in their classrooms. For instance, some researchers found that science has not been taught as frequent as literacy, art, or mathematics in early years of education (see Sackes et al., 2011; Appleton & Kindt, 1999). It is expected that the present study would help to explain why early childhood teachers hesitate or avoid teaching science in their classrooms. In addition, the study would present the possible barriers that early childhood teachers experience in teaching science in their classrooms and provide information related to conditions that might facilitate science instruction at early childhood level.

In this study, an extended version of the Theory of Planned Behaviour (Ajzen, 1985) was used as an explanatory model for early childhood teachers' science teaching intentions, in turn, their practice of teaching science. Even though the TPB has been used to predict human intention and behaviours in diverse contexts, and researchers conducted meta-analyses to test the efficiency of the theory (see Ajzen, 1991; Armitage & Conner, Godin & Kok, 1996, Rivis, Sheeran & Armitage, 2009), the number of the TPB studies conducted in the context of teacher behaviour was restricted (e.g. Akyol, 2015; Kilic, 2011; Kilic, Soran & Graff, 2011, Lumpe, Haney,

& Czerniak, 1998, Ballone & Czerniak, 2001). In addition, to the best of my knowledge, none of research studies examined early childhood teachers' science teaching behaviour in the TPB framework. Moreover, regarding the proposed model in the study, it could be asserted that the extended TPB model of the study was precursor in teacher behaviour research examining the influence of several variables on teacher intention to teach science. In this perspective, the present research proposed a model based on the TPB suggesting that teachers' science teaching intentions is predicted directly by attitude toward science teaching, subjective norm, perceived behavioural control, personal norm, self-efficacy beliefs, and science content knowledge, and indirectly by scientific epistemological beliefs, behavioural beliefs, normative beliefs, and control beliefs. Besides, teachers' science teaching was predicted directly by intention, perceived behavioural control and self-efficacy beliefs. This model was tested by structural equation modelling with partial least square approach.

In line with the purpose of the present study an instrument, named as *Early Childhood Teachers Science Teaching Intention and Behaviour Questionnaire*, was developed in the framework of the TPB. The validity and reliability of the instrument was provided in Turkish context. Therefore, this research contributes to the teacher education literature by providing valid and reliable instrument exploring possible factors that influence teachers' science teaching intention and behaviour and introduced it to the researchers to use in Turkey's conditions.

Teachers keep their vital role in classrooms in spite of all technological developments in education system. Teacher attributes such as attitudes, ideas, beliefs, or knowledge determine their classroom approaches. Kagan (1992) asserts that the quality of teaching and learning interactions and teachers' personal improvements are most probably determined by the teachers' beliefs. Therefore, revealing teacher beliefs and improving them before their teaching service and also during their teaching service is crucial. Accordingly, the findings of the present study can guide early childhood teacher education (ECE) programs by proposing suggestions how to improve ECE programs regarding teacher attributes about science instruction. In addition, professional development programs or in-service trainings could be prepared for in-service early childhood teachers to developed favourable attitudes, beliefs or knowledge about science by considering the results of the study. The present study also would give clues about the solutions that educators and the Ministry of National Education take into consideration to motive early childhood teachers to teach science in their classrooms. Furthermore, the findings would provide some practical information about the predictors of science teaching intention and behaviour of early childhood teachers which could be regarded as a great attempt to achieve the goals of science education.

1.5 The study context

Since this study was conducted with early childhood teachers working in public schools, short descriptions of early childhood education in Turkey and teacher education program are explained in this section.

Early childhood education in Turkey: Turkish National Education aims to bring up children be able to think scientifically and independently and be constructive, creative and productive as well as prepare them for life by equipping them with the necessary knowledge, skills, and attitude (MoNE, 2013). Early childhood institutions in Turkey can be founded as three types, namely; independent kindergarten for 36-66 months of children, nursery class within the body of primary schools for 48-66 months of children and laboratory classes within the body of girl's vocational and technical high schools for 36-66 months of children (Regulation of Early Childhood Education and Primary School Education Institution, 2014). In addition, early childhood education in Turkey is an optional education for children aged between 3 and 5, before the compulsory schooling.

The Turkish communities increased demand for pre-schooling and realizing the importance of early educational experiences have forced to take governmental actions to meet societies' needs. Accordingly, the early childhood education program for 36-72 months children had been experienced between 2006 and 2013 and improved in accordance with the national and international early childhood studies, feedback of teachers, and the results of the status analysis as apart of the Strengthening Preschool Education Project with the Ministry of National Education. The updated early childhood education program has completed in 2013 and put into action from now on (MoNE, 2013; Olgan, 2015). In the meantime, the number of the children enrolled in an early childhood institution, the number of teachers and schools have obviously increased. By illustration, in both public and private schools, while the total number of the children enrolling in a preschool was 701,762 and the total number of early childhood teachers was 10, 819 in 2006-2007 Educational Year, the total number of children and teachers has increased to 1,156,661 and 29,698; respectively in 2014-2015 Educational Year (National Education Statistics, Formal Education, 2015).

Some of the properties of Turkey's early childhood education program are reported as child-centred, flexible, spiral, and play-based. This progressive program aims to develop children's social, emotional, psychomotor, cognitive, and language skills as well as self-care skills by a favour of holistic-approach. In the ECE program, objectives and indicators help teachers to plan and implement activities in early childhood classrooms (Olgan, 2015). The program gives priority of discovery learning and creativeness which are naturally essentials of science learning and teaching. In addition, some of the cognitive objectives can be adapted into science teaching such as predicting and observing events /objects, or organizing living beings or objects (MoNE, 2013).

In early childhood education program, some examples of science activities were as preparing a board about seasons and weather, examining books and journals, taking photos, discoveries and inventions, observing living and non-living things, walking in nature, preparing food in the kitchen, watching documentaries, introducing the materials of magnets, lens, magnifying glass, compass, mirrors, microscope, and telescope as well as models such as skeleton model, human body model and food pyramid In addition, the program emphasizes the teaching young children environmental awareness, science process skills, daily life events, animal kingdom, chemicals and states of matter, mechanical tools, and etc. as a part of science activities (MoNE, 2013).

Teacher education program: In Turkey, teachers working in preschools or kindergartens have at least a bachelor degree. Turkish teacher education curriculum has prepared in terms of three knowledge categories. Although it can be changed from department to department, in general, 50% of the teacher program is based on field knowledge and skills, 30% of courses are about professional teaching knowledge, and reminder 20% of courses are based on general education courses such as computer application, the history of science, or effective communication courses. In a three credit compulsory science education course, early childhood teacher candidates learn the importance of science and nature activities, teaching techniques of basic science concepts and scientific thinking skills, developing materials, and curriculum of early childhood. In addition to this theoretical part, science education course has a practical part to experience what they learned theoretically (Higher Education Council, 2007; Olgan, 2015).

1.6 Definition of important terms

In line with the purpose of the study, following terms were defined:

Early childhood education: Education program for children aged between 3 and 6 (MoNE, 2013).

Early childhood teacher: Teachers working in preschools or kindergartens with at least a bachelor degree. Early childhood teachers are responsible for preparing and conducting activities on the basis of annual plans provided by MoNE (2013).

The following terms were defined for this dissertation by considering the Theory of Planned Behaviour.

Science teaching behaviour: Science related responses of early childhood teachers in order to teach science.

Science teaching intentions: Likelihood of an early childhood teacher's science teaching.

Attitude toward behaviour: Early childhood teachers' positive or negative evaluation of "science teaching".

Subjective norm: Early childhood teachers' feelings of perceived social pressure to teach science.

Perceived behavioural control: Early childhood teachers' perceived controllability of teaching science.

Personal norms: Early childhood teachers' personal feelings about teaching science.

Self-efficacy beliefs: Early childhood teachers' confidence in their own ability to teach science.

Behavioural beliefs: Early childhood teachers' beliefs about the consequences of teaching science.

Normative beliefs: Early childhood teachers' beliefs about other people's or institutions' approval or disapproval with respect to science teaching.

Control beliefs: Early childhood teachers' beliefs about presence of necessary factors to teach science.

Epistemological beliefs: Early childhood teachers' beliefs about nature of knowledge and knowing.

CHAPTER II

LITERATURE REVIEW

The present study aimed to examine factors influencing early childhood teachers' (ECTs') intentions and behaviours regarding science teaching in the light of the TPB. Accordingly, the aim of this section is to settle the significance of the current study with its relation to previous research and to manifest the issue under consideration is open to investigate (Creswell, 2003). This chapter provides a comprehensive literature review about teaching science to young children and continues with a review of the studies considering science education at the level of early childhood, and finally presents the research studies using the TPB framework in the context of science education. So, this chapter is organized in four main parts: The TPB studies regarding science education, studies conducted with in-service teachers, studies conducted with pre-service teachers, and studies conducted with children.

2.1 The TPB studies in the context of science education

Although the TPB studies are not common in teacher education literature, science education literature serves a few examples of studies employing the theory of planned behaviour as a theoretical framework. To illustrate, Czerniak, Lumpe, Haney, and Beck (1999) studied the science teachers' beliefs and intentions regarding implementing educational technology in the framework of the TPB. The research comprised two stages; uncovering salient beliefs and researchers purposely selected 33 K-12 teachers from North-western Ohio to reveal salient beliefs considering the implementation of educational technology. For the second stage of the study, a randomly chosen 250 teachers responded the research questionnaire. According to the results of the first stage, teachers believed that using educational technology offer teachers to use a range of instructional strategies, make science more enjoyable and interesting, motivate students in science classrooms, provide contemporary science information to students and etc. In addition, teachers thought that school administrators, colleagues, parents, students, college professors, and school board members were the referent group approving or disapproving their use of educational technology. Moreover, teachers stated that availability of resources, staff development opportunities, internet access, classroom conditions, the number of students, and administrative supports were things that would facilitate or impede their use of educational technology in their classrooms. In the second stage of the study, regression analyses were conducted to examine which factors influence teachers' intention to use of educational technology. Results indicate that subjective norm and perceived behavioural control were significantly predicted the teachers' intention and accounted for 62 % of the variance in teachers' intention to use educational technology. In addition, teachers' self-reported behaviour of educational technology usage was influenced from their intention to use of educational technology and accounted for by 18 % of the variance. At the end of the study, researchers concluded that teachers need support in five areas which are the support from the normative group, resources such as equipment, and software, supporting classroom structures, staff development opportunities, and time for learning, planning and implementing educational technology.

In another TPB study, Czerniak, Lumpe and Haney (1999) examined the teachers' beliefs and intentions regarding implementation of thematic units in science classrooms due to the fact that new science reform documents expects teachers to include thematic curriculum. As similar to their previous study (Czerniak et al., 1999), this study included two stages. In the first stage, purposively selected 18 K-12 teachers' salient beliefs regarding thematic teaching of science were revealed by open ended questions and the research questionnaire was constructed. In the second stage of the study, randomly selected 76 teachers participated in the study. Teachers from all grade levels from kindergarten to grade twelve were included in the sample. Open ended responses indicated that using thematic units during teaching science make science interesting and meaningful for students. On the other hand, some teachers stated that using thematic units would be time consuming and less content would be taught by thematic units. Teachers stressed that professional organizations expect them to teach thematic units in addition to principal, students, colleagues, university professors, and educational psychologists. Moreover, availability of resources and staff development opportunities were listed as the facilitating factors to implement thematic units. On the other hand, some teachers felt that testing and assessment, lack of time, lack of resources, and lack of experience using thematic units were impeding factors to implement thematic units. In the second stage, regression analyses yielded that all three direct measures of the TPB (i.e. attitude, subjective norm and perceived behavioural control) were significantly predicted teachers' intention to implement thematic units and 56 % of the variance in intention was explained by these three constructs. The most influential construct was found to be perceived behavioural control and the subjective norm has the weakest influence on intention. In addition, the impacts of demographic variables on the model variables were examined and only there was a significant relationship between the grade level taught and intention to implement thematic units. Teacher of lower grade levels had higher intention to include thematic units than the teachers who taught upper grade levels. At the end of the study, the researchers concluded that both in-service and pre-service programs should consider teachers beliefs before planning seminars, workshops and classes due to the fact that teachers beliefs have a strong influence on their implementation of thematic units. In addition, teachers need some support to implement thematic units such as resources, curriculum materials, staff developments and etc.

More recently, Kilic, Soran and Graff (2011) examined the factors influencing Turkish and German pre-service biology teachers' intentions to teach evolution in the framework of the TPB. One hundred and sixteen pre-service teachers in Turkey and 154 pre-service teachers in Germany participated in the study. In the first stage of the study, interviews were conducted with 40 Turkish and 77 German pre-service teachers. Then, the survey questionnaire was developed in line with the TPB and frequently mentioned beliefs during interviews. The questionnaire was named as "Evolution Teaching Intention Survey". The model was tested by structural equation modelling, and the differences two group of participants were tested by independent samples t-test and MANOVA. The descriptive statistics showed that Turkish and German pre-service biology teachers illustrated quite high motivation to teach evolution. In addition, Turkish participants' intentions to teach evolution were higher than German participants. The t-test indicated that there was not a significant difference between Turkish and German pre-service teachers regarding intention to teach evolution. However, it was found that there was significant difference between Turkish and German pre-service teachers' attitudes, subjective norms, and perceived behavioural control regarding teaching evolution. According to the structural modelling, Turkish pre-service biology teachers' intentions of teaching evolution was influenced by the attitude and perceived behavioural control; however, German participants were impacted by attitude and subjective norm. The strongest factor for two groups was attitude toward behaviour. The factors explained 61 % of variance of Turkish participant pre-service teachers' intention to teaching evolution, 52% of variance in German participants. Besides, the differences in culture and educational systems affected the attitudes of the two groups regarding the underlying beliefs. Two reasons for insignificance of subjective norms in Turkish participants were indicated. Turkish pre-service teachers believed that people were expected them to teach evolution but other people's expectations did not make any effect on their choice to teaching evolution. And also, the perceived behavioural control did not affect the German participants' intentions because they did not have any issues with dedicated time for evolution, teaching materials and the place of the evolution in the curriculum. As a result the authors reflected the existence of other factors in German participant's intentions due to the fact that explained variance in German participants' intentions was smaller than Turkish participants.

Another study reported by Kilic (2012) as the Turkish and German biology teachers' intentions in teaching evolution and factors regarding their intentions in the light of the TPB. In her study, 25 Turkish and 12 German biology teachers participated. Teachers' teaching experience was ranged from 2.5 to 30 years. In line with the TPB, semi-structured interviews were conducted. It was revealed that Turkish and German biology teachers' intentions and related factors were different. It was believed that the reasons of those differences were the values related to the culture and religion. According to the findings, except five of the Turkish teachers, all of the participants in both groups showed a positive attitude in teaching and intentions to teach evolution. Besides, 18 of the Turkish teachers were in the idea that the society did not want them to teach evolution. However, all of the German teachers believed that they should teach evolution as a part of their work. Furthermore, all German participants had strong perceived control in teaching evolution. Whereas, three of the Turkish teachers' mentioned that current conditions were not suitable for teaching evolution. The researcher concluded that, in general, German teachers showed more desire to teach evolution in their classrooms.

Recently, Akyol (2015) conducted a study with a sample of pre-service science teachers (N= 1172) in order to examine the applicability of the TPB in predicting pre-service teachers' integrating of NOS intentions in their science teaching. The participant pre-service science teachers were applied *to "Intention to Integrate NOS Questionnaire"*. The researcher proposed a model in the TPB framework suggesting that intention to teach NOS during their instruction was explained by attitude toward behaviour, subjective norm, and perceived behavioural control. Unconstrained approach based on double-mean-centering strategy was used to assess the research model. The researcher found that attitude toward behaviour and perceived behavioural control were significantly predicted pre-service science teachers' NOS instruction whilst subjective norm did not (β = .04, p >.05). The contribution of these two constructs in the model; namely, attitude toward behaviour (β = .24), and perceived behavioural control (β = .25) was approximately the same. In addition, the model explained 16.9 % of the variance in participant pre-service teachers' integration of NOS intention. It was concluded that there could be other factors influencing pre-service teachers' intention to integrate NOS in their science classes; therefore, future studies can include factors such as NOS knowledge, personal norm, and self-identity in the model.

These studies indicated that TPB can be applied in the context of science education in diverse settings. In the TPB components, while some studies found that attitude toward the behaviour was the most influential factor (Kilic et al., 2011), some others found perceived behavioural control was the most important factor to predict teachers' intentions (Czerniak et al., 1999). On the other hand, Akyol (2015)'s study indicated that attitude toward behaviour and perceived behavioural control regarding teaching NOS in science education had the equal impact on intention. In addition, subjective norm component was found weakest predictor for intention (Akyol, 2015; Czerniak et al., 1999; Kilic et al., 2011).

2.2 Research on in-service teachers

Although a considerable amount of literature exists on the factors influencing teachers' science teaching behaviours, the number of such studies in the context of early childhood education is restricted. Previous empirical studies regarding science instruction for young children have focused on various issues in different contexts. In conjunction with the present study, the studies regarding early childhood teachers' perceptions about conducting science activities, science content knowledge, confidence in science teaching, scientific epistemological beliefs, and attitudes toward science teaching were examined in detail to display the findings of previous research studies. In respect of methodological perspectives, while a few researchers attempted to find out the underlying factors in qualitative studies (e.g. Cain, 2012; Appleton & Kindt, 1999), the others focused on specific constructs such as attitude, or self-efficacy beliefs of teachers regarding science teaching in a quantitative manner. In this part, firstly international studies, then the studies conducted in Turkey were reported.

In an earlier attempt to understand what kind of factors influencing teachers' science teaching, Appleton and Kindt (1999) conducted a study with beginning teachers' regarding science teaching. What factors facilitate or impede teaching science of beginning teachers were investigated in a qualitative manner. Nine beginning teachers including preschool teachers and primary teachers were interviewed in their schools in a length of 30 to 45 minutes. One of the participant teachers was taught both preschool and grade one, 2 of them were preschool teachers, and the other teachers were taught the grades from 2 to 6. While three teachers' schools were located in small cities, the remained teachers' schools were in rural towns. Only one of the participant teachers was male, the others were female. The data were analysed by discourse analyses after transcription was done. It was found that collegial support, self-confidence in science, perceived importance of teaching science, and resources were the main factors influence teachers' science teaching behaviours. Seven of the participants did not feel confident during science teaching. One of the teachers who stated herself as feeling confident in teaching science had taken science education courses at high school and at university. Besides, she practiced modern science in her classroom. In addition, four of the teachers stated that science was not an important subject until high school level and those teachers attached priority to other subjects such as language or math. Another factor of teachers' science teaching was availability or usability of the resources need for science instruction. Six of the teachers emphasized the importance of resources for activities. The researchers concluded that in addition to the teachers' personal limitations such as self-confidence or motivation, systematic support of the schools was missing for effective science teaching.

Align with the educational reform process; professional development programs have gained importance in terms of providing evolution of teachers. An example of this situation is the study carried out by Duran, Ballone-Duran, Haney, and Beltyukova (2009) in which they explored the impact of a unique professional development program (named as ASTER III, Active Science Teaching Encourages Reform) on the teachers' self-efficacy beliefs and perceptions regarding inquiry- based science teaching while designing science program and field trips in line with the national science education standards. Twenty-six early childhood teachers teaching K-3 level were composed the sample of the study. Participant teachers were previously participated in the ASTER I and II professional development projects and they work in public or private schools. Data were collected by both quantitative and qualitative methods. “Survey of Teacher Beliefs in Inquiry-Based Teaching” (STBIBT), the “Science Teaching Efficacy Belief Instrument” (STEBI-A; Riggs & Enochs, 1990) and reflective journals were used as data collection tools. Results showed that professional development program significantly influence teachers beliefs in a positive way. In addition, analysis of reflective journals revealed three themes; namely, effect on inquiry understanding of teacher, improvement in teacher confidence for science teaching, and advantage of collaboration. This study indicated the importance of professional development programs for teachers.

Similarly, regarding the importance of professional development program, Roehrig, Dubosarsky, Mason, Carlson, and Murphy (2011) carried out a study to reveal the effect of a long term, sustained, culturally-based professional development program on early childhood teachers’ science teaching practices. Research was designed by mixed method study. The quantitative part was designed to find out changes in the quality of science teaching practices over time with a focus on teacher-student interactions. The qualitative part of the study was designed to understand deeply the teachers’ science teaching practices throughout the 2 years of the professional development program and it included informal interviews, surveys, and observations of professional development sessions and teaching practices. “Classroom Assessment Scoring System” (CLASS; Pianta, La Paro, & Hamre, 2008), a validated instrument by 3,000 classrooms across the United States, was used as an observation protocol. CLASS is concerned about the interactions in the classrooms and measures the quality of interactions in three domains: *Emotional Support, Classroom Organization,* and *Instructional Support.* The results of the research showed that sustained, culturally based professional development program positively changed the quality of science teaching practices of teachers. After this program, teachers were observed as that they look, listen and notice more.

In another study, Edwards and Loveridge (2011) carried out an exploratory study in order to find out how professionally trained early childhood teachers supported young children's science learning and their thought about science related issues such as children scientific interest or their own beliefs about science. It was a case study conducted in a well-established, full-day and profitless childcare centre located in New Zealand. Six teachers who completed their professional training participated in this qualitative study. Data were collected in three week by means of video and audio recordings, interviewing, and note-taking equipment. Results showed that teachers' personal teaching philosophy, science content knowledge, and nature of science (NOS) conceptualization were considerable factors to support children's science learning. Moreover, participant teachers referred mostly collective knowledge and teaching team. For instance, they received support of other teachers to accomplish perceived obstacles in relation with children's science learning. Teachers' NOS understandings were in various extents and they showed inconsistent ideas about nature of science. Researchers discussed that this result might be due to lack of emphasis on NOS in teacher training programs in New Zealand.

Cho (1997) conducted a study in order to explore early childhood teachers' attitudes toward science teaching and found causal agents of teachers' attitudes. In this study, researcher used both quantitative and qualitative methodologies. A modified form of "Revised Science Attitudes Scale" (Thompson & Shringley, 1986), demographic questionnaire, and in-depth interviews were used for data collection. 128 early childhood teachers were participated in the study from New York City. It was found teachers had rather positive science teaching attitude; however, several teachers were distressing about teaching science for young children. Multiple regression analysis showed that five variables out of eight variables (i.e. teachers' education levels, experience, teaching level, child to teacher ratio, number of science content courses, taken science method courses, participation in in-service science workshops, and personal science interest) were determinants of early childhood teachers' attitudes toward science teaching. These related variables were teaching level, ratio of child to teacher, taken science methods courses, attendance of in-service training about science workshops, and personal interest on science. Interviews were used to enlighten the quantitative analysis by providing teachers' crucial experiences and perceptions about science teaching. It was concluded that there is a need a well-assisting ECE teacher training programs to make early childhood teachers improve positive attitudes toward science teaching since early childhood teachers' positive attitude is fundamental to young children science learning.

Regarding science corners in preschool contexts, Tu (2006) conducted a study investigating preschool science environments. Twenty preschool classroom environment and preschool teachers' practices were examined in terms of science materials, science activity centres, and teacher science related activities. Science related activities are named as *sciencing* by Neuman (1972) and this concept guided Tu's study. Three instruments were used in this study in order to measure aforementioned issues. These were "The Preschool Classroom Science Activities Checklist", "The Preschool Classroom Science Materials/Equipment Checklist", and the "Preschool Teacher Classroom/ Sciencing Coding Form". It was found that vinyl animals, plants, sensory tables, posters and charts, and magnets were the most common materials, respectively. In addition, prisms, timers, and flower pots were the most common equipment, respectively. On the other hand, only half of the classrooms had a science area and the percent of science related activities were quite low. Formal science activities were only 4.5%, and informal science activities were

8.8 % of total activities. At the end of the study, it was suggested that preschool teachers should be aware of their teaching practices, and increase their usage of science materials available in their classroom in order to engage their children scientific activities.

Another study was conducted with Greek female kindergarten teachers in order to investigate their knowledge and scientific understanding and how their science knowledge were performed in real classrooms (Kallery & Psillos, 2001). Researchers divided the study in two parts. In the first part, all participant teachers (N = 103) were asked to complete a semi structured questionnaire about their own conceptions of the phenomena and issues. In the second part of the study, 11 of the participant teachers were asked to be observed in their classrooms for a whole school year in order to investigate the type of knowledge they used in real classrooms. Both parts of the study showed the consistent results in terms of teachers' conceptions about science. It was found that science content knowledge of teachers and their conceptual understandings were poor. In addition, the teachers used irrelevant scientific conceptions, which was named as alternative conceptions (e.g. misconceptions and confusing expressions), during science activities in their classrooms. The researchers evaluated teachers' alternative conceptions may be because of lack of information, personal beliefs, or lapsed knowledge.

In a separate study, Sackes, Trundle, Bell, and O'Connell (2010) conducted a study to predict teachers' science teaching practices in terms of frequency and duration of science instruction. "Kindergarten Teacher Questionnaire", "Science Materials, Frequency and Duration of Science Teaching", "Children's Science Activities" instruments were used to collect data from teachers. The results indicated that teachers' science teaching was facilitated by means of availability of science materials in kindergarten classroom, and this also increased the children participation in science activities. In addition, the frequency and the duration of science teaching was found as a significant predictor of children's science activities;

whereas, this did not influence the children's science achievement scores at the end of the kindergarten. Children's active participation in science activities by using science equipment did not influence the end of kindergarten science achievement scores. However, cooking activities was a significant predictor for science achievement scores and prior knowledge of children, gender, motivation, and socio-economic status were all statistically significant predictors of at the end of the kindergarten and third grade. Researchers concluded that early science experiences did not significantly influence the children immediate and later science achievement. This result was discussed in terms of limited time and nature of science instruction.

In another study of Sackes (2014), a theoretical model was developed in line with the related literature to examine frequency of early childhood teachers' teaching science concepts. In this model, teachers' background (taken science method course and teaching experience), teachers' perceptions (child capacity to learn, curriculum content), and classroom resources were used as independent variables and teaching of science concepts in kindergarten was used as a dependent variable. A large data set (N=3305) coming from early childhood teachers' in Unites States was used to test proposed model and multi-level structural equation modelling was used as an analytical tool to analyse data. The results showed that the frequency of teaching science concepts were influenced by the number of science method course taken by teachers, the presence of materials to teach science or presence of science and nature areas, and perceptions of teachers about children learning. On the other hand, teachers' perceptions about curriculum content and their teaching experience did not have any influence on the frequency of science teaching.

In another study, Walker et al. (2012) conducted a study in order to explore the association between Australian early childhood teachers' (the researchers stated as early years teachers) epistemic beliefs and their beliefs about moral learning of children. 379 teachers participated in this study and completed research survey. It was found that the more sophisticated epistemic beliefs teachers had, the more they thought that children could take responsibility for their moral learning. On the contrary, teachers who had simplistic epistemic beliefs thought that children should learn morals during learning the behaviour rules. Researchers discussed the results from the point of implications of moral pedagogy in the classroom and professional development of teachers. In addition, Walker and his friends suggested that as a part of professional development explicit focus on epistemic beliefs may help teachers to determine how their beliefs can be related to their moral pedagogies.

In a more recent study, in Turkish context, Erden and Sonmez (2011) aimed to investigate early childhood teachers' attitudes toward science teaching and its relationship with teachers' science teaching practices, and some demographic characteristics such as experience, or educational level. The data were collected by "Early Childhood Teachers' Attitudes toward Science Teaching Scale" (ECTASTS) from 292 early childhood teachers employed 'n public and private schools in Ankara, Turkey. ECTASTS was modified by Cho, Kim, and Choi (2003) for ECT from the initial version of "The Science Attitude Scale" (Thompson & Shringley, 1986) which was developed for pre-service elementary teachers primarily. It was found that there was a positive relationship between the frequency of science activities conducted by teachers and attitudes towards science teaching, but the relationship was very small ($r = 0.06$). Therefore, researchers concluded that there might be other factors influencing teachers' science teaching practice and attitude. On the other hand, it was found that there was no impact of teachers' educational level on their attitude towards science teaching. Regarding experience of teachers, it was revealed that teaching experience did not have an impact on classroom preparation, managing hands-on science and comfort level of teachers; whereas, it had a significant effect on developmental appropriateness. Lastly, the teachers worked in private schools showed more positive attitude towards science teaching. Researchers discussed that the reason of this result might be that private schools had more opportunities (e.g. activity materials, or equipment) to carry out science activities than public schools.

In a similar study, Ünal and Akman (2006) conducted a study to reveal early childhood teachers' attitudes towards science teaching. Researchers collected data from 160 teachers. "A Science Attitude Scale" (Hyung-Sook-Cho, 2003) was used as data collection tool. Researchers found a significant relationship between teachers' attitudes toward science and their school levels, in-service training and cities they work.

Similarly, Ozturk-Yılmaztekin and Tantekin-Erden (2011) conducted a case study aimed to reveal early childhood teachers views about science teaching by using interview and observation method. Five early childhood teachers working in private schools participated in this qualitative study. Teacher educational background was diverse. Two of the participant teachers had a graduation degree from the Girl Vocational High School, one of them graduated from two-year vocational training school, one had a bachelor degree from the department of elementary education, and the last teacher graduated from the department of radio, television, and cinema. Teachers' experiences were ranged from 2 to 10 years. Participants were asked about their ideas on conducting science activities, science concepts, implementation of science process skills and their choice of science teaching method by a 10-question of interview. In addition, researcher collected observational data by taking field notes in classroom settings. At the end of the study, researcher found that all participant teachers allocate time for science activities at least once a week, however, their choice of activities may differ in accordance with children's interests or requirement of the day. Some of them took into consideration children's interest; whereas some pursued on daily planning. The participant teachers mostly stated that they used "field trips and investigation" as a teaching method and "observation" as a science process skill. One of the participant teachers emphasized that parents' did not think that science learning of their children were as important as their children's reading, writing, and mathematic learning. Researchers concluded that to understand teachers' classroom practices their beliefs should be examined. In addition, this study emphasized the importance of school environment to motivate teachers' to teach science.

In another study, Sigirtmac and Ozbek (2011) conducted a study in order to determine early childhood teachers' opinions regarding planning and implementation of science activities. The sample of study was included 64 early childhood teachers working in MoNE preschools in Nigde, Turkey. Both quantitative (survey for teacher opinions on preschool science education) and qualitative methods (interview and observation) were used for data collection. Quantitative data was collected by using “Survey of Preschool Teachers' Views on Science Education” and qualitative data was collected by science activities observation record form and semi-structured interview. The results of this study showed that the participant teachers were aware of the importance of science education in early ages, however; almost half of them expressed that they did not feel comfortable to teach science and to answer children questions based on scientific knowledge. In addition, teachers stated that they did not have adequate materials and science corners to conduct science activities which in turn resulted in delimitation of science activities. Researchers suggested that teacher education programs and in-service training programs on teaching science and developing science materials are necessary for effective science education in early childhood programs.

In an earlier study, Ayvacı, Devecioglu and Yigit (2002) explored early childhood teachers’ ideas on science and nature activities. Fifteen teachers were randomly selected in both public and private schools. Data were collected by interviews and classroom observations. Almost half of the teachers thought that science and nature activities can be conducted in laboratory, natural environment or classroom. On the other hand some teachers believed that science and nature activities can be conducted only in laboratory. In addition, all the participant teachers preferred to use traditional science teaching methods. It was found that teachers were incapable of science material design for science activities, they were lack of fund to get science materials, they were not open to inquiry methods, and did not spend time for science activities. Results indicated that participant teachers had inadequate skills on planning and conducting science and nature activities, they could not develop original materials, and they were not aware of effective teaching methods such as drama or role playing.

In another study, Karamustafaoglu and Kandaz (2006) aimed to find out the science teaching methods used in preschool classroom and the difficulties encountered during science instruction. Survey of the study was completed by 50 early childhood teachers employed in preschools in Trabzon, Turkey and 10 teachers participated in semi-structured interviews. The results indicated that materials necessary for science activities were inadequate or lacking. The most frequent science teaching method used by teachers was expository teaching and none of the teachers used computer based instruction and problem solving technique. Participant teachers reported the problems that they faced with during science teaching as crowded classrooms, lack of place or laboratory, reluctance of parents or administration, deficiency in teachers' pedagogical knowledge, inappropriate curriculum and classroom management.

More recently, Olgan (2015) conveyed a study in order to investigate the topics taught in Turkish early childhood settings in addition to early childhood teachers' frequency of teaching science. Three hundred and eighty two (372 female and 10 male) early childhood teacher participated in the study in Ankara, Turkey. Participant teachers were predominantly young teachers and had an experience of zero to five years. The questionnaire of the study was adapted from the “Early Childhood Longitudinal Study - Kindergarten Class of 1998–1999” (ESLS-K) kindergarten data file (National Centre for Education Statistics [NCES], 2001). The list of science topics were given to participant teachers and then asked to rate which topics they taught in their classrooms. In addition, teachers were asked to rate the frequency of their science teachings on a 6-point scale (1 stands for "should be taught at higher grades, 3 stands for "less than once a week", and 6 stands for "do not know") and the time they spent for science teaching in a day. Moreover, Olgan conducted interview with 14 early childhood teachers in the sample on the effectiveness of ECE programmes, teachers' confidence in science instruction, barriers they encountered during science instruction, collegial and school support regarding science teaching. Results indicated that teachers mainly preferred to teach life and health science topics which include human body (97.9 %), health and nutrition (92.2 %), and plants and animals (97.4 %). Mostly, participants stated that science courses taken during their undergraduate program were inefficient in making them ready for teaching science both theoretically and practically. Thus, most of them thought that teacher education program needed to be improved to provide more functional science instruction for young children. Moreover, almost 72 % of the participant teachers complained about inadequate materials to teach science and some of the participants (35.7 %) underscored the significance of having sufficient place to perform science activities. Other obstacles teachers faced during science activities were listed as time restriction, difficulty in preparing and conducting science activities, experience in science, pedagogical content knowledge, lack of collegial and school support. Researcher concluded that Turkish early childhood teachers do not allocate enough time to teach science and do not give enough importance on science teaching. Therefore, it was suggested that Turkish early childhood teachers should participate in professional development programs regarding science instruction.

2.3 Research on pre-service teachers

In an earlier attempt, Coulson (1992) developed an instrument, called as “Early Childhood Educators' Attitudes towards Science Scale” (ECEASS), in order to measure early childhood educators' attitudes towards science and to assess the effectiveness of science courses given in college. Two hundred students at their first year in the department of "Early Childhood Studies" were participated in the study. Most of the participants were female (N = 197). The instrument included Likert type scale, demographics, and two open-ended items. Likert type scale comprises four dimension; namely, confidence, enjoyment, usefulness, and appropriateness of science for young children. Varimax factor analysis is conducted in order to check whether the items were in their intended scales, and principal components analysis is conducted to see whether there was a general factor for the all items. In the former analysis, the reliability coefficients were varied from .83 to .88, and the latter analysis it was found that the combined scale had a reliability coefficient of .94. Although this was an instrument development study, the researcher reported that participant pre-service early childhood students who attend at least one science subject showed more positive attitude than the students who did not study science.

In a more recent study, Cain (2012) conducted a study in order to grasp the relationship between teacher trainees' beliefs about teaching and learning and their classroom practices by using case study method in Trinidad and Tobago. Participant trainees hold well-structured beliefs about teaching and learning and their beliefs had impacts on their classroom practices. Some situational and personal factors such as confidence, skills in given area, experience, and knowledge were found to have influence on teacher classroom action. The researcher stated that personal factors were presented both as facilitators and barriers. In addition, knowledge and skill in a specific area was found to be key factors for trainees to enact, or not enact their teaching beliefs in their classrooms.

Akerson, Buzzelli, and Donnelly (2010) carried out a research in order to explore how early childhood pre-service teachers' concerns about teaching NOS and their Perry intellectual positions (dualism, multiplicity, or relativism) influence their NOS teaching at the preschool and primary classrooms (K-3). Data were collected by videotaped classroom observations and lesson plans during pre-service teachers' internship in preschool and primary classrooms. Four participants were selected purposely with a range of intellectual levels and NOS concerns to see whether and how these characteristics influence NOS instruction. Stages of Concern Questionnaire (SOCQ) pre- and post-internship to reveal NOS instruction concerns and the Learning Context Questionnaire (LCQ) to determine intellectual levels. Results indicated that neither NOS instruction concerns nor intellectual levels were impact on teaching NOS; however, all pre-service early childhood teachers started their internship in a “worried” profile for NOS concerns. Two of pre-service teachers’ cooperating teachers had sophisticated NOS views and they gave place to NOS in their science instruction. These two pre-service teachers were influenced from their cooperating teachers about the factors that hindered or facilitated teaching and how the curriculum could be modified in order to include NOS. On the other hand, pre-service teachers whose cooperating teachers did not provide NOS instruction in their science teaching did not include NOS in their teaching. This study has drawn the attention toward teacher preparation programs and their internship.

In a more recent study, Bell, Mulvey, and Maeng (2016) conducted a qualitative study to examine the effectiveness of NOS instruction on the development of pre-service science teachers' NOS conceptions and intention to teach NOS in line with the conceptual change theory. Seventy pre-service science teachers in the USA (50 female and 20 male) participated in the study. Data was collected by “pre- and post-instruction Views of NOS” (VNOS-Form C) questionnaire and a post-instruction interview during the first and last day of science methods course. It was found that pre-service teachers' NOS conceptions were changed from non-aligned to partially or fully aligned and the differences between pre- and post-test were statistically significant for each NOS tenet. In addition, participant stated that they planned to teach NOS as a part of science instruction. The researchers concluded that NOS instruction along a context continuum is effective for both pre-service teachers' NOS conceptualization and their intention to teach NOS.

In another study, Alisinanoglu, Inan, Ozbey, and Usak (2012) conducted a study in order to explore early childhood teacher candidates' qualifications of science teaching and developing science process skills. Survey data were collected from 197 senior teacher candidates studied at three different universities in Turkey. The teacher candidates completed all their courses since the data was collected just one week before their graduation. Collected data was included teacher candidates point of views about their own science teaching behaviour (given importance, used methods, and etc.), their skills on science material construction, their planning and performing of science activities, and their ideas about future science practices. In addition to open ended questions, “The Early Childhood Teachers' Qualifications in Science Activities Scale” developed by Ozbey and Alisinanoglu (2010) and “The Questionnaire Form for the Identification of the Opinions, Attitudes, and Expectations of the Early Childhood Teachers about Science Activities” were used in order to reveal opinions, attitudes and expectations of teacher candidates about science teaching. At the end of the study, participant teacher candidates were found to have some misbelieves about the application of science activities. For instance; they thought that children should watch the experiments and teachers should do the experiments or the topics of world, light, stars, and magnetism were not applicable in ECE centres. Moreover, the levels of qualifications of teacher candidates to carry out and plan science activities were really high in general. Teacher candidates thought that they would not allocate time for science activities in a regular basis since they thought that planning and performing science activities were not easy tasks and many of them felt uncomfortable about this issue. Also, teacher candidates stated that the present science activity books were not sufficient for them to conduct science activities.

In a more recent study, Olgan et al. (2014) investigated how pre-service early childhood teachers' outcome expectancy beliefs were influenced by their scientific epistemological beliefs, personal self-efficacy beliefs, and attitudes toward science. 362 pre-service teachers participated in this quantitative study. The data were collected by these instruments: “Epistemological Beliefs Questionnaire”, the “Science Teaching Efficacy Belief Instrument” and the “Science Teaching Attitude Scale”. Researchers found that personal self-efficacy beliefs and justification of scientific knowledge, a dimension of epistemological beliefs, were significant determinants of pre-service early childhood teachers' outcome expectancy beliefs as to science teaching. However, other dimensions of epistemological beliefs (source/certainty of scientific knowledge and development of scientific knowledge) and attitude towards science teaching did not have an impact on outcome expectancy beliefs of pre-service early childhood teachers.

An overview of research studies has revealed that early childhood teachers play a vital role in drawing children curiosity toward science and their behavioural choices shape the learning environment (e.g. Sackes et al., 2011). In addition, teachers' confidence about their science content knowledge directly influences the frequency of science activities and the way science taught (e.g. Czerniak, 1989; Harlen, 1997). Furthermore, teacher beliefs and perceptions, teachers' confidence in science teaching, science content knowledge, and collegial support are the key factors having impacts on teaching science in early childhood classrooms (see Appleton & Kindt, 1999; Erden & Sonmez, 2011; Sigirtmac & Ozbek, 2011). As well as personal and social factors, contextual factors such as availability of resources, teacher training programs or classroom/school conditions are also significant impacts on teachers' classroom behaviours. Several researchers concluded that the more teachers have science-related instructional materials, the more they conduct science activities and also teach inquiry skills in kindergarten classrooms (e.g. Tu, 2006; Saçkes et al. 2011; Inan, Trundle, & Kantor, 2010; Appleton & Kindt, 1999; Sigirtmac & Ozbek, 2011; Erden & Sonmez, 2011). For that reason, availability and usability of the resources are under issue for effective science teaching in early childhood classrooms.

2.4 Research on science conceptions of children

In this part, some examples of research studies conducted on children's science conceptualizations were given.

Venville (2004) conducted a case study in a Year-1 classroom in one of the London primary school in order to explore children opinions about living and non-living things. The study lasted 5 weeks during studying the topic of living and non-living things in science. The ordinary teacher of the classroom was a female teacher having 5-years of teaching experience and the researcher worked in a cooperation with her on this project. The data was collected by interviews, observations and field notes. Then the data was analyses by analysing these data sources coming from student, class, and teacher. A total of six lessons were observed in a 5-week period. Eleven students participated in the interviews before and after the instruction in order to take their ideas about living and non-living things. The interview data was examined in detail for grasping clear patterns and distinctions about students' conceptualizations and their ideas were classified as "non-scientific" or "scientific" views before and after instruction, and "transitional" during the instruction. The children using a non-scientific criteria for living things made non-scientific classification. On the other hand, children who had scientifically accepted criteria made classifications scientifically. In addition, only two children indicated transitional views about living and living things by using both scientifically accepted and non-scientific criteria. The results indicated that participant students held either stable and scientific theories, or stable and non-scientific theories about living and non-living things in both pre- and post- instruction. In addition, students who had non-scientific views showed many ontological opinions about living things such as that living things live in home, or living things can not be broken. On the other hand, students having scientific views also indicated ontological opinions such as living things have babies, or living things can act by themselves. At the end of the study, the researcher concluded that it is significant to teach living things to the children in their early years of schooling. Therefore, Venville recommended that teaching should be elaborated by conceptual change method due to the fact that the findings of the study showed that teaching methods based on knowledge accumulation, belief revision, and discussions are not sufficiently change the students' ideas scientifically.

In Poland, Grodziéska-Jurczak, Stepska, Nieszporek, and Bryda (2006) conducted a study in order to explore pre-school children's (N= 674) and their parents' (N= 686) attitudes toward environment and environmental problems and to identify their environmental knowledge. The sample of the study was selected among 30 pre-schools. "Children's Attitudes toward Environment Scale-Preschool Version" (CATES-PV) was used to collect data. The survey of the children was composed of 10 pairs of drawings and the survey of their parents was composed of 27 questions. It was found that children were aware of basic concepts and could detect incorrect environmental behaviour; however, children did not have knowledge of detailed environmental issues and they were not good at practicing environmental protection principles. In addition, attitudes of children toward the environment was based on their residential areas and a great majority of children had positive attitudes towards environment such as respecting animals and plants as well as protecting their surroundings clean. With respect to the parents, they had positive attitudes toward environment although they were not always ready to change their environmental protection habits. In addition, parents' attitudes were influenced by their gender and educational level. Researchers concluded that the findings of this study would be useful for environmental educational programmes.

Herakleioti and Pantidos (2015) designed a body-base activity about shadow formation for kindergarten children. The activity was based on the 3-D light setting, human body, and a shadow outcome. In the activity, children used their bodies like an obstacles to the light and tried to discover the direction of the light by changing their positions. Children were asked to construct hypotheses and checked them by experimenting. Researchers seek for the answer of whether this activity resulted in positive learning outcomes for preschool children and whether the children can use their bodies to discover shadow formation. Sixteen children (between the age of 4 and 5.5) attending a state kindergarten were participated in the study. All the children did not introduce the concept of shadow previously. The study was included a pre-test (one week before the activity) for children ideas, implementation of the activity, and a post-test (one week after the activity). All the steps were video recorded. Pre-test and post-test results indicated a significant change in student ideas. In a 16 children, a total of 11 children for the first stage, 13 children for the second stage, and 12 children for the last stage indicated positive change in their answers. Therefore, this activity was resulted in positive learning outcomes for the children. In addition, video analysis indicated that majority of the children could use their bodies to adapt to different setting to get necessary knowledge. Researcher concluded that this could be a strong evidence for conceptual change in science education.

Galperin and Raviolo (2015) conducted a study in order to understand students' frame of reference during trying to explain the day and night cycle. Teachers and students from different ages participated in the study in Argentina. Participants came from 5 elementary schools and a rural high school as well as a College of Education. Totally, 279 students from diverse ages participated in the study. Participants were asked to draw day/night phenomenon on a blank paper with an explanation, if it was needed. Then, 10 students were interviewed from different ages. The drawings were classified in terms of students' explanations by using astronomical reference systems such as topocentric or heliocentric as well as whether the explanations were scientifically accepted or not. A great portion of elementary students (77.1 %) indicated scientifically unacceptable explanations. Overall, the results showed that students and also teachers had important comprehension problems about the day/night topic.

Similarly, Valanides, Gritsi, Kampeza, and Ravanis (2000) conducted a study about pre-school children's conceptions related to the Earth's and Sun's shapes as well as the day/night cycle. They administered a semi-structured interview individually to 33 children aged 5–6. Participant children had never taken any instruction about the topic of the shape of the Earth and the Sun. Researchers conducted interviews with children as a semi-structured interviews. The interview questions were about both the shapes of the Sun and the Earth, and the cause of the day/night cycle. By means of a teaching intervention, the ideas that the Earth and Sun have spherical shapes and that the Earth rotates on its axis and around a stationary Sun introduced to children. In addition, day/night cycle with relation to Earth's rotation was also introduced to children. Two weeks later, the evaluation was held on by a post-test. Pre-school children could easily identify the shapes of the Earth and the Sun, and also the Earth movement around the sun. If the children did not grasp the shape of the Earth unconnected to the intervention, they could not explain the day/night cycle regarding Earth's rotation. In addition, children's minds were confused about two Earth's movements and only a few children could make correlation between the day/night cycle and rotation of the Earth on its axis. The researchers concluded that in accordance with the findings of the study, astronomy concepts should be integrated in the pre-primary schooling time.

As it was seen from these research studies, researchers focused on children's scientific conceptualizations about basic science content areas such as living and non-living things, environmental awareness and environmental problems, light (shadow formation), day and night cycle or the movements of Earth and Sun. In general, researchers found that children were not good at making scientifically acceptable explanations about issues under questions even if after teaching intervention. Therefore, it was recommended that children should be taught science concepts by conceptual change method (see Venville, 2004; Herakleioti & Pantidos, 2015).

CHAPTER III

RESEARCH METHODOLOGY

This chapter explains the research methodology of the current study. In particular, the chapter describes the research design, population and sampling, instrumentation, procedures and data analysis in line with the rationale behind them.

3.1 Design of the study

This dissertation employed the positivism approach as a philosophical perspective with quantitative research methodology. According to positivist research, there is a single reality that can be measured objectively and the researcher beliefs are not penetrated into the research (Wilson, 2010). Under this assumption, the present study employed survey method to collect data which is widely used in positivist approach (Fraenkel, 2012), and the investigation is correlational in which the relationships among several variables were studied without any attempt to manipulate these variables (Tabachnick & Fidell, 2001). In addition, the data were collected in a single point time which means that the time of examination was cross-sectional (Johnson, 2001).

Hereinbefore, this research study was designed to gain greater understanding of the early childhood teachers' science teaching intention and behaviour. Predictor variables influencing the criterion variable of early childhood teachers' science teaching intention included teachers' attitudes toward science teaching, subjective and personal norms about teaching science, perceived control over science teaching, science content knowledge, and self-efficacy beliefs regarding teaching science. In addition, belief components of the TPB (i.e. behavioural, normative, and control beliefs) were included in the model as indirect measurements of science teaching intention as well as epistemological beliefs as a predictor of science content knowledge of teachers.

The study included 12 theoretical constructs including main TPB constructs (i.e. intention, behaviour, attitude toward behaviour, subjective norms, perceived behavioural control, behavioural, normative and control beliefs) and additional constructs (i.e. personal norm, self-efficacy beliefs, science content knowledge, and scientific epistemological beliefs) in the model. The hypotheses were generated in order to test the associations among variables based upon the previous research, relevant literature and the theory of planned behaviour. The instruments were tested in pilot study.

3.2 Population and sampling

This was a nationwide study; therefore, the target population of the study was all early childhood teachers working at public schools in Turkey. According to 2012-2013 Educational Year National Education Statistics for formal education, there were total 52,985 pre-school teachers working in public schools including independent kindergartens and nursery classes.

Table 3.1

Population of Pre-school Teachers in Turkey in the Educational Year 2012-2013

School type	Number of teachers		
	Female	Male	Total
Independent Kindergarten	16,596	1,811	18,407
Nursery Class	33,066	1,512	34,578
Total	49,662	3,323	52,985

In the current study, the sample size was determined by using two different approaches. Firstly, Nunnally's (1967) suggestion was followed. According to Nunnally, a rule of thumb, ten times of observed variables was required. In this study, ninety-one indicators (observed variables) were used in the research model and so, there should be 910 (91x10= 910) participants in the sample which was corresponding to 1.7 percent of population (52,985). Secondly, Cohen's (1988) statistical power analysis for sample size determination was followed. With small effect size (0.1) and desired statistical power (0.8) in 95 % confidence interval, 820 participants were required to detect effect for fourteen latent variables. Accordingly, the data of 914 teachers were collected for this study. However, 893 participants' data were used in the study due to the fact that 21 of them were intentionally missing or coded as with the same number. These were eliminated from the study data prior to analyses.

The sample representativeness was provided by including teachers from different statistical regions of Turkey. Turkey has been classified into twelve statistical regional units by Turkish Statistical Institute (Turkey in Statistics, 2013). The distribution of sample across the country was given in Table 3.2. However, it should be noted that convenience sampling was used to select teachers due to constraints regarding time, cost, and travel.

In Turkey, 94 % of the early childhood teachers working in public schools were women. As in the population, a large majority of the sample was women with the ratio of 90.6%. The teachers participated in this study were all work in public school in different cities of Turkey. Thirty seven percent of the teachers worked in independent public kindergartens; while, 61% of them worked in nursery classes within the body of primary schools. Most of the participant teachers were in their first five years in their teaching career since the assignment of the early childhood teacher has been increased rapidly by the government. In addition, all participant teachers had bachelor degree. That is, the sample is homogenous in terms of graduation level. Table 3.3 presented the characteristics of the teachers participated in the study.

Table 3.2

Sample Distribution with respect to Statistical Regions

Region	Cities	Number of preschool teacher (*N*=52,985)	Number of participant teacher (*N*=893)
North East Anatolia	Erzurum, Erzincan Ağrı, Ardahan	1786	42
Central East Anatolia	Malatya, Elazığ, Muş, Bitlis, Bingöl	3229	55
South East Anatolia	Gaziantep, Sanlıurfa, Sırnak, Diyarbakir	6096	68
Istanbul	Istanbul	9211	76
West Marmara	Kırklareli, Balıkesir, Edirne	2099	34
Aegean	İzmir, Aydın, Afyon, Kütahya, Muğla	7040	72
East Marmara	Bursa, Eskişehir, Kocaeli, Sakarya, Düzce , Bolu	4706	42
West Anatolian	Ankara, Konya	6510	103
Mediterranean	Antalya, Isparta, Adana, Mersin, Hatay	7516	36
Central Anatolia	Kırıkkale, Kırşehir, Kayseri Sivas, Yozgat	2686	212
West Black Sea	Samsun, Amasya, Tokat	3199	77
East Black Sea	Trabzon, Gümüşhane, Rize, Artvin	1805	76

Moreover, in demographic information questionnaire, participants were asked to evaluate their level of science knowledge and interest. Almost half of the participants (47.7 %) rated their knowledge as "moderate" and 44.1% of participant evaluated themselves as having "little" science knowledge. On the other hand, 39.9% of participant teachers reported themselves as "very little" interest in science and 39.1 % of them reported as "little" interest in science. Only 3.1 % of teachers rated themselves as "a lot" interest in science and, 8.3 % of them stated that they were not interested in science. Participant teachers were also asked to evaluate their proficiency level to teach science. While 40.1 % of teacher rated themselves as "very little" proficient to teach science, 41.9 % of them claimed as "little" proficient to teach science. Besides, participants were asked to how many courses taken related to science education. Of the participants, 3.8 % of them stated that they did not any course related to science education. On the other hand, 43.9 % of them had taken only one course, 33.8 % of them had taken two courses, and 10.9 % of teachers had taken three courses related to science education. Lastly, teachers were asked what they think about the importance of science teaching in comparison to other subject areas such as math or literacy. Of the participants, 41.0 % reported that science teaching was not important, 11.2 % of them evaluated science teaching as "very little" important, 9.4 % of them evaluated science teaching as "little" important, and 35.5 % of them thought that science teaching was "very important" in comparison to other subject areas. Table 3.3 provides detailed information about participant teachers' level of science interest, knowledge about science, number of courses related to science taken at university, and in-service training.

Table 3.3

Characteristics of the Participant Teachers

	Frequency	Percentage (%)
Gender		
Male	72	8.1
Female	809	90.6
Missing	12	1.3
Year of experience	Frequency	Percentage (%)
1-5	448	52.8
6-10	235	27.6
11-15	99	12
16-20	25	2.9
20-30	43	4.9
Missing	42	4.7
Knowledge about science	Frequency	Percentage (%)
Not at all	19	2.1
A little	394	44.1
Moderate	426	47.7
A lot	28	3.1
Missing	24	2.7
In-service training	Frequency	Percentage (%)
Yes	141	15.8
No	501	58.3
Missing	231	25.9
Science Interest	Frequency	Percentage (%)
Not at all	74	8.3
A little	356	39.9
Moderate	349	39.1
A lot	90	10.1
Missing	24	2.7
Number of courses related to science taken at university	Frequency	Percentage (%)
0	34	3.8
1	392	43.9
2	302	33.8
3	97	10.9
Missing	38	4.3

3.3 Instrumentation

In the present study, two instruments were used in order to collect data. These are Demographic Information Questionnaire and Early Childhood Teachers' Science Teaching Intention and Behaviour Questionnaire. In this section, detailed information about the questionnaire development and results of the pilot study with reliability and validity issues were explained.

3.3.1 Demographic Information Questionnaire

Demographic Information Questionnaire was prepared in order to obtain personal information about participant teachers such as gender, year of experience, school type, city, in-service training on science teaching, number of science related courses taken during university education, graduation level, science interest, and knowledge about science.

3.3.2 Early Childhood Teachers' Science Teaching Intention and Behaviour Questionnaire

Early Childhood Teachers' Science Teaching Intention and Behaviour Questionnaire was constructed based on Ajzen and Fishbein's (1980) and Ajzen's (1988, 2002, 2006) recommendations and in accordance with the results of the elicitation study. Then, the items were evaluated by three university professors from the departments of science education and early childhood education. In the scale, following the recommendation of Ajzen (2002), the items were in the form of 7-point Likert type. However, two of the additional variables (i.e. self-efficacy beliefs and epistemological beliefs) were in 5-point Likert scale in order to keep the original forms of these scales. The questionnaire included both direct (behaviour, intention, attitude toward behaviour, subjective norm, perceived behavioural control, personal norm, self-efficacy beliefs, science content knowledge) and indirect measurements (behavioural, normative, and control beliefs, and epistemological beliefs). The formation of direct and indirect measurement items explained in next subsections.

3.3.2.1 Construction of the indirect measurement items

In this study, belief components of the TPB (i.e. behavioural, normative, and control beliefs) were included in order to understand teachers' underlying beliefs about science teaching. Ajzen (1985) reported that interviews should be done in order to elicit and measure underlying beliefs. For this reason, semi-structured interviews were conducted with 8 in-service early childhood teachers working at public schools in Ankara. Teachers were asked a series of questions designed to elicit salient beliefs about science teaching. This elicitation study provided the list of the most commonly held beliefs of teachers about science teaching (see Table 3.4). Once salient beliefs were identified, behavioural, normative, and control beliefs of the questionnaire were constructed. Table 3.4 shows the open-ended questions asked to teachers during semi-structured interviews and the list of salient beliefs revealed during interviews.

Table 3.4

Interview Questions and List of the Salient Beliefs of Teachers for Teaching Science

Interview questions	Salient beliefs
What do you believe as the advantages of including science activities in your classroom?	• Science teaching allows switching between activities • Science teaching improves children's cognitive, psychomotor and affective skills. • Children better understand daily life events and develop a sense of curiosity. • Children are prepared for primary schools. • Children learn how to conduct research and try to find out answers for their own 'why?' questions. • The class time passes enjoyable and fun. • Science teaching develops environmental awareness in children. • Children discover nature and develop love of nature. • Children can analyse and evaluate the events around. • Children learn problem solving. • Children are familiar with science concepts before they start primary school.

Table 3.4

(*Continued)*

What do you believe as the disadvantages of including science activities in your classroom?	• Science is a difficult subject for children. • It is difficult to teach science. • Preparing experiments take too much time. • Problems or accidents may occur during experimenting.	• Science experiments may be dangerous for children. • Science teaching takes too much time. • Children may be confused about science concepts. • Getting materials can create financial problems.
Are there any individuals or groups who approve your inclusion of science activity?	• Children • Parents • School manager	• Inspector • Faculty members
Are there any individuals or groups who disapprove your inclusion of science activity?	• Parents • School manager	

Table 3.4

(Continued)

What factors or circumstances enable you to introduce science activities in your classroom?	• Curriculum • Necessary materials and equipment • Teachers' willingness to teach • Having necessary knowledge	• Physical conditions • Teacher training • Children's willingness to learn • Having science and nature corner
What factors or circumstances make it difficult or impossible for you to introduce science activities in your classroom?	• Lack of science content knowledge • Lack of materials • Lack of area to conduct activities • Unfavourable physical conditions • Time restrictions • Planning issues • School administration's attitude toward science teaching • Unwillingness of teacher • Professional exhaustion	• Weather conditions • Teacher psychology • Financial difficulties • Children level • Lack of science and nature corner • Financial problems • Technical shortcomings • Inadequate preschool program

Behavioural Beliefs: In the matter of present study, the benefits of science instruction for young children as well as the costs of science instruction were produced behavioural beliefs. Behavioural beliefs have two dimensions: behavioural belief strength and behavioural outcome. The items of behavioural belief strengths were formulated by asking interviewees the question of " What do you believe as the advantages / disadvantages of including science activities in your classroom?". Then based on the responses, possible behavioural outcomes were identified. Totally, 16 behavioural belief strength and corresponding outcome evaluation items were constructed. Teachers asked to evaluate each items on a 7-point Likert scale ranging from 1 to 7 (1 stands for strongly disagree and 7 stands for strongly agree). After that, sum of behavioural beliefs were calculated in line with the expectancy-value model (Fishbein, 1970). Expectancy-value model remarks that attitude toward behaviour (A) can be determined by the total set of salient behavioural beliefs linking the behaviour to various outcomes and other attributes. Thus, the strength of each belief (b) is weighted by the evaluation (e) of the outcome or attribute, and the products are aggregated, as shown in the following equation:

$$A \infty \sum b_i e_i \qquad (1)$$

Table 3.5

Sample Items for the Behavioural Outcome Scale

If I teach science during my teaching service, ...
Children are prepared for primary schools
Children learn observation
Children can easily understand science concepts
Children show interest to science activities and experiment

Thus, the range of behavioural belief scale was from 1 to 49 after multiplication of beliefs and corresponding outcome evaluation. Table 3.5 shows sample items for the behavioural outcome scale.

Normative Beliefs: To construct normative belief component of the TPB Questionnaire, interviewees were asked "Are there any individuals or groups who expect your inclusion of science activity?" or "Are there any individuals or groups who do not expect your inclusion of science activity?" In accordance with the responses, *normative belief strengths* and their *motivation to comply* dimensions were formulated. Totally, 5 item measures of normative beliefs (i.e. colleagues, children, parents, MoNE, and school administration) were prepared to measure teachers' normative beliefs regarding science teaching (see Table 3.6). Then, teachers were asked to evaluate whether school principals, colleagues, children, parents, and MoNE expected them to teach science on a 7-point Likert scale ranging from 1 to 7 (1 stands for strongly disagree and 7 stands for strongly agree). After that, the strength of each normative belief (n) is weighted by motivation to comply (m) with the referent in question, and the products are aggregated, as shown in the following equation:

$$SN \infty \sum n_i m_i \qquad (2)$$

Thus, the range of normative beliefs items was from 1 to 49.

Table 3.6

Normative Referents

Normative referent
Colleagues
Children
Parents
Ministry of National Education (MoNE)
School Administration

Control Beliefs: To construct control belief component of the TPB Questionnaire, interviewees were asked "What factors or circumstances enable you to introduce science activities in your classroom?" and " What factors or circumstances make it difficult or impossible for you to introduce science activities in your classroom?". In accordance with the responses, *control belief strengths* and *perceived power of the control factor* dimensions were formulated. Totally, eight item measures of control beliefs were constructed. Like other belief components (i.e. behavioural and normative beliefs), teachers were asked to evaluate these two dimensions on a 7-point Likert scale ranging from 1 to 7 (1 stands for strongly disagree and 7 stands for strongly agree). Then, the strength of each control belief (c) is weighted by the perceived power (p) of the control factor, and the products are aggregated, as shown in the following equation:

$$PBC \propto \sum c_i p_i \qquad (3)$$

Thus, the range of control beliefs items was from 1 to 49. Table 3.7 shows samples for control factors used in the present study.

Table 3.7

Samples for Control Factors

Control factors
Children willingness to learn science
Children interest in science
Sufficient time
Presence of available resources to get information about science
Presence of necessary equipment and materials

In addition to original belief components of the TPB, scientific epistemological beliefs were used as an indirect measurement of the science teaching intention of teachers through its effect on science content knowledge.

Scientific Epistemological Beliefs: "Epistemological Beliefs Questionnaire" (EBQ) firstly developed by Conley et al. (2004) in order to measure students' epistemological beliefs. The questionnaire originally consists of 26 five-point Likert type items. It was translated and adapted into Turkish by Özkan (2008) with a reliability coefficient of .78. Small changes in the Turkish form were committed to the scale in order to apply it in the context of this study. Conley et al. (2004) reported four dimensions for EBQ: source, certainty, development, and justification. However, the Turkish version of the questionnaire yielded three dimensions by combining source and certainty dimensions (Ozkan & Tekkaya, 2011; Ozkan, 2008). Table 3.8 shows sample items for each dimension with the number of items.

Table 3.8

Dimensions of Epistemological Beliefs

	Sample item	Number of item
Source-Certainty	Scientific knowledge is always true Everybody has to believe what scientists say If you read something in science book, you can be sure it is true	11
Justification	In science, there can be more than one way for scientists to test their ideas. It is good to try experiments more than once to make sure of your findings. Ideas about science experiments come from being curious and thinking about how things work.	9
Development	Some ideas in science today are different than what scientists used to think. The ideas in science books sometimes change. Ideas in science sometimes change.	6

3.3.2.2 Construction of the direct measurement items

The direct measurements of the TPB include the constructs of attitude toward behaviour, subjective norm, perceived behavioural control, intention, and behaviour. In addition to these, three constructs (i.e. personal norms, self-efficacy beliefs, and science content knowledge) were added as a direct measurement of the teachers' science teaching intention. The TPB literature and current science education literature guided the formulation of direct measurement items.

Attitude toward Science Teaching: Teachers' attitude toward science teaching was assessed by a set of attitudinal adjectives in a nine 7-point semantic differential scales to reveal their disposition regarding science teaching. Teachers evaluated *science teaching* by means of the pair of adjectives. While 7 of the adjective pairs (i.e. easy-difficult, necessary-unnecessary, useful-useless, enjoyable-boring, important-unimportant, valuable-worthless and good-bad) adapted from the TPB literature (Ajzen, 2006; Conner, Norman, & Bell, 2002; Mummery & Wankel, 1999), the remained two adjective pairs (i.e. practical-time consuming and worth to pay effort-waste of effort) were newly developed in the context of this study.

Subjective Norm regarding Science Teaching: Subjective norms of teachers were measured by 4 items by inquiring whether they were influenced by other people or institutions that were important in their teaching profession. Teachers were asked to rate their opinions in a statements like " People who are important to my teaching career expect me to teach science." on a 7-point scale ranging from 1 to 7 (1 stands for strongly disagree and 7 stands for strongly agree). These items were adapted from the TPB literature (Fishbein & Ajzen, 2010; Ajzen, 2006; Davis et al., 2002) for the context of this study. Table 3.9 shows the items related to subjective norms.

Table 3.9

Subjective Norm Items

Item
People who are important to my teaching career expect me to teach science.
Institutions that are important to my teaching career expect me to teach science.
People who are important to my teaching career support me to teach science.
Institutions that are important to my teaching career support me to teach science.

Perceived Behavioural Control: The questionnaire had only one controllability item to measure teachers' perceived behavioural control over science teaching. Teachers were directly asked to rate their opinion on the statement of "If I want to teach science in my classroom, it is under my control." to reveal the control of teaching science in their own power. This item was also rated on a 7-point scale ranging from 1 to 7 (1 stands for strongly disagree and 7 stands for strongly agree). This item was adapted from the TPB literature (Ajzen, 2006; Davis et al., 2002) by making necessary revisions for the context of this study.

Behavioural Intention: To reveal teachers' intention to teach science, three items were used in the TPB Questionnaire. All items adapted from Ajzen's (2006) standard direct measures by revising for science teaching behaviour. For instance, teachers were asked to rate the statement of " I plan to teach science in this educational term" on an agreement scale ranging from 1 to 7 (1 stands for strongly disagree and 7 stands for strongly agree). Table 3.10 indicates the items related to behavioural intention.

Table 3.10

Items Related to Behavioural Intention

Item
In this educational term, I will try to teach science
In this educational term, I intend to teach science
In this educational term, I plan to teach science

Behaviour: There was only one item measuring the science teaching behaviour of early childhood teachers. Teachers were asked how often they teach science in their classroom with a rating scale (never to always). Thus, science teaching behaviour of teachers was assessed by one self-reported item adapted from Ajzen (2006).

Personal Norms: In this study, in addition to what the others expected from teachers to teach science (i.e. subjective norms), teachers' own normative opinions (i.e. personal norms) were included. Items of this scale were adapted from the previously developed personal norm items (Vining & Ebreo, 1992; Harland, Staats, & Wilke, 1999). The scale was composed of a 7-point Likert type of 10 items, and so teachers were expected to evaluate the items from 1 to 7 (1 stands for strongly disagree and 7 stands for strongly agree). Table 3.11 shows sample items of the personal norms.

Table 3.11

Sample Items of the Personal Norms

Items
I would feel guilty if I do not teach science
I feel happy, if I allocate time to teach science
I am willing to put extra effort to teach science

Self-efficacy Beliefs: The Self-efficacy Beliefs Scale was adapted into the context of this study from the Science Teachers Efficacy Beliefs Instrument (STEBI), which was primarily developed by Enochs and Riggs (Enochs & Riggs, 1990; Riggs & Enochs, 1990). In STEBI, there are originally two dimensions; namely, self-efficacy beliefs and outcome expectancy beliefs. However, only items of self-efficacy component were used in this study due to the fact that control beliefs component of the TPB included the items similar to dimension of outcome expectancy beliefs. There were 11 items in the form of 5-point Likert type ranging from 1 'strongly agree' to 5 'strongly disagree' in the scale. Table 3.12 shows sample items of this scale.

Table 3.12

Sample Items of the Self-Efficacy Beliefs

Items
I generally teach science ineffectively
I know the steps necessary to teach science concepts effectively
I continually find better ways to teach science

Science Content Knowledge: Science Content Knowledge Test was constructed to assess early childhood teachers' basic science knowledge by examining related literature and early childhood curriculum in Turkey (MoNE, 2013). The test was developed in three main domains of science (Life and Health Science, Physical Science, and Earth Science) at three cognitive levels (knowledge, comprehension, application) regarding Bloom's taxonomy (Bloom, 1956). The test plan of the Science Concept Knowledge Test was available in Appendix A. The test consists of 20 multiple choice questions with five alternatives including the alternative of "I do not know". MoNE (2013) emphasizes the importance of teaching environmental awareness, science process skills, daily life events, animal kingdom, chemicals and states of matter, mechanical tools, and etc. as a part of science activities in early childhood classrooms. In relationship with the suggestions of early childhood program, the science content knowledge test was prepared for early childhood teachers. Basic science topics were included in the science content knowledge test.

3.4 Pilot study

In the pilot study, the questionnaire was administered to 110 early childhood teachers (9 men, 101 women) who worked in five Central Anatolia cities of Turkey (Kayseri, Kırıkkale, Kırsehir, Yozgat, and Sivas) during 2012-2013 spring semester. The schools and the cities where the pilot data were collected were selected by means of convenience sampling due to time, cost, and travel constraints. However, only the teachers who had a university degree from the department of early childhood education were included in the study.

The data of the pilot study was checked for reliability and explanatory factor analyses. Then, the problematic items were detected. If necessary, the items were revised or deleted and the last forms of the scales were constructed for the main study. In next sections, the pilot analyses were explained in detail.

3.4.1 Explanatory factor analysis for scales

Explanatory factor analysis (EFA) was performed with pilot data of the study to assess whether the data of the study conformed to the Theory of Planned Behaviour and to determine the dimensions of the epistemological beliefs. EFA was conducted using principle axis factoring with promax rotation method. The reason of promax rotation usage was that correlations among factors were conceded in this method. Explanatory factor analyses conducted in this study were divided into three groups: Firstly, the constructs of intention, attitude toward science teaching, subjective norms, perceived behavioural control, personal norm, and self-efficacy beliefs were tested. Secondly, EFA conducted for salient beliefs, that is, behavioural beliefs, normative beliefs, and control beliefs. Lastly, the EFA for scientific epistemological beliefs was conducted to test the dimensions of that scale. In EFA analysis, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy value should be greater than .70 and Barlett's Test of Sphericity score should be significant (p < .05) to ensure the data is suitable for factor analysis (Tabachnick & Fidell, 2007).

3.4.1.1 Explanatory factor analysis for behavioural intention and direct measurements of the TPB

The research model included six direct measurements (i.e. attitude toward science teaching, subjective norms, perceived behavioural control, personal norm, self - efficacy beliefs, science content knowledge). Since behaviour and perceived behavioural control had one items and science concept knowledge was tested by TAP, these variables were not included in factor analysis. A relatively clear pattern was reached for these five variables. The factor analysis yielded significant Barlett's test of sphericity (p <.05) and acceptable Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (.786) (Tabachnick & Fidell, 2007) as reported in Table 3.13. Factor loadings of these variables were given in Appendix B.

Table 3.13

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.786
Bartlett's Test of Sphericity	Approx. Chi-Square	2779.563
	Df	528
	Sig.	.000

3.4.1.2 Explanatory factor analysis for indirect measurements

Explanatory factor analysis was performed for indirect measurements; that is, behavioural beliefs, normative beliefs, and control beliefs with the data of pilot study in order to identify factor structures. EFA results directed the final version of the scale. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .893 and Bartlett's Test of Sphericity value found to be significant (p =.000). This implied that the data was reasonable for factor analysis. Although two items (CB8 and NB2) loaded in two different factors, they were retained in the test for further analysis with main data. The reason of keeping these items in the questionnaire was that they were explicitly remarked by early childhood teachers during interview. Factor loadings for indirect measurements were given in Appendix C.

3.4.1.3 Explanatory factor analysis for epistemological beliefs

According to Conley (2004), epistemological beliefs were divided into four dimensions: source, certainty, development, and justification. However, in the present study, like in other studies in Turkish context (see Ozkan, 2008; Ozkan & Tekkaya, 2011) the factor solutions yielded three factor structures by combining dimensions of source and certainty. The explanatory factor analysis produced KMO measure of sampling value of .778 and significant Bartlett's Test of Sphericity value (p =.000). In addition, factor loadings ranged from .367 to .907 (See Table 3.14). Items which had item loading below .6 were obligated to retain in the scale in order not to decrease dimension reliability. For instance, EB4 was retained in the scale since the number of item influence scale reliability and it was belongs to development dimension as a one of the four items. However, items which did not fit into factor structures were eliminated from the study. These were EB11, EB12, EB13, and, EB21.

3.4.2 Reliability analysis for scales

Reliability analysis was conducted for each scale by using Cronbach's alpha. As a criterion, the value of at least .70 is commonly acceptable Cronbach's alpha level (Churchill & Brown, 2006; Nunnally 1978). As seen in Table 3.15, the Cronbach's alpha values for scales were satisfactory by taking a value of greater than the recommended value of .70 after deleting problematic items (BB Thus, internal validity of the scales was ensured. It should be remarked that reliability analysis did not conducted for one-item measures (i.e. perceived behavioural control and behaviour). In addition, the reliability analysis for the science concept test was determined by the Test Analysis Program (TAP; Brooks & Johanson, 2003).

Table 3.14 Dimensions of Epistemological Beliefs Scale

Items	Dimensions		
	Justification	Source / Certainty	Development
EB3	.907		
EB5	.850		
EB24	.802		
EB26	.776		
EB22	.631		
EB14	.576		
EB7	.541		
EB9	.519		
EB18	.453		
EB6		.851	
EB1		.768	
EB15		.700	
EB16		.675	
EB2		.576	
EB19		.521	
EB10		.487	
EB23		.468	
EB20		.426	
EB8			.743
EB17			.676
EB25			.622
EB4			.367

Note. EB Epistemological beliefs

Table 3.15

Reliability of the Scales

	Number of item	Cronbach α
Attitude	9	.924
Subjective norm	4	.911
Behavioural beliefs	16	.971
Subjective beliefs	5	.850
Control beliefs	8	.880
Intention	3	.933
Personal norm	10	.886
Self-efficacy beliefs	11	.832
Epistemological beliefs		
Source-certainty	9	.848
Development	9	.897
Justification	4	.733

3.4.2.1 Item and test analysis for science concept knowledge test

Item analyses were conducted to determine item discrimination and item difficulty of each items and to find out the contributions of items to the reliability of instrument (Crocker & Algina, 1986). The Test Analysis Program (TAP) Version 4.2.5 (Brooks & Johanson, 2002) was performed for test analysis. According to scale statistics, there were 110 examinees in the data file. The mean was found to be 10.973 out of 20 and standard deviation was found to be 3.535. Skewness and Kurtosis values were between +1 and -1 indicating normal distribution. In educational research, internal consistency reliability (KR20) values of above .70 are accepted as satisfactory and the KR20 of the test was found to be .736; however, six of the items were signed as problematic. These items were examined in detail. According to TAP results, item 1 (D = 0.12), item 6 (D = -0.08), item 16 (D = 0.14) and item 19 (D = 0.20) had discrimination indexes less than (or equal to) 0.20. For the item discrimination parameter, Ebel and Frisbie (1986) suggested that items with item discrimination index lower than .20 were poor items and they should be eliminated from the test. Thus, these four items were removed from the test.

The other index for item analysis was item difficulty. It is the percentage of examinees answering an item correctly. It takes a value ranging from .00 (any of person answered the item correctly) to 1.00 (all examinees answered the item correctly) (Thorndike, Cunningham, Thorndike, & Hagen, 1991). According to the results of item difficulty, item 9 (p = .18) and item 17 (p = .25) were found to be very difficult items that may threaten the validity of the test. Therefore, these two items were also eliminated from the test. Rest of the 14 items was discriminating well and so, they were retained in the final form of the test. Table 3.16 shows the item statistics of the science concept test.

Table 3.16

Statistics of Item Analysis for Science Concept Test

Number of Examinees	110	Total Possible Score	20
Minimum Score	.0	Maximum Score	17.0
Median Score	11.0	Mean Score	10.9
Standard	3.5	Variance	12.5
Skewness	-0.7	Kurtosis	.7
Mean Item Discrimination	.386	Mean Item Difficulty	.549
KR20 (Alpha)	.736	KR21	.636

After the pilot analysis, the change in number of items can be seen Table 3.17.

Table 3.17

Number of Items in Pilot and Main Study

	Pilot study	Main study
Attitude	9	9
Subjective norm	4	4
Perceived behavioural control	1	1
Behavioural beliefs	16	16
Subjective beliefs	5	5
Control beliefs	8	8
Intention	3	3
Behaviour	1	1
Personal norm	10	10
Self-efficacy beliefs	11	11
Epistemological beliefs	26	22
Science content knowledge	20	14

3.5 Data collection procedure

After necessary revisions were applied to the research instruments, the permissions from METU Human Subjects Ethics Committee (see Appendix D) and Ministry of National Education (see Appendix E) were obtained to collect data countrywide during the spring semester of 2013-2014 and fall semester of 2014-2015 Academic Years. In two education semester, totally 914 data were collected. The completion of the instruments took about 30 - 40 minutes.

3.6 Data analysis procedure for the main study

Prior to model assessment, data was examined for data screening and preliminary analysis including missing data treatment, outliers, normality, and common method bias by using IBM SPSS 18.0 statistical software. In addition, descriptive statistics including mean, standard deviation, frequencies, percentages and minimum and maximum values were calculated by means of IBM SPSS 18.0 statistical software. Then, the hypotheses were tested in a complex correlational technique, Structural Equation Modelling (SEM). Partial least squared structural equation modelling (PLS-SEM) was used in this study. A detailed explanation of SEM and PLS-SEM was given in following sub-section.

3.6.1 Structural Equation Modelling (SEM)

SEM is a composition of patterns of relationships among variables and provides opportunity to formulate a theory about the relationships among variables. Tabachnick and Fidell (2007) reported that researchers referred to SEM as "causal modelling, causal analysis, simultaneous equation modelling, analysis of covariance structures, path analysis, or confirmatory factor analysis". Some preliminary terminologies used in structural equation modelling were given in Table 3.18. SEM has found to be useful for the developing and testing theories by the researchers studying in diverse areas such as psychology, or marketing (Steenkamp & Baumgartner, 2000; Ringle et al., 2012) by using the second generation multivariate analysis technique. There are five main steps in SEM analysis. The first one is *model specification*. In accordance with the existing literature the model is proposed for estimation (Hoyle, 1995). The models are represented by diagrams to make it clearer. The second step is *identification*. In identification process, researchers look for a unique value for each and every free parameter from the observed data. The model can be *just identified, over indentified or under identified* as to the value of free parameters (Kelloway, 1998).

The third step is *estimation*. Hoyle (1995) reported that there were various methods for estimation like single-stage least square, maximum likelihood or generalized least square. The forth step is *testing fit*. It is the issue of goodness of fit test. The last step is *model modification*. According to the test results, the model can be modified by adding new paths in the model or eliminating non-significant paths from the model (Kelloway, 1998).

Structural Equation Modelling has two different statistical methods. One is covariance based SEM (CB-SEM; Diamantopoulos and Siguaw, 2000; Rigdon, 1998) and the other one is partial least square based SEM (PLS-SEM; Wold, 1982; Hair, Sarstedt, Pieper, & Ringle, 2012; Hair, Hult, Ringle, & Sarstedt, 2013; Lohmoller, 1989; Rigdon, 2012). These two approaches are very dissimilar in their basic philosophy and estimation process (Henseler, Christian, Ringle, & Rudolf, Sinkovics, 2009; Hair, Ringle, & Sarstedt, 2011). While PLS-SEM attempts to predict the model by means of maximizing the explained variance and significant t-values, CB-SEM tries to minimize the difference between the proposed model covariance matrix and the sample covariance matrix to confirm the proposed model (Gefen, Straub, & Boudreau, 2000). In addition, these two approaches differ in their assumptions and fit statistics. In the forthcoming section, PLS-SEM and the reason of preference of it explained in detail.

Table 3.18

Definition of SEM Terms

Term	Definition of the term
Measurement model	It is the model which maps the links between the latent variables and their observed scores.
Structural model	It represents the causal links between the theoretical or latent variables.
Direct effect	A directional relationship between an independent and a dependent variable. Represented by an arrow (⟶).
Indirect effect	The effect of an independent variable on a dependent variable through one or more other variables.
Exogenous variable	A variable that is not influenced by any other variables in a model and can be called as independent latent variable.
Endogenous variable	A variable that is influenced by other variables in a model can be called as dependent latent variable.
Latent variable	A variable that is not directly measured or observed. It is represented in the model by circles:
Manifest variable	It is directly measured or observed variables in the model. Represented in the model by a rectangle:

3.6.1.1 Partial least square-structural equation modelling (PLS-SEM)

Although PLS-SEM has been proposed by Wold (1982), it does not become popular as covariance based structural equation modelling (CB-SEM). Nowadays, PLS-SEM is widely seen in social science research areas (Hair et al., 2012a; Hair, Sarstedt, Ringle, & Mena, 2012b; Lee, Petter, Fayard, & Robinson, 2011; Ringle, Sarstedt, & Straub, 2012; Sosik, Kahai, & Piovoso, 2009) when the research design does not meet basic assumptions of CB-SEM. Researchers stated that PLS-SEM can be preferred if the research objectives mainly focused on the predicting variance of dependent variables rather than item covariance since PLS-SEM is based upon to strengthen the explained variance of the endogenous constructs. In addition to these, PLS-SEM is evaluated as more user friendly when nonparametric analyses are needed (Hair, 2010; Hair et al., 2012a; Henseler et al., 2009; Chin, 1998). Jakobowicz (2006) stated that PLS-SEM can be applied to complex problems or small sample since its characteristics of malleable assumptions make it be advantageous over CB-SEM. Furthermore, PLS-SEM is more applicable to single item measures than the CB-SEM. Single item measure is easy to practice, and cost-effective; whereas, researchers usually avoid using single item (Hair et. al, 2013; Fuchs & Diamantopoulos, 2009). In CB-SEM, single item creates identification problem because of small degree of freedom and concern about validity issue. However, in PLS-SEM it is effortless to handle single item for prediction (Afthanorhan, 2014).

In this study, at the beginning of the study, covariance structure analysis was thought to be used for modelling; however, initial analyses of data indicated that assumptions of CB-SEM were not met. First of all, the distribution of data was non-normal, and negatively skewed. Second, some constructs (science teaching behaviour and controllability) had single item measure and the model was fairly complex with many latent and observed variables. Accordingly, during covariance based analysis many identification problems would be occurred. According to Jakobowicz (2006), PLS-SEM could be a satisfying alternative for parameter estimation of structural equation modelling for such situations. To sum up, in this study, measurement and structural model assessments were conducted by using SmartPLS 3 software (Ringle, Wende, & Will, 2005).

3.7 Model assessment

PLS -SEM was used in this study in order to describe measurement and structural model of the present study. As defined previously, the measurement model of the study indicated the associations among latent and manifest variables, while the structural model of the study indicated the associations between latent variables or theoretical constructs under issue (Chatelin, Vinzi & Tenenhaus, 2002). It should be remarked that PLS-SEM does not yield any goodness of fit criterion (Henseler et al., 2009). Thus, a group of criteria has been asserted to evaluate PLS path models (Chin, 1998). The criteria of analysis PLS models include two-stages.

3.7.1 Assessment of measurement model of the study

The measurement model assessed in terms of reliability and validity in the first stage. The composite reliability is used instead of internal consistency reliability and interpreted like Cronbach alpha (Werts, Linn, & Joreskog, 1974). Nunnally and Berstein (1994) reported that values around 0.8 or 0.9 required for composite reliability. After testing composite reliability, indicator reliability would be tested which implied that the absolute correlations between a latent variable and each of its observed variables. Absolute standardized outer loadings should be greater than 0.7. After that construct validity analyses were conducted. Convergent validity was measured by using average variance extracted (AVE) score which should be equal or greater than the 0.5 to imply the set of data represents one and the same construct (Fornell & Larcker, 1981). Discriminant validity was used as a second validity analysis. Discriminant validity is the issue of those measures of two different theoretical constructs should exhibit sufficient difference. Fornell-Larcker criterion and cross-loadings would be used in this PLS-SEM analysis to examine discriminant validity. While Fornell-Larcker criterion ensures validity of constructs by using AVE scores (each latent variable's AVE score should be greater than the squared correlations with all other latent variables), cross-loadings checks it at the indicator level (each indicator variable should be correlated higher with its latent variable assumed).

3.7.2 Assessment of structural model of the study

At the second stage of PLS model testing, structural model was assessed in terms of explained variance of endogenous latent variables, estimation of path coefficients, effect size and, predictive relevance. Chin (1998) defines the explained variance of endogenous latent variables (R^2) as to be substantial, moderate, and weak for the values of 0.67, 0.33, and 0.19; respectively. After assessing the path coefficients regarding magnitude and sign, their significance would be tested by means of bootstrapping technique. Bootstrapping technique provides researcher to create subsamples with randomly drawn observations from the original data set (Chin, 1998; Henseler et al., 2009, Efron, 1981; Efron & Tibshirani, 1993). After that, effect size (f^2) which explains the impact of a predictor construct on an endogenous construct would be calculated. Effect size values of 0.02, 0.15, and 0.35 were evaluated as small, medium, and large, respectively (Cohen, 1988). In the present study, lastly predictive relevance (Q^2 and q^2) was assessed by using blindfolding technique. Geisser (1975) and Stone (1974) was promoted Q^2 test for the predictive relevance of the endogenous constructs to describe how well the model and its parameter estimates regenerate manifest variables.

3.8 Ethical issues

The present study addressed ethical considerations in each part of the study in order to keep participants from any deception. Participants were informed about their privacy with an informed consent (Neuman, 1997). Thus, all necessary permissions from Ethical Committee of Middle East Technical University and from Ministry of National Education were obtained to ensure meet the requirements of ethical issues (see Appendix D and E). In addition, only voluntary teachers participated in the study by signing Voluntary Participation Form (see Appendix F). Participant teachers were not subject to any kind of harm (physical or psychological) and the study did not include any form of deception. Thus, the purpose of the research, keeping data, and guarantee of confidentiality were all explained clearly in the informed consent form.

3.9 Assumptions and limitations of the study

The assumptions and limitations of this study considered by the researcher were given below:

3.9.1 Assumptions

The study has the following assumptions:

1. The participants of the study accurately reported their beliefs, attitudes and knowledge of science and respond to instrument items seriously.

2. The instruments of the study were administered under the standard conditions.

3. There was no interaction among participant teachers during filling the instruments.

3.9.2 Limitations

The present study has several limitations which can be achieved in further research studies. These limitations are as follow:

1. Since this study is based on the self-report data, the study findings may be affected at some level due to response bias. Particularly, in the context of this study it was practically difficult to measure teachers' actual behaviour. Therefore, the future research may overcome this problem by finding more reliable measurement approaches such as observing teachers in different time intervals.

2. The Early Childhood Teachers' Science Teaching Intention and Behaviour Questionnaire may have weaknesses with respect to number of items in scales. Perceived behavioural control and behaviour scales had only one item. The potential risk of these scales was that items could not be comprehensive and reliable. Future research may be increased the number of the items in scales and conduct reliability analyses for them.

3. The data of the present study were collected at a single point in time (cross-sectional) by using a single method (survey). For that reason, there is a possibility of common method bias which is recognized as a leading source of measurement error disrupting the validity of the model due to social desirability, leniency biases or common scale formats (Podsakoff & Organ, 1986). By using Harman's one-factor test (Podsakoff, Todor, Grover, & Huber, 1984; Podsakoff et al., 2003), it was concluded that common method bias was not a threat for this study. However, there can be still spurious effect in the data. Future research may use additional alternative approaches to reduce the spurious effect in the data.

4. The participants of this study were only included voluntary early childhood teachers working in public schools in Turkey, and so the sample of the study was homogenous with respect to graduation level. In addition, early childhood teachers in Turkey are composed of mostly females. This situation limits the generalizability of the research findings or the external validity of the study. To increase the external validity, future research should be conducted indifferent type of schools and in different contexts, and cultures.

5. The results of study were limited to the questionnaire developed by the researcher in line with the Theory of Planned Behaviour. Although some potential variables such as personal norms or self-efficacy beliefs were included in the research model, future research may expand the model by adding some demographic variables such as year of experience or gender to see their moderating effects.

CHAPTER IV

RESULTS

This chapter presents the results of statistical analysis used to explain the factors influencing science teaching practices of early childhood teachers. Data screening, preliminary analyses, descriptive statistics, model validation, hypothesis testing, and model modification were given in detail throughout this chapter.

4.1 Data screening and preliminary analysis

As an initial step of data analysis, the data assessed about psychometric assumptions which included missing data treatment, normality of data distribution, and common method bias by using IBM SPSS 23.0 statistical software.

4.1.1 Missing data treatment

As explained in Chapter III, twenty-one responses were eliminated from the data since either they all answered the questionnaire by the same number, or too many items were missing in the data set. The remained 893 responses also had 1910 missing data points in 91855 total data points. However, in the PLS-SEM analysis, there were only 1136 missing data points since the remained 774 data points were in demographic measures such as gender, experience, or etc. The total missing data points were 1.4 % which was not significant. In addition, each variable was analysed in itself for the missing value. The result showed that all variable had less than three percent of missing value. According to Tabachnick and Fidell (2001) any variable having less than five percent of missing values can be ignored.

There are different types of approaches for missing data treatment used by the researchers. The point of handling missing data of this study was based on structural equation modelling (Bentler, 1992; Bollen, 1989; Jöreskog & Sorbom, 1993). SmartPLS 3.0 provides three options (mean replacement, casewise deletion, and pairwise deletion) for missing data treatment. Bollen (1989) pointed to enticing features of listwise approach with eliminating all cases that have missing points; however, listwise deletion of missing data results in losing lots of set of data. Another option of mean replacement may result in change in the nature of data. In present study, pairwise deletion was chosen for handling missing data by means of SmartPLS software utility since pairwise deletion retains as much data as possible by only deleting cases that include missing values in each pair of variables. Accordingly, the sample size for each analysis can be different in parameter estimation.

4.1.2 Outliers

Following missing data treatment, outliers were checked. Standardized score value (z scores) of +/-3 were used as a cut-off criteria while detecting outliers for a sample size of 80 and above (Hair, Anderson, Tatham & Black 1998). Based on this criterion, data of 14 participants showed outliers in a range of -5.7 to -3.1. Outliers were the worth noting on attitude (ATT), behavioural beliefs (BB) and intention (INT) variables. Since there were no evidence these observations had measurement errors, all of them retained in the sample.

4.1.3 Tests for multivariate normality

In general**,** participants used the entire choices on scales as understood from minimum and maximum values. However, tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk tests) indicated that almost all items deviated from normality and the data was negatively skewed (p =.000, α =.05). The descriptive statistics including the minimum and maximum values, mean, standard deviation, skewness and kurtosis could be seen in Appendix G. Since the skewness values endure outside +/- 1 times its standard error and kurtosis values were +/-2 times its standard error, evaluating the data as normally distributed would create a problem (Klein, 2005). Additionally, when the data does not provide univarite normality, it cannot be have multivariate normality (DeCarlo, 1997). Concerning the normality issue, the PLS structural equation modelling would be a preferable alternative technique for model development (Henseler et al., 2009).

4.1.4 Common method bias

Common method bias has been recognized as a leading source of measurement error which disrupts the validity of the model especially in self-report studies may be due to social desirability, leniency biases or common scale formats (Podsakoff & Organ, 1986). Harman's one-factor test was performed in order to see whether the majority of the variance was explained by a single factor (Podsakoff, Todor, Grover, & Huber 1984; Podsakoff et al., 2003). Exploratory factor analysis (EFA) was conducted using principle axis factoring with fixing the number of factors extracting to one rather than extracting via eigenvalues. As a result, single factor explained only 22. 42% of the variance figured in Table 4.1. Thus, common method bias was not a threat for this study.

Table 4.1

EFA for Common Method Bias

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	21.001	23.078	23.078	20.405	22.423	22.423
2	7.296	8.018	31.096			
3	5.616	6.172	37.267			
4	4.743	5.212	42.480			
5	4.322	4.749	47.229			
6	3.520	3.868	51.096			
7	2.863	3.146	54.242			

4.2 Descriptive statistics

In this part, descriptive statistics including mean, standard deviation, minimum and maximum values, and frequency distribution of each variable were reported prior to determination of inferential statistics. The first research question of the present study which was "What are early childhood teachers' attitude toward science teaching, subjective science teaching norms, perceived behavioural control, personal science teaching norms, self-efficacy beliefs regarding science teaching, science concept knowledge, science teaching intentions, science teaching behaviours?" answered in this part.

Table 4.2 shows the descriptive analyses of each construct used in the research model. As to remember, in this study, original TPB components (i.e. attitude, subjective norm, perceived behavioural control, behavioural, normative and control beliefs, behavioural intention, and behaviour) and personal norm construct were in 7-point Likert type scale; however, epistemological beliefs and self-efficacy belief constructs were in 5-point Likert type scale in order to keep their original forms. On the other hand, Science Content Knowledge Test was in a form of multiple choices with 5 alternatives.

As seen in Table 4.2, the mean score of variables having 7-point scales were ranged from 5.45 to 6.48 and the mean score of variables having 5-point scales were ranged from 2.97 to 4.19. Particularly, participant teachers had the highest score on power of control factor (M = 6.48, SD =.90), followed by outcome expectancy (M = 6.41, SD = .91), and behavioural belief strength (M = 6.37, SD = 1.02). The lowest score was on the source and certainty dimension of epistemological beliefs (M = 2.97, SD = 1.24). From these results, it can be concluded that teachers' give the highest importance to power of control factors, outcome expectancy, and behavioural belief strengths. On the other hand, participant teachers were care about subjective norms as much as their personal norms. Regarding participant teachers' epistemological beliefs, they had more sophisticated beliefs in justification and development dimensions in contrast to source and certainty dimension.

Table 4.2

Mean, Standard Deviation, Minimum and Maximum Values of the Constructs

Construct	M	St. D	Actual Range	Possible Range
Attitude	6.03	1.15	1-7	1-7
Subjective norms	5.45	1.47	1-7	1-7
Perceived behavioural control	6.20	1.31	1-7	1-7
Personal norms	6.06	0.95	1-7	1-7
Intention to teach science	6.18	1.09	1-7	1-7
Science teaching behaviour	4.91	1.13	1-7	1-7
Behavioural belief strength	6.37	1.02	1-7	1-7
Outcome expectancy	6.41	0.91	1-7	1-7
Normative belief strength	5.58	1.57	1-7	1-7
Motivation to comply	5.65	1.64	1-7	1-7
Control belief strength	5.88	1.24	1-7	1-7
Power of control factor	6.48	0.90	1-7	1-7
Self-efficacy beliefs	3.40	0.68	1-5	1-5
Epistemological beliefs	3.68	1.05	1-5	1-5
Source-certainty of knowledge	2.97	1.24	1-5	1-5
Development of knowledge	4.12	.95	1-5	1-5
Justification of knowledge	4.19	.90	1-5	1-5
Science content knowledge	7.82	2.41	1-12	0-14

Note: M mean, St. D standard deviation

In the following sections, descriptive statistics of each construct were explained in detail. It should be remarked that to interpret data, the participant responses on the scores of 5, 6, and 7 were totalized which correspond to somewhat agree, agree, and strongly agree, respectively.

4.2.1 Attitude toward science teaching

In the present study, teachers' attitude toward science teaching was assessed by a set of attitudinal adjectives to reveal their disposition regarding science teaching. Early childhood teachers' attitudes toward science teaching scores were ranged from 4.93 to 6.34 on a 7-point semantic differential scale. The overall mean score of attitude toward science teaching (*M* = 6.03, *SD* = 1.15) indicated that teachers' attitude toward science teaching was very favourable (*M* = 6.03, *SD* = 1.15). In other words, early childhood teachers, who participated in this study overwhelmingly, reported that science teaching was necessary (89.6 %), useful (89.3 %), important (84.2 %), valuable (82.0 %), practical (85.1 %), good (85.0 %), enjoyable (86.4 %) and worth to pay effort (82.4 %).

Table 4.3

Means, Standard Deviations, and Frequency Distributions of Attitude Items

Items	Percentages (%)									
	For me, science teaching is									
	7	6	5	4	3	2	1		M	St. D
Necessary	67.0	13.8	8.8	5.6	3.1	0.2	1.3	Unnecessary	6.3	1.2
Good	55.1	19.0	10.9	7.5	3.1	0.7	1.1	Bad	6.1	1.3
Useful	66.1	15.2	8.0	4.7	2.2	0.7	1.1	Useless	6.3	1.2
Enjoyable	57.0	19.0	10.4	5.5	3.7	0.9	1.1	Boring	6.0	1.3
Easy	23.6	16.8	18.4	19.0	11.3	4.7	3.8	Hard	4.9	1.7
Important	59.7	15.3	9.2	8.5	3.4	0.4	1.1	Unimportant	6.2	1.3
Valuable	56.4	16.9	8.7	8.6	5.2	0.9	0.9	Worthless	6.1	1.4
Practical	59.1	15.7	10.3	7.3	2.9	0.9	1.3	Time consuming	6.2	1.3
Worth to pay effort	56.7	17.2	8.5	9.1	3.6	0.4	1.8	Waste of effort	6.1	1.4

Note. M mean, St. D standard deviation

4.2.2 Subjective norms regarding science teaching

Subjective norms of teachers were directly measured by 4 items on a 7-point Likert type scale by inquiring whether they were influenced by other people and institutions that were important in their profession. The overall mean score of subjective norm (*M* = 5.45, *SD* = 1.47) indicated that participant teachers feel social pressure to teach science explicitly. For instance, most of the participants thought that people who are important for their profession expect them to teach science (75.9 %) and people who are important for their profession support them to teach science (79.1 %). Additionally, almost all items showed the same mean score as seen in Table 4.4.

Table 4.4

Frequency Distributions of Subjective Norm Items and Corresponding Item Means and Standard Deviations

	Percentages (%)								
	1	2	3	4	5	6	7	M	St.D
People who are important to my teaching career expect me to teach science.	5.5	2.2	3.5	11.5	19.6	24.9	31.4	5.4	1.6
Institutions that are important to my teaching career expect me to teach science.	5.6	1.6	3.0	9.5	23.3	23.3	32.5	5.5	1.6
People who are important to my teaching career support me to teach science.	5.2	1.6	3.6	12.3	18.6	25.1	32.5	5.5	1.6
Institutions that are important to my teaching career support me to teach science.	4.3	2.0	4.0	12.9	18.3	25.3	32.3	5.5	1.6

Note: M mean, St.D standard deviation

4.2.3 Perceived behavioural control over science teaching

The questionnaire had only one perceived behavioural control item to measure teachers' controllability over science teaching. Teachers were directly asked by this item whether the control of teaching science in their own power. As shown in Table 4.5, teachers mostly felt that they were in control of teaching science during their teaching service (*M* = 6.20, *SD* = 1.31).

Table 4.5

Mean, Standard Deviation, and Frequency Distribution of Perceived Behavioural Control

Item	Percentages (%)								
	SD						SA		
	1	2	3	4	5	6	7	M	St.D
If I want to teach science in my classroom, it is under my control	2.2	1.2	1.3	4.4	10.6	20.2	59.2	6.20	1.34

Note: SA strongly agree, SD strongly disagree, M mean, St.D standard deviation

4.2.4 Behavioural beliefs regarding teaching science

In line with the TPB, behavioural beliefs were used to be as a direct measurement of attitude toward science teaching. There were 16 items measuring early childhood teachers' behavioural beliefs regarding teaching science. Behavioural beliefs were composed of behavioural belief strength and outcome evaluation of corresponding belief. Table 4.6 and Table 4.7 gives the mean, standard deviation and the frequency distribution of behavioural belief strength and outcome evaluation; respectively.

The overall mean score of behavioural belief strength was 6.37 with a standard deviation of 1.02 on a 7-point Likert scale. This indicates that participant early childhood teachers had favourable beliefs about outcomes of teaching science. As shown in Table 4.6, the highest mean scores of outcome evaluation were on the items " Children understand natural events around them" (*M* = 6.72, *SD* = .76) and " Children learn making observation" (*M* = 6.70, *SD* = .70). On the other hand, the lowest mean score was on the item of "Children understand the characteristics of scientific knowledge" (*M* = 5.92, *SD* = 1.29).

Table 4.6

Mean, Standard Deviation and Frequency Distribution of Behavioural Belief Strength

If I teach science during my teaching service,	Percentages (%)								
	SD						SA		
	1	2	3	4	5	6	7	M	St.D
Children better understand natural events around them.	0.6	0.0	1.0	0.6	3.4	11.9	82.7	6.7	0.7
Children acquire the critical thinking skills.	2.8	1.3	0.3	2.7	4.6	18.2	70.2	6.4	1.3
Children become more interested in the events taking place in their environment.	0.6	0.0	0.1	2.5	4.1	19.6	73.2	6.6	0.8
Children learn making observation.	0.6	0.0	0.1	0.7	2.9	18.5	77.1	6.7	0.7
Children make predictions about the events taking place in their environment.	0.6	0.0	0.1	3.3	5.7	21.2	69.2	6.5	0.8
Children can compare the objects and events around them.	0.6	0.1	0.3	2.5	8.5	26.3	61.7	6.4	0.9
Children can classify the objects and events around them.	0.6	0.1	2.8	2.5	7.4	23.6	62.9	6.4	1.0
Children easily solve the problems they encounter in daily life.	0.9	0.1	0.6	4.7	10.9	22.2	60.6	6.3	1.0
Children better understand the science concepts.	0.6	0.3	2.9	1.7	6.6	18.6	69.4	6.5	1.0
Children become interested in science activities and experiments.	0.4	0.1	0.7	2.8	8.1	18.8	69.0	6.5	0.9

Note: SD strongly disagree, SA strongly agree, M mean, St.D standard deviation

Table 4.6

(Continued)

If I teach science during my teaching service,	Percentages (%)								
	SD						SA		
	1	2	3	4	5	6	7	M	St.D
Children understand the characteristics of scientific knowledge.	0.6	1.1	3.9	8.8	18.0	20.8	46.9	5.9	1.3
Children are prepared for the primary school.	0.9	0.1	0.7	8.8	8.2	25.5	55.7	6.2	1.1
Children understand the Science – Technology – Society - Environment interaction.	0.6	0.8	1.3	6.0	13.0	23.0	55.3	6.2	1.1
Children grow up as scientifically literate individuals.	0.7	1.8	2.8	2.8	18.3	25.7	47.8	6.0	1.2

Note: SD strongly disagree, SA strongly agree, M mean, St.D standard deviation

With respect to outcome expectation items, participant teachers' mean scores were ranged from 6.18 to 6.57 and the overall mean score was 6.41 with a standard deviation of 0.91. This shows that teachers also had a favourable outcome expectations regarding science teaching; that is, teachers gave importance to all items in the scale. To illustrate, as shown in Table 4.6, a great majority of participants believed that that children better understand natural events around them (99.0 %), that children develop their critical thinking skills (95.5 %) and that children learn making observation (97.9 %) were important for them.

Table 4.7

Mean, Standard Deviation and Frequency Distribution of Outcome Expectation

How important to you are the following situations?	Percentages (%)								
	NI						VI		
	1	2	3	4	5	6	7	M	St.D
That children better understand natural events around them.	0.6	0.0	0.3	0.1	5.6	28.3	65.1	6.5	0.7
That children develop their critical thinking skills.	0.6	0.3	0.3	3.5	4.5	23.2	67.8	6.5	0.9
That children become more interested in the events taking place in their environment.	0.6	0.0	0.3	0.3	5.7	26.5	66.7	6.6	0.7
That children learn making observation.	0.6	0.0	0.3	1.3	3.8	23.6	70.5	6.6	0.8
That children make predictions about the events taking place in their environment.	0.6	0.0	0.7	0.7	8.8	32.4	56.8	6.4	0.8
That children can compare the objects and events around them.	0.6	0.0	0.3	1.4	5.0	29.1	63.7	6.5	0.8
That children can classify the objects and events around them.	0.6	0.0	0.4	1.3	9.5	27.1	61.2	6.4	0.8
That children easily solve the problems they encounter in daily life.	0.6	0.0	0.3	2.7	5.0	23.7	67.7	6.5	0.8

Note: NI Not important at all, VI very important, M mean, St.D standard deviation

Table 4.7

(Continued)

How important to you are the following situations?	Percentages (%)								
	NI						VI		
	1	2	3	4	5	6	7	M	St.D
That children can develop a scientific perspective.	0.7	0.3	0.6	3.8	6.3	26.5	61.9	6.4	0.9
That children understand the difference of science form areas like literacy, painting and music.	1.0	0.1	2.1	5.4	14.1	22.0	55.2	6.2	1.1
That children understand the characteristics of scientific knowledge.	0.7	0.3	1.1	3.9	17.5	25.4	51.1	6.2	1.0
Preparation of the children for the primary school.	0.7	0.4	0.6	1.1	6.8	27.6	62.8	6.5	0.9
That children understand the Science – Technology – Society - Environment interaction.	0.8	0.1	0.6	4.6	12.3	26.4	55.2	6.3	1.0
That children grow up as scientifically literate individuals.	0.8	1.1	0.4	2.9	8.9	27.9	57.9	6.3	1.0

Note: NI Not important at all, VI very important, M mean, St.D standard deviation

4.2.5 Normative beliefs regarding science teaching

Normative belief also has two dimensions: The strength of each normative belief and motivation to comply. In line with the TPB, normative beliefs were used to be as a direct predictor of subjective norms regarding science teaching. There were 5 items measuring early childhood teachers' normative beliefs regarding teaching science. Normative beliefs were composed of two scales: normative belief strength and motivation to comply. Table 4.8 and Table 4.9 gives the mean, standard deviation and the frequency distribution of normative belief strength and motivation to comply; respectively.

Table 4.8

Mean, Standard Deviation and Frequency Distribution of Normative Belief Strength

	Percentages (%)								
	SD						SA		
Items	1	2	3	4	5	6	7	M	St.D
Colleagues	4.7	2.6	4.5	14.4	17.0	28.5	27.8	5.34	1.618
Children	3.1	1.3	4.3	13.8	16.5	22.6	38.2	5.61	1.520
Parents	4.1	3.2	4.6	11.5	15.8	28.7	32.1	5.46	1.612
MoNE	3.2	2.9	2.5	9.9	8.3	22.5	50.6	5.87	1.573
School Administration	3.1	2.8	4.6	10.6	13.9	26.6	38.2	5.63	1.563

Note: SD strongly disagree, SA strongly agree, M mean, St.D standard deviation

The overall mean score of early childhood teachers' normative belief strength was 5.58 with a standard deviation of 1.57 on a 7-point Likert scale. It could be concluded that participant teachers had moderately strong beliefs about normative referents. As evident to Table 4.8, most of the participants agreed that colleagues (73.3 %), children (77.3 %), parents (76.6%), MoNE (81.4 %), and school administration (78.7 %) expected them to teach science.

Regarding motivation to comply, the overall mean score of early childhood teachers was 5.65 with a standard deviation of 1.64 on a 7-point Likert scale. That is, similar to normative belief strength, participant teachers had moderately strong beliefs about expectation of normative referents. As seen in Table 4.9, most of the participants thought that the expectation of colleagues (73.2 %), children (97.5 %), parents (85.1 %), MoNE (81.7 %), and school administration (79.9 %) were important for them. It should be remarked that teachers gave the highest priority for the children expectations (97.5%).

Table 4.9

Mean, Standard Deviation and Frequency Distribution of Motivation to Comply

How important are expectation of people or institutions related to your teaching science for you?	Percentages (%)								
	NI						VI		
	1	2	3	4	5	6	7	M	St.D
Colleagues	10.3	2.0	6.8	7.7	13.8	27.8	31.6	5.2	1.9
Children	0.4	0.7	0.7	0.7	5.9	12.9	78.7	6.6	0.9
Parents	3.1	2.5	3.1	6.2	12.1	25.6	47.4	5.9	1.5
MoNE	2.6	0.6	4.7	10.4	13.0	23.3	45.4	5.8	1.5
School Administration	2.5	1.3	6.3	10.0	12.8	28.0	39.1	5.7	1.5

Note: NI Not important at all, VI very important, M mean, St.D standard deviation

4.2.6 Control beliefs about science teaching

Control beliefs were used as a predictor of perceived behavioural control. There were eight items measuring control beliefs on a 7-point Likert scale. Like other belief components, control beliefs also had two components: control belief strength and power of the control factor. Table 4.10 and Table 4.11 gives the mean, standard deviation and the frequency distribution of control belief strength and power of the control factor; respectively.

The degree of early childhood teachers' control belief strength regarding teaching science was found moderately high (M = 5.88, SD = 1.24). This means that the factors would be present during science teaching in their classrooms. As seen in Table 4.10, children eagerness (96.7 %), children interest (97.3 %), having enough time (84.8 %), the courses taken during undergraduate years (84.7 %), or having adequate materials and equipment to teach science (88.2 %) would possibly found during teaching science in their classrooms.

Table 4.10

Mean, Standard Deviation and Frequency Distribution of Control Belief Strength

During your teaching service, to what extent do you expect the following factors are present?	Percentages (%)								
	NP						CP		
	1	2	3	4	5	6	7	M	St.D
Children's eagerness to learn science	0.4	0.1	2.0	0.7	9.4	26.1	61.2	6.3	0.7
Children's interest to science activities	0.6	0.0	1.3	0.8	10.0	26.9	60.4	6.3	1.3
Existence of enough time to teach science	0.7	0.1	5.6	8.9	24.1	27.7	33.0	5.8	0.8
The courses taken during undergraduate years	2.5	2.0	3.9	6.9	19.6	29.7	35.4	5.5	0.7
Help from experienced teachers	1.1	1.5	10.0	6.9	17.2	25.9	37.3	6.2	0.8
Children's eagerness to attend different science activities	0.4	0.1	1.7	2.5	10.2	26.4	58.6	6.2	0.9
Having adequate resources gaining information about science.	1.3	1.3	3.8	5.5	22.6	26.2	39.4	5.6	1.0
Possessing sufficient materials and equipment (book, CDs, lens, compass, etc.) to teach science.	7.0	4.9	7.4	13.6	22.8	18.4	25.8	5.1	1.0

Note: NP not possible at all, CP certainly possible, M mean, St.D standard deviation

With respect to power of control factor, early childhood teachers' scores was found relatively high (*M* = 6.48, *SD* = 0.90). This means that the items used in the scale facilitate teaching science in early childhood classroom. As seen in Table 4.11, children eagerness (97.9 %), children interest (98.4 %), having enough time (97.1 %), the courses taken during undergraduate years (91.4 %), or having adequate materials and equipment to teach science (94.7 %) facilitate to teach science.

Table 4.11

Mean, Standard Deviation and Frequency Distribution of Motivation to Comply

The presence of the following factors facilitate to teach science during my teaching service:	Percentages (%)								
	SD						SA		
	1	2	3	4	5	6	7	M	St.D
That children become eager to learn science	0.6	0.0	0.1	1.4	1.7	16.8	79.4	6.7	0.7
That children show interest to science activities	0.6	0.0	0.3	0.6	3.6	20.5	74.3	6.9	1.3
Having enough time to teach science	0.7	0.3	0.9	1.0	5.4	22.2	69.5	6.5	0.8
That the courses taken during undergraduate years help me	2.4	0.3	1.8	4.1	8.0	26.6	56.8	6.2	0.7
That experienced teachers help me	0.6	0.3	4.3	10.6	5.3	20.6	58.4	6.1	0.8
That children become eager to attend different science activities	0.6	0.0	0.6	0.8	2.3	18.6	77.2	6.6	0.9
Having enough source to gain information about science	0.6	0.3	1.5	3.0	9.7	21.7	63.3	6.3	1.0
Having adequate materials and equipment (book, CDs, lens, compass, and microscope) to teach science	0.8	1.0	1.4	3.1	9.6	14.6	69.4	6.4	1.0

Note: SD strongly disagree, SA strongly agree, M mean, St.D standard deviation

4.2.7 Intention to teach science

Three items measuring teachers' intention to teach science on a 7-point Likert scale. The overall mean score for intention to teach science was 6.18 with standard deviation of 1.09. In addition, with 92.3 % of the participants responded in the range of 5 to 7. This implied that more than half of the teachers highly intend to teach science in their early childhood classrooms.

Table 4.12

Mean, Standard Deviation and Frequency Distribution of Behavioural Intention

In this educational year,	Percentage (%)								
	SD						SA		
	1	2	3	4	5	6	7	M	St.D
I will try to teach science	0.7	0.8	1.6	3.8	17.9	21.3	53.1	6.2	1.1
I intend to teach science	0.7	0.9	3.0	2.7	15.0	20.9	55.7	6.2	1.2
I plan to teach science	0.9	0.2	2.9	3.8	14.3	23.1	53.6	6.2	1.2

Note. SA strongly agree, SD strongly disagree, M mean, St.D standard deviation

4.2.8 Science teaching behaviour

There was only one item to measure science teaching behaviour of teachers in their classroom on a 7-point Likert scale. Teachers were asked how often they teach science in their classroom. The score of 7 represented that teachers *always* teach science in their classroom, and score of 1 represented that they *never* teach science in their classrooms. The mean score of behaviour item was 4.91 with standard deviation of 1.13. This indicated that teachers allocated time for science teaching on average. Table 4.13 indicated the frequency distribution for teachers' science teaching behaviour. 67.8 % of teachers scored in 4 and 5 and this showed that most of the teachers do not teach science frequently. In addition, the overall mean score of science teaching behaviour was found to be fairly lower than the overall mean score of science teaching intention. Table 4.16 shows the frequency distribution, mean and standard deviation of teachers' science teaching behaviours.

Table 4.13

Mean, Standard Deviation and Frequency Distribution of Behaviour

	Percentages (%)								
	Never	Seldom	Rarely	Sometimes	Often	Usually	Always		
	1	2	3	4	5	6	7	M	St.D
Frequency of teaching science	0.4	1.1	7.2	23.9	43.9	11.9	11.6	4.92	1.13

Note. M mean, St.D standard deviation

4.2.9 Personal science teaching norms

A 10 items scale was used to measure early childhood teachers' personal science teaching norms on a 7-point Likert scale. The overall mean score (*M* = 6.06, *SD* = 0.95) indicated that participant teachers had relatively high personal science teaching norms. That is, participant teachers had feelings of personal obligation to teach science. As evident in Table 4.14, great majority of participants agreed on the following statements "I feel happy, if I allocate time to teach science" (94.1 %) and "I am willing to put extra effort to teach science" (91.8 %). On the other hand, the lowest agreement score was on the item of "I would feel guilty if I do not allocate enough time to teach science" (78.7 %).

Table 4.14

Mean, Standard Deviation, and Frequency Distribution of Personal Science Teaching Norm

Item	Percentages (%)								
	SD						SA		
	1	2	3	4	5	6	7	M	St.D
I am willing to put extra effort to teach science	0.0	0.2	2.1	4.7	18.3	36.2	37.3	6.0	0.9
I would feel guilty if I do not allocate enough time to teach science.	2.0	1.3	4.5	11.8	19.1	26.3	33.3	5.6	1.4
I feel responsible toward children to allocate time for teaching science	1.1	1.1	2.0	5.4	17.9	26.3	44.5	6.0	1.2
It is wrong for me not to allocate time for science teaching.	8.7	0.9	0.8	2.9	11.0	21.9	52.3	5.9	1.8
All pre-school teachers are responsible for allocating time for science teaching.	0.8	2.5	1.6	2.7	12.7	22.1	56.1	6.2	1.2
I feel happy, if I allocate time to teach science.	0.0	1.8	0.4	1.8	8.7	26.9	58.5	6.4	0.9
When I attach importance to the science teaching, I improve my working motivation.	0.4	2.2	1.0	4.3	10.1	26.1	54.0	6.2	1.2
Avoidance of teaching science is incompatible to my teaching approach.	6.0	2.2	2.4	3.0	15.1	20.7	48.8	5.8	1.7
I feel strong obligation to teach science.	0.4	0.4	0.6	2.2	12.3	22.5	59.6	6.4	0.9
Not allocating time for science teaching is inconsistent to my work ethic.	4.3	1.8	2.9	4.6	12.4	22.7	48.9	5.9	1.6

Note: SA strongly agree, SD strongly disagree, M mean, St.D standard deviation

4.2.10 Science teaching self-efficacy beliefs

Early childhood teachers' self-efficacy beliefs regarding teaching science were measured by 11 items on a 5-point Likert scale. The mean score (*M* = 3.4, *SD* = 0.68) was found slightly higher than the midpoint of 3, which was stand for undecided. Of the participants, 46.7 % of them reported that "I generally teach science ineffectively" and 74.3 % of them stated that " I know the steps necessary to teach science concepts effectively", and 44.7 % of them stated "Even if I try very hard, I will not teach science as well as I do most subjects". Table 4.15 shows mean, standard deviation, and frequency distribution of teachers' self-efficacy beliefs.

Table 4.15

Mean, Standard Deviation, and Frequency Distribution of Science Teaching Self-efficacy Beliefs

	Percentages (%)						
	SD				SA		
In my teaching service,	5	4	3	2	1	M	St. D
I generally teach science ineffectively	26.9	19.8	17.9	19.1	13.7	2.7	1.4
I know the steps necessary to teach science concepts effectively.	1.6	3.8	18.5	36.6	37.7	4.2	0.9
I continually find better ways to teach science.	1.1	9.1	27.4	35.2	25.4	3.8	0.9
I can sufficiently monitor the children while teaching science.	0.0	5.3	19.6	33.6	39.8	4.1	0.9
I understand the science concepts well enough to teach them effectively.	1.3	6.5	18.8	41.5	29.3	3.9	0.9
I am typically able to answer children's science questions.	0.7	3.7	13.2	39.3	41.1	4.2	0.8
Even if I try very hard, I cannot teach science as well as I do most subjects.	28.1	16.6	18.5	19.3	15.1	2.8	1.4
I wonder if I have the necessary skills to teach science.	14.7	13.8	20.0	26.9	21.4	3.3	1.3
Given a choice, I do not invite the principal to evaluate my science teaching.	24.1	10.0	21.6	16.0	26.3	3.1	1.5
I do not know what to do to turn children on to science.	32.5	14.8	12.7	20.7	17.8	2.8	1.5
When a child has difficulty understanding a science concept, I am usually at a loss as to how to help the children understand it better.	29.8	14.4	18.4	21.2	14.4	2.8	1.4

Note: SD strongly disagree, SA strongly agree, M mean, St.D standard deviation

4.2.11 Scientific epistemological beliefs

Scientific epistemological beliefs questionnaire included three dimensions: source-certainty of knowledge, development of knowledge, and justification of knowledge. The responses for the items of source –certainty of knowledge dimensions were reversed prior to the analysis in order to make the values represent the same thoughts. The overall mean score of epistemological belief questionnaire was 3.68 (*SD* = 1.05) on a 5-point Likert scale. This means that participant teachers had moderate level of sophisticated epistemological beliefs. While the justification of knowledge dimension had the highest mean score (*M* = 4.19, *SD* = 0.90), source-certainty of knowledge dimension had the lowest mean score (*M* = 2.97, *SD* = 1.24). These results indicated that the participant teachers generally agreed with the idea that " Ideas about science experiments come from being curious and thinking about how things work" (86.1 %), " The most important part of doing science is coming up with the right answer " (76.6 %), and "The ideas in science books sometimes change" (80.1 %). In short, having greater mean value in the dimensions of justification of knowledge (*M* = 4.19) and development of knowledge (*M* = 4.12) indicated that participant teachers strongly tended to believe the significance of scientific evidence and assessing claims to justify knowledge (justification) and they in general, believed that science has an evolving nature and can subject to change. On the other hand, participant teachers showed undecided position regarding the source and certainty of knowledge (*M*= 2.97). Their beliefs were closer to the view that there is only single right answer in science. Table 4.16 gives the descriptive statistics of epistemological beliefs questionnaire.

Table 4.16

Mean, Standard Deviation and Frequency Distribution of Epistemological Beliefs

Item	Percentages (%)					M	St.D
	SD				SA		
	1	2	3	4	5		
Everybody has to believe what scientists say	25.2	16.8	28.3	19.7	9.9	2.7	1.3
All questions in science have one right answer	11.4	12.3	21.1	30.6	24.6	3.4	1.3
Ideas about science experiments come from being curious and thinking about how things work	3.4	3.4	7.0	33.1	53.0	4.3	0.9
Some ideas in science today are different than what scientists used to think	1.7	8.1	15.2	33.1	41.9	4.0	1.0
It is good to have an idea before you start an experiment.	0.6	1.4	7.2	27.4	63.4	4.5	0.7
In science, you have to believe what the science books say about stuff	22.4	17.9	26.4	23.4	10.0	2.8	1.3
The most important part of doing science is coming up with the right answer	3.6	4.0	15.9	31.0	45.6	4.1	1.0
The ideas in science books sometimes change	1.1	4.6	14.2	32.4	47.7	4.2	0.9
In science, there can be more than one way for scientists to test their ideas	0.4	1.0	14.2	31.4	53.0	4.4	0.8
Whatever the teacher says in science class is true	29.9	20.8	22.1	21.0	6.2	2.5	1.2

Note. SA strongly agree, SD strongly disagree, M mean, St.D standard deviation

Table 4.16

(Continued)

Item	Percentages (%)					M	St.D
	SD				SA		
	1	2	3	4	5		
Scientific knowledge is always true	13.2	15.8	28.2	30.3	12.5	3.1	1.2
Ideas in science sometimes change	0.7	6.3	18.8	27.7	46.5	4.1	0.9
It is good to try experiments more than once to make sure of your findings	0.4	3.7	9.8	23.3	62.8	4.4	0.8
Only scientists know for sure what is true in science	24.5	20.7	25.7	16.2	12.9	2.7	1.3
Once scientists have a result from an experiment that is the only answer	35.1	16.5	24.0	15.0	9.5	2.5	1.3
Good ideas in science can come from anybody. not just from scientists	1.3	2.7	14.0	37.2	44.6	4.2	0.8
Scientists always agree about what is true in science	32.5	20.7	18.9	19.3	8.7	2.5	1.3
Good answers are based on evidence from many diff erent experiments	0.9	2.8	16.8	28.2	51.1	4.3	0.9
Sometimes scientists change their minds about what is true in science	1.0	3.8	19.3	36.9	38.9	4.1	.9
A good way to know if something is true is to do an experiment	0.8	1.7	12.0	35.8	49.2	4.3	0.8

Note. SA strongly agree, SD strongly disagree, M mean, St.D standard deviation

4.2.12 Science content knowledge

There were 14 questions in Science Content Knowledge Test to test the early childhood teachers' science content knowledge. As explained in Chapter III, 6 questions were eliminated in pilot study due to the fact that lack of item discrimination and unacceptable item difficulty level. The remained items' content areas, domains of science were given in Table 4.17 with the percentages of correct answers, wrong answers and the alternative of "I do not know". It was seen that participant teachers mostly did the questions correctly about recycling (66.9 %), heat and temperature (65.4 %), day and night (72.3 %) energy resources (72.5 %), light (refraction) (73.9 %), and food chain (67.2 %). On the other hand, participant teachers could not answer correctly the questions about adaptation (35.6 %), sky (34.5 %), buoyancy force (41.5 %), matter properties (41.6 %), biodiversity (32.9 %). In addition, they mostly selected the alternatives of "I do not know" in the questions of buoyancy force (35.0 %), and sky (27.8 %). When the domains of science were examined in terms of correct and wrong answers and alternative of "I do not know", it was seen that teachers mostly answered correctly in Earth Science. It should be remarked that the items were not equally distributed in three content domains; therefore, it was difficult to compare domains of science.

Table 4.17

Participant Teachers' Responses in Science Content Knowledge Test

Question number	Content of the question	Correct answer (%)	Wrong answer (%)	"I do not know" (%)
1	Recycling	66.9	24.3	0.6
2	Adaptation	40.4	35.6	18.7
3	Heat and temperature	65.4	28.4	4.8
4	Shadow	61.4	25.2	8.0
5	Day and night	72.3	21.7	0.4
6	Sky	31.6	34.5	27.8
7	Buoyancy force	17.7	41.5	35.0
8	Matter properties	28.5	41.6	23.7
9	Biodiversity	58.5	32.9	2.9
10	Energy resources	72.5	9.7	11.7
11	Light (refraction)	73.9	13.1	7.2
12	Ozone layer	55.1	29.6	9.2
13	Food chain	67.2	21.6	11.6
14	Atmosphere	24.0	42.6	27.1

4.3 Structural equation modelling

As explained in Chapter 3, the hypothesized model of the study was tested by partial least square based SEM (PLS-SEM). The steps of the PLS-SEM for the model assessment was followed in the present study (see section 3.6). Accordingly, in the first stage, the measurement model was assessed in terms of reliability and validity. This stage included testing of composite reliability, indicator reliability, convergent validity, and discriminant validity. In the second stage, structural model was assessed in terms of explained variance of endogenous latent variables, estimation of path coefficients, effect size and, predictive relevance (Henseler et al., 2009). Prior to model testing confirmatory factor analysis was conducted in order to see whether the data fit the hypothesized model.

4.3.1 Confirmatory factor analysis

Confirmatory factor analysis (CFA) was performed for all reflective constructs without any discrimination on whether the construct was pre-validated by using SmartPLS 3.0 software. CFA provided convergent and discriminant validities in addition to reliability of all constructs. By means of the CFA, the model with its latent and manifest variables was ready to test.

PLS algorithm with *path* weighting scheme and *300 maximum iteration* was run in order to get factor loadings of the items. In this stage, the model built in SmartPLS was called as *measurement* or *outer model*. Most of the items' loadings were above .70 cut-off value except for fourteen manifest variables out of 91 variables. In these variables, some of them had loading very close to .70 (i.e. ATT5, CB4, CB5, CB8, EB1, EB4, EB22, EB5, EB8, EB15, EB2, EB3, EB7 and EB9, PN4, PN8, NB2). All of these items were retained in the model since Henseler et al. (2009) stated that researchers should be careful while eliminating any items from the scale and take into account composite reliability. If an item's outer loading is below .70 and removing it from the model increases the composite reliability, it is meaningful to remove item. Accordingly, items which had lower loadings decreasing the composite reliability of the measurement scale were dropped from the model. These items were EB11, EB12, SE1, SE7, SE8, SE9, SE10, and SE11. In Figure 4.1 measurement model was shown after dropping items in behalf of CFA. In the model, circles represented latent variables and rectangles represented manifest (observed or indicator) variables. The numbers in the circles indicated composite reliability and the numbers on the arrows from one latent variable to another latent variable described the path coefficients which could be thought as β coefficient in regression analysis. The numbers on the arrows from latent variables to its indicator variables showed factor loadings (outer loadings) of the item.

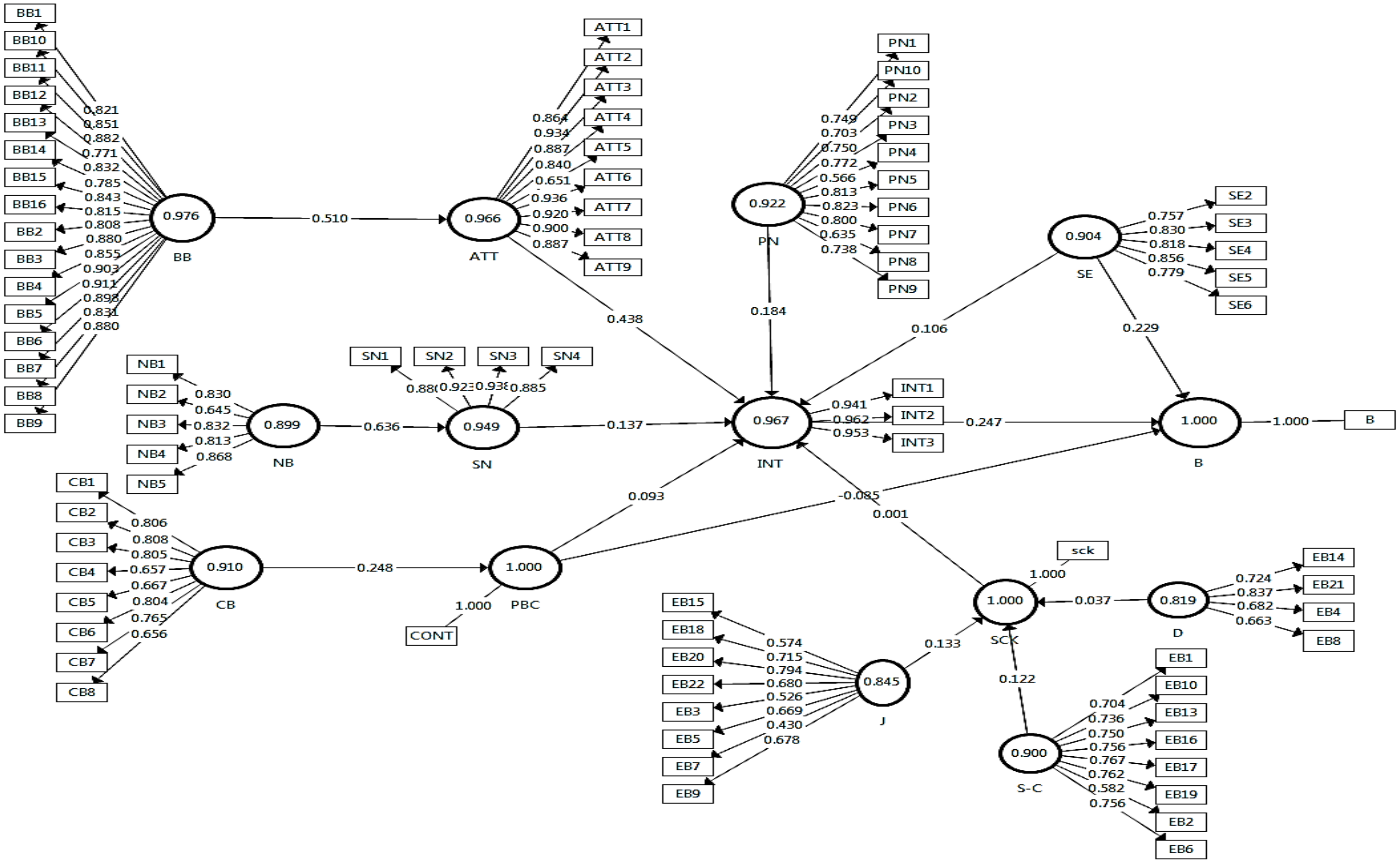


Figure 4.1 Measurement model after CFA

4.3.2 Measurement (Outer) model assessment

The measurement or outer model assessment included the reliability and validity of the reflective constructs.

4.3.2.1 Internal consistency reliability

Composite reliability (CR) is regarded as more appropriate indicator of internal consistency rather than Cronbach α (Werts, Linn, & Jöreskog, 1974) due to the fact that Cronbach α critically underestimates internal consistency reliability of latent variables in PLS path modelling. Composite reliability takes into account the actual loadings while calculating indicators and it is annotated like Cronbach α in which the critical value is above .7 (Hair et al., 1998). In addition, Nunnally and Bernstein (1994) interpreted that values above .8 or .9 would be better in more advanced stages of the model validation. CR values of the constructs were reported in Table 4.18. All constructs had a respectable internal consistency having a CR value above .8.

4.3.2.2 Convergent validity

Convergent validity was determined by means of average variance extracted (AVE) scores in PLS-SEM (Fornell & Larcker, 1981; Bagozzi & Yi, 1988). Acceptable convergent validity requires AVE value above .5. The AVE value of .5 refers that latent variable is capable of clarifying more than 50 percent of the variance of its indicators (Chin & Newsted, 1999). As evident to Table 4.17, all constructs had AVE score above the cut off value of .5. Thus, all constructs in the model had an acceptable convergent validity.

Table 4.18

Composite Reliability and AVE Values of Constructs

	CR	AVE
Attitude	.972	.810
Subjective norms	.949	.822
Perceived behavioural control	1.000	1.000
Personal norms	.923	.602
Self-efficacy beliefs	.904	.654
Science content knowledge	1.000	1.000
Intention to teach science	.967	.906
Science teaching behaviour	1.000	1.000
Behavioural beliefs	.976	.720
Normative beliefs	.913	.725
Control beliefs	.920	.699
Justification	.841	.516
Source-certainty	.899	.559
Development	.807	.585

Note. CR composite reliability, AVE average variance extracted

4.3.2.3 Discriminant validity

Discriminant validity as a complementary part of convergent validity is defined that appropriate pattern of loadings is expected from the indicators. In other words, indicators should be loaded in their theoretically defined factors not the other one. There are two control figurations for discriminant validity. The first measure is the Fornell- Larcker criterion which hypothesizes each construct's square root of AVE should be above the highest squared construct's correlation with any other constructs (Fornell & Larcker, 1981). The second measure is the cross loading; each indicator is expected to load highest on its own construct (Chin, 1998; Gregoire & Fisher, 2006). As presented in Table 4.19 all indicators were loaded belonging constructs and discriminant validity was fulfilled.

Table 4.19

Fornell-Larcker Discriminant Validity

	ATT	B	BB	CB	D	INT	J	NB	PBC	PN	S-C	SCK	SE	SN
ATT	**0.873**													
B	0.245	**1.000**												
BB	0.510	0.241	**0.849**											
CB	0.321	0.205	0.504	**0.749**										
D	0.054	0.007	0.180	0.126	**0.730**									
INT	0.553	0.289	0.484	0.432	0.070	**0.952**								
J	0.101	0.074	0.210	0.185	0.612	0.141	**0.642**							
NB	0.242	0.093	0.288	0.446	0.067	0.307	0.107	**0.802**						
PBC	0.146	0.011	0.128	0.248	0.021	0.231	0.057	0.116	**1.000**					
PN	0.279	0.208	0.425	0.446	0.276	0.413	0.338	0.332	0.128	**0.739**				
S-C	0.049	-0.027	0.040	-0.070	0.025	0.004	-0.027	-0.111	-0.033	-0.019	**0.729**			
SCK	0.034	-0.002	-0.034	0.005	0.122	0.031	0.153	-0.052	-0.029	0.081	0.119	**1.000**		
SE	0.140	0.281	0.203	0.287	0.197	0.265	0.237	0.169	0.168	0.374	-0.128	-0.006	**0.809**	
SN	0.255	0.071	0.337	0.446	0.162	0.353	0.170	0.636	0.235	0.394	-0.069	0.023	0.095	**0.907**

Note. Bold diagonal numbers are square roots of AVE

4.3.3 Structural (inner) model assessment

The outer model assessments yielded acceptable results in terms of reliability and validity; therefore, the way had opened to test the inner model. In this section the quality of the structural model was assessed by calculating parameters of coefficient of determination (R^2), effect size (f^2), bootstrapping technique for significance of path coefficient estimates, blindfolding technique for cross validated redundancy (Q^2), cross validated communality (H^2), and goodness of fit (GoF). The results of assessments were reported in the following subsections particularly.

4.3.3.1 Coefficient of determination (R Square)

Chin (1998) recommended that the first step for the structural model evaluation should be the examination of the coefficient of determination (R^2, percentage of variance explained) since the coefficient of determination is figured out as the essential criterion for the endogenous latent variables (Henseler et al., 2009). In PLS- SEM, R^2 values of 0.67, 0.33, and 0.19 are evaluated as substantial, moderate, and weak, respectively (Chin, 1998). The researchers should seek for substantial R^2 value for these constructs since the model stand on several exogenous latent variables. Otherwise, the model may raise doubt about its theoretical underpinnings and imply that the model cannot explain the endogenous latent variables (Henseler et al., 2009). The coefficient of determination of attitude, perceived behavioural control, science teaching behaviour, and science concept knowledge were found weak R^2; while intention and subjective norms had moderate R^2 (see Table 4.20). However, the main concern of this point was on intention and behaviour, which were two certain endogenous variables of the study.

Table 4.20

R Square Evaluation

Construct	R^2	Evaluation of R^2
Attitude	0.253	Weak
Intention to teach science	0.412	Moderate
Perceived behavioural control	0.050	Weak
Science teaching behaviour	0.135	Weak
Subjective norms	0.373	Moderate
Science concept knowledge	0.040	Weak

It was clearly seen in Table 4.18 and Figure 4.2 that the model had relatively low R^2 value to explain teachers' science teaching behaviour and moderate level to explain intention to teach science which can be acceptable for models having a few exogenous variables. According to the results of R^2, the present model needed to be modification or revision. This would be discussed in next sections in model modification.

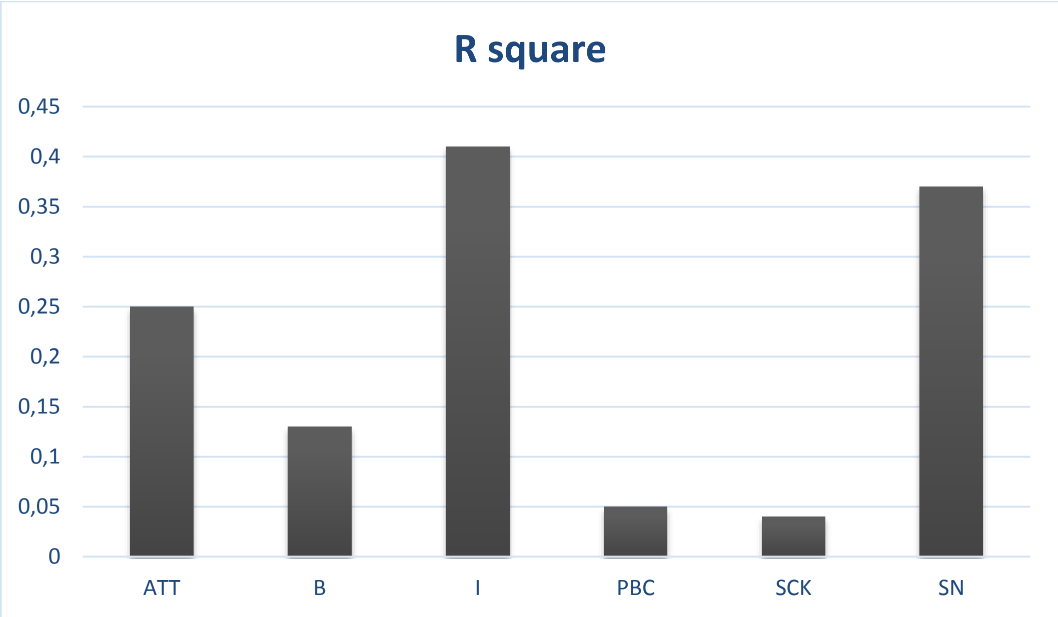


Figure 4.2 R square of latent variables in the model

4.3.3.2 Bootstrapping

Without assuming data normality, parametric significance tests used in regression analyses are worthless for PLS estimates. Accordingly, PLS path modelling carries out a nonparametric and distribution-free approach, named as bootstrapping, to test the significance of the coefficients. Bootstrapping technique provides researchers to create subsamples with randomly drawn observations from the original data set (Chin, 1998; Efron, 1981; Efron & Tibshirani, 1993; Henseler et al., 2009). In this study, 5000 bootstrap subsamples, a large number as recommended, were chosen to assure stability. Critical t-value at 99 percent confidence interval (α =.01) is 2.58 for a two -tailed t-test. The significance of path coefficients was determined by evaluating t and p values. Among 14 paths, only three of them had statistically non-significant t values (*t* <2.58 and *p* >0.01). These paths were between *development of knowledge* and *science content knowledge, perceived behavioural control* and *science teaching behaviour*, and *science content knowledge and intention to teach science*. Table 4.21 showed significance of path coefficients by using bootstrapping technique.

Table 4.21

t and p Values of Path Coefficients

Path	t values	p values
Attitude → intention to teach science	9.488	0.000
Behavioural beliefs → attitude	12.425	0.000
Control beliefs → perceived behavioural control	6.113	0.000
Development → science content knowledge	**0.877**	**0.361**
Intention to teach science → science teaching behaviour	7.022	0.000
Justification → science content knowledge	3.441	0.000
Normative beliefs → subjective norms	26.719	0.000
Perceived behavioural control → intention to teach science	2.816	0.005
Perceived behavioural control → science teaching behaviour	**2.369**	**0.123**
Personal norms → intention to teach science	5.347	0.000
Science content knowledge → intention to teach science	**0.025**	**0.921**
Self-efficacy → intention to teach science	3.372	0.000
Source-certainty → science content knowledge	4.462	0.000
Subjective norms → intention to teach science	4.009	0.000

4.3.3.3 Blindfolding

PLS path modelling yields the cross-validated communality (H^2), the cross-validated redundancy (Q^2) and the *Goodness of Fit* (*GoF*) as fit indexes via blindfolding procedure to test model fit (Chin, 1998; Lohmöller, 1989). Geisser (1975) and Stone (1974) was promoted Q^2 test in order to assess the predictive relevance of the endogenous constructs. Q^2 test indicates how well the model and its parameter estimates regenerate manifest variables. Chin (1998) asserted that cross validated redundancy is appropriate to test the predictive relevance of the structural model. If the Q^2 value is greater than zero, the model has predictive relevance. In other words, the more positive Q^2 value the model produces, the more predictive relevance the model has. As seen in Table 4.20, in the present study, a cross-validated redundancy (Q^2) and a cross-validated communality (H^2) of constructs were all greater than zero which means the model of present study had predictive relevance. To be more illuminative, the Q^2 index measures the structural model quality for each endogenous block by considering measurement model, and the H^2 index measures the measurement model quality for each block (Tenenhaus et al., 2005). Like effect size, values of 0.02, 0.15, and 0.35 were evaluated as small, medium, or large predictive relevance in SEM models. Table 4.22 shows the predictive relevance of each exogenous construct on corresponding endogenous construct.

Table 4.22

Evaluation of predictive relevance (Q^2)

Construct	Q^2	Size of Q^2
Attitude	0.203	Medium
Intention	0.369	Large
Perceived Behavioural Control	0.047	Small
Science Teaching Behaviour	0.124	Small
Science Content Knowledge	0.027	Small
Subjective Norms	0.304	Medium

4.3.3.4 Goodness of fit (GoF)

As mentioned previously, PLS SEM does not yield any universal goodness of fit criterion (Chin, 1998). In order to surpass the problem of PLS path modelling about overall assessment of model, Tenenhaus et al. (2004) has been introduced a universal criterion of goodness-of-fit (GoF) index. GoF index is conceptually appropriate if measurement models are reflective as in this study.

$$\text{GoF} = \sqrt{\text{average communality} \times \text{average } R^2}$$

Figure 4.3 Calculation of GoF

The calculation of GoF was given in Figure 4.8. GoF score takes a value between 0 and 1. GoF for the existent model was 0.329 which means that the model was capable to take into account 33 % of the achievable fit. Since the GoF is a descriptive index, there is no threshold to assess its statistical significance. However, Ringle et al. (2009) reported that GoF value around 0.50 can be evaluated as 'moderate' fit. The reason of low GoF value of the present study may be due to insignificant paths and indirect effects. By considering these issues model modification was conducted in next section.

As it is seen in the Table 4.23, the research model had a better measurement model (H^2= 0.521) than the structural model (Q^2= 0.179).

Table 4.23

R^2, H^2, and Q^2 of the Structural Model

Construct	R^2	H^2	Q^2
Attitude	0.253	0.734	0.203
Behavioural beliefs		0.687	
Control beliefs		0.536	
Development		0.184	
Intention to teach science	0.412	0.762	0.369
Justification		0.257	
Normative beliefs		0.529	
Perceived behavioural control	0.049	1 *	0.047
Personal norms		0.482	
Science teaching behaviour	0.132	1 *	0.124
Science content knowledge	0.037	1 *	0.027
Self-efficacy		0.469	
Source& certainty		0.396	
Subjective norms	0.372	0.693	0.304
Average	0.208	0.521	0.179
GoF	**0.329**		

* Single item constructs were excluded during computating of the average communality (Tenenhaus, Amato, & Esposito Vinzi, 2004).

4.3.3.5 Effect Size

In this study, five latent variables were used in order to assess early childhood teachers' intention to teach science and three latent variables were used to assess corresponding behaviour. In addition to these, four of latent variables were predicted again different numbers of latent variables. In order to see whether a predictor variable has a concrete effect on a dependent variable, effect size (f^2) can be calculated (Cohen, 1988). By means of effect size, the contribution of each construct predicting another construct can be determined. The formula of effect size is postulated by Cohen (1988) as in Figure 4.4.

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

Figure 4.4 Calculation of f^2

Effect size is divided into three categories regarding its computed value: small (0.02), moderate (0.15), and large (0.35) (Cohen, 1988). Small effect size should be taken into account since it is not an insignificant effect by creating meaningful beta changes (Limayem, Hirt & Chin, 2001). Effect sizes were resulted as in Table 4.24 in this study. As a result, behavioural intention had a small effect on behaviour (f^2 = .063) and attitude was a construct which showed a more substantial effect on intention than the other constructs (f^2 = .281).

Table 4.24

Effect Sizes

	Attitude	Behaviour	Intention	Perceived behavioural control	Science content knowledge	Subjective norms
Attitude			0.281			
Behavioural beliefs	0.339					
Control beliefs				0.053		
Development					**0.002**	
Intention		0.063				
Justification					**0.011**	
Perceived behavioural control		**0.008**	0.015			
Personal norms			0.038			
Normative beliefs						0.594
Science content knowledge			**0.000**			
Self-efficacy beliefs		0.056	0.020			
Subjective norms			0.027			
Source- certainty					**0.014**	

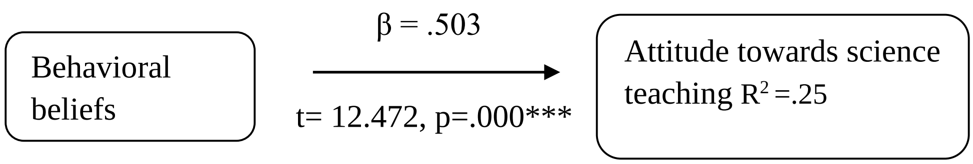
4.4 Hypothesis testing

The first hypothesis of the study was explained earlier in this chapter in the part of descriptive findings. The remained hypotheses were related to structural model explained in this section.

Research Question 2: In what ways early childhood teachers' behavioural beliefs, normative beliefs, control beliefs, and epistemological beliefs are related to attitudes, subjective norms, perceived behavioural control, and science content knowledge?

According to the TPB, three direct factors of human intentions (i.e. AB, SN, and PBC) are guided by three types of salient beliefs: behavioural beliefs (BB), normative beliefs (NB), and control beliefs (CB). In addition to these three kinds of salient beliefs, epistemological beliefs were included in this study as an indicator of science content knowledge.

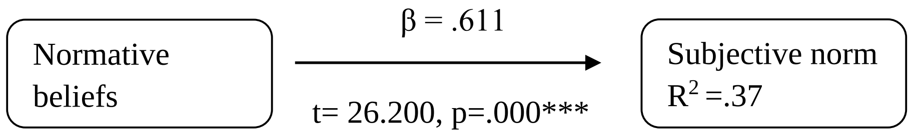
The results indicated that there was a strong relationship between behavioural beliefs, normative beliefs, control beliefs and attitudes, subjective norms, perceived behavioural control; respectively. Behavioural beliefs regarding Early childhood teachers' science teaching behaviours were found to be significant determinant of their attitudes toward science teaching (β = .503). The path between behavioural beliefs and attitude was the second highly significant path in the model (t =12.472, p = .000). In addition, PLS structural model indicated that the sixteen behavioural belief items accounted for 25.3 % of the variance in attitude towards science teaching.



* p < .05, **<.01, *** < .001

Figure 4.5 Pathway to ECTs' attitude towards science teaching from behavioural beliefs

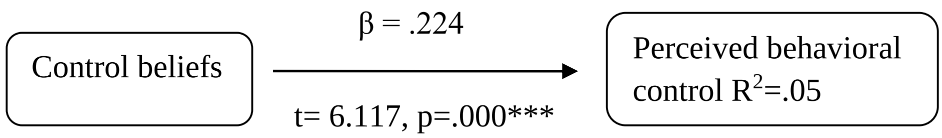
The relationship between normative beliefs and subjective norm constructs showed the highest path coefficient in the research model (β = 0.611) and correspondingly the highest significant path (t = 26.200, p =.000). In addition, normative beliefs were accounted for 37% of the variance of subjective norm construct. Thus, normative beliefs of teachers supported to be underlying basis of their subjective norms in the context of science teaching.



* p < .05, **<.01, *** < .001

Figure 4.6 Pathway to subjective norm regarding science teaching from normative beliefs

The relationship between control beliefs and PBC was slightly lower (β = .224) than the other relationships between direct and indirect measurements (i.e. behavioural beliefs-attitude and normative beliefs-subjective norms) but still significant (t = 6.117, p =.000). In addition, control beliefs were explained only 5 % variance of PBC.



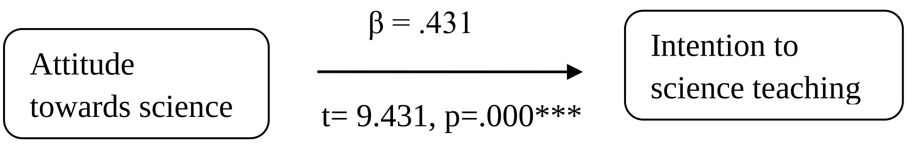
* p < .05, **<.01, *** < .001

Figure 4.7 Pathway to PBC from control beliefs regarding science instruction

Lastly, two dimensions of scientific epistemological beliefs (i.e. source-certainty of knowledge and justification of knowledge) significantly predicted science content knowledge of teachers (p =.000); while development dimension did not (t = .877, p =.361). This finding implied that participant teachers who tended to believe scientific knowledge is evolving and changing (development of knowledge) did not better do in science content knowledge test. However, teachers tented to believe the significance of scientific evidence and assessing claims to justify knowledge (justification) and that there are more than single answer in science and knowledge can be constructed by the knower did better on science content knowledge test.

Research Question 3: How well can early childhood teachers' science teaching intentions be explained by their attitude toward science teaching, subjective science teaching norms, perceived behavioural control, personal science teaching norms, self-efficacy beliefs regarding science teaching, and science concept knowledge?

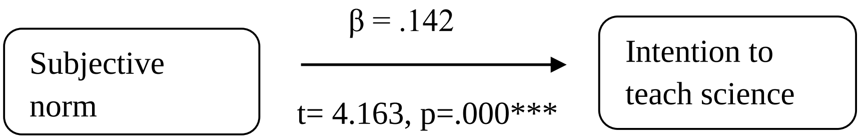
In the present study, PLS structural model analysis yielded that attitude made the strongest (β = .431) contribution by explaining the large part of the variance in behavioural intention. This finding implied that the more early childhood teachers hold positive attitudes towards science teaching or the more they believe that science instruction is necessary and enjoyable, the more they plan or intend to teach science in their classrooms. Therefore, in line with the suggestion of Ajzen (2001) considering the TPB constructs, it can be concluded that attitudes towards science teaching was the most influential construct of early childhood teachers' science teaching intentions with medium effect size (f^2 = 0.28).



* p < .05, **<.01, *** < .001

Figure 4.8 Pathway to teachers' science teaching intention from attitude towards science teaching

Although the significance of path from subjective norm to behavioural intention was found to be low (β = 0.142), subjective norm was still significant agent of Early childhood teachers' intention to teach science (t = 4.163, p = .000).



* *p* < .05, **<.01, *** < .001

Figure 4.9 Pathway to teachers' science teaching intention from subjective norm regarding science teaching

Early childhood teachers' perceived behavioural control over science teaching was a significant determinant of their science teaching intention (t = 2.819, p =.005) although this component had the lowest path coefficient (β = .096).

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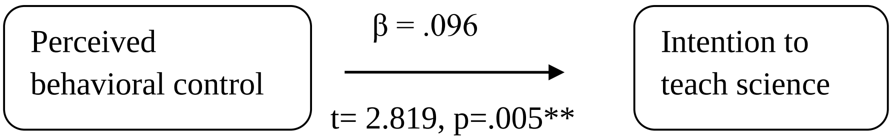
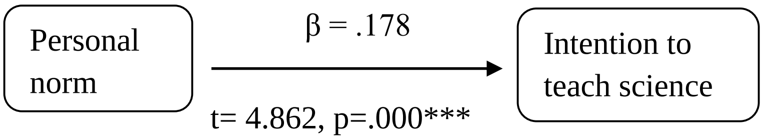


* *p* < .05, **<.01, *** < .001

Figure 4.10 Pathway from perceived behavioural control to science teaching intention

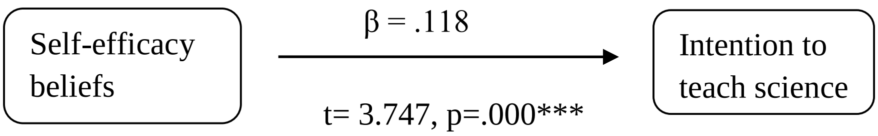
Another significant determinant of teachers' science teaching intention was personal norms (t = 4.862, p =.000) as seen in Figure 4.11. While the subjective norm refers to other people's expectation with regard to the behaviour, personal norms were self-expectations and personal obligations arisen by internalized values (Schwartz, 1977; Schwartz & Howard, 1980). In the context of this study, early childhood teachers may believe that their instructional choices would influence their children and so, they allocate more time to teach science.



* $p < .05$, **<.01, *** < .001

Figure 4.12 Pathways from personal norm to intention to teach science

Moreover, present study indicated that early childhood teachers' self-efficacy beliefs regarding science teaching directly influenced their science teaching intention (t = 3.747, p=.000).



* $p < .05$, **<.01, *** < .001

Figure 4.13 Pathways from self-efficacy beliefs to intention to teach science

Nevertheless, the PLS structural model analysis indicated no relationship between teachers' SCK and their science teaching behaviour (β = .003) with an insignificant path (t = .100, p=.921).

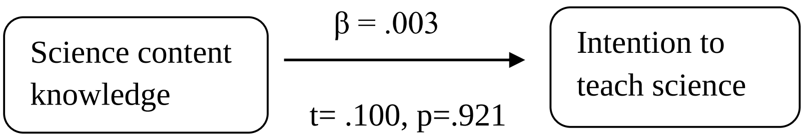
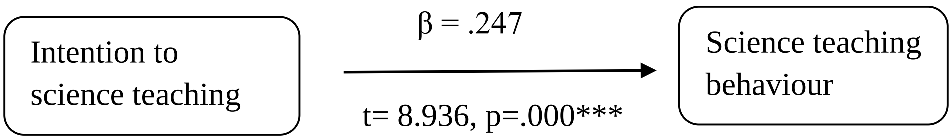


Figure 4.14 Pathways from science content knowledge to intention to teach science

Research Question 4: How well can early childhood teachers' science teaching behaviours be explained by their perceived behavioural control, self-efficacy beliefs regarding science teaching, and science teaching intentions?

The present study aimed to explain early childhood teachers' science teaching behaviour by the favour of three constructs, namely teachers' science teaching intention, perceived behavioural control and self-efficacy beliefs regarding science teaching. Consistent with the TPB (Ajzen, 1991), Early childhood teachers' science teaching intentions was found to be significant and direct predictor of their self-reported science teaching behaviour (t=8.936, p =.000). Thus, early childhood teachers' intent to teach science was one of the significant indicators of the number of science activities provided in the classroom. Figure 4.15 shows the direction and size of the relationship.

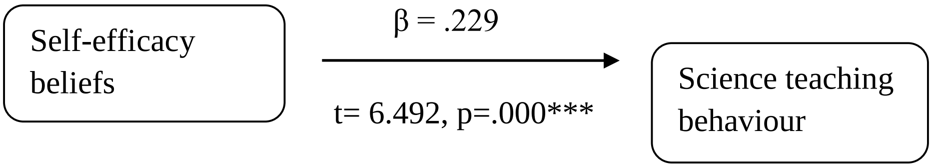


β = Standardized regression weight

* p < .05, ** <.01, *** < .001

Figure 4.15 Pathway to behaviour from intention to science teaching

Moreover, self-efficacy beliefs of early childhood teachers' towards science teaching played a significant role in predicting their science teaching behaviour (t = 6.492, p =.000). Moreover, the amount of relationship between self-efficacy beliefs and behaviour, and intention to teach science and behaviour was very close (β = .229, β =.247; respectively).



* p < .05, **<.01, *** < .001

Figure 4.16 Pathway from self-efficacy beliefs to science teaching behaviour

Furthermore, self-efficacy beliefs added 5.0 % of variance to explain early childhood teachers' science teaching behaviour. On the other hand, perceived behavioural control regarding Early childhood teachers' science teaching behaviours were not significant determinant of teachers' science teaching behaviour (t= 1.541, p=.123). That is, contrary to the TPB model, teachers' behaviour of science teaching did not directly related with availability of essential resources and opportunities. In this situation, it can be inferred that the early childhood teachers felt themselves having high actual control over science teaching behaviour, and so perceived behavioural control did not make any impact on their behaviour. This situation was supported that participant teachers mostly felt that they were in control of teaching science during their teaching service (M = 6.20, SD = 1.31). Another possibility of this insignificant relationship may be due to the single-item measure of perceived behavioural control which was "The decision to teach science in my classroom is beyond my control" although PLS-SEM is effortless to handle single item for prediction (Afthanorhan, 2014).

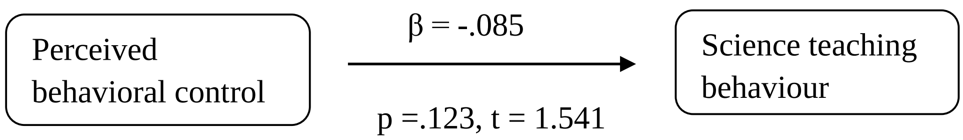


Figure 4.17 Pathway from perceived behavioural control to actual behaviour

4.5. Model modification

The last step in SEM analysis is model modification. According to the test results, the model can be modified by adding new paths in the model or eliminating non-significant paths from the model (Kelloway, 1998). In the present study, the original model was revised by removing insignificant paths from the model since some analysis such as R^2 or f^2yielded weak support for the initially proposed model. Firstly, two insignificant paths were omitted from the model (Perceived behavioural control and behaviour, and science content knowledge and intention to teach science) by examining non-significant total effects. After omitting the insignificant paths from the model, the remained variables analysed and a new structural model was constructed in SmartPLS software. All the relationships between constructs were found to be significant ($t > 2.58$, $p < 0.01$) as in seen in Figure 4.18.

Secondly mediation analysis was conducted by remained variables in order to provide more accurate explanation for the effects of exogenous variables on endogenous variables and to improve proposed model if necessary. In TPB model, it was assumed that constructs except for 'perceived behavioural control' were all fully mediated by behavioural intention. In the present model, 'self-efficacy beliefs' was also performed like the 'perceived behavioural control' by fully mediated by behavioural intention. Mediation analysis was performed to test this assumption of TPB. The results of mediation analysis showed that the proposed full mediation model for the TPB constructs was confirmed in this study. While subjective and personal norm constructs yielded non-significant path for partial mediation, the remained constructs were indicated very small change with partial mediation. In the situation of significant path for partial mediation small change in effect size was considered and the proposed full mediation effect was accepted. Table 4.25 indicated the mediation analysis results for each mediation effect.

Table 4.25

Mediation Analyses

		Full mediation		Partial mediation		No mediation		Accepted mediation
BB on I		R^2	β	R^2	β	R^2	β	
	I	.412	-	.430	-	.332	-	Small change in effect size.
	ATT	.253	-	.253	-	-	-	
	ATT-->I	-	.431	-	.366	-	-	Proposed full mediation effect was accepted.
	BB-->ATT	-	.503	-	.503	-	-	
	BB-->I	-	-	-	.167	-	.333	
SB on I								
	I	.412	-	.413	-	.404	-	Non-significant path in partial mediation model.
	SN	.373	-	.372	-	-	-	
	SN-->I	-	.142	-	.123	-	-	
	SB-->SN	-	.611	-	.610	-	-	Proposed full mediation effect was accepted.
	SB-->I	-	-	-	**.031**	-	.096	
CB on I								
	I	.412	-	.432	-	.426	-	Small change in effect size.
	PBC	.050	-	.052	-	-	-	
	PBC-->I	-	.096	-	.081	-	-	Proposed full mediation effect was accepted.
	CB-->PBC	-	.224	-	.215	-	-	
	CB-->I	-	-	-	.174	-	.184	

ATT on B	R^2	β	R^2	β	R^2		
	B	.128	-	.136	-	No attempt to omit "intention".	Small change in effect size.
	I	.412	-	.412	-		
	I-->B	-	.230	-	.174		Proposed full mediation model was accepted.
	ATT-->I	-	.431	-	.431		
	ATT-->B	-		-	.103		
SN on B							
	B	.128	-	.129	-		Full mediation model was accepted.
	I	.412	-	.412	-		
	I-->B	-	.230	-	.243		
	SN-->I	-	.142	-	.142		Non-significant path in partial mediation model.
	SN-->B	-	-	-	**.036**		
PN on B							
	B	.128		.130			
	I	.412		.412			Full mediation model was accepted.
	I-->B		.230		.214		
	PN-->I		.178		.177		
	PN-->B				**.049**		Non-significant path in partial mediation model.

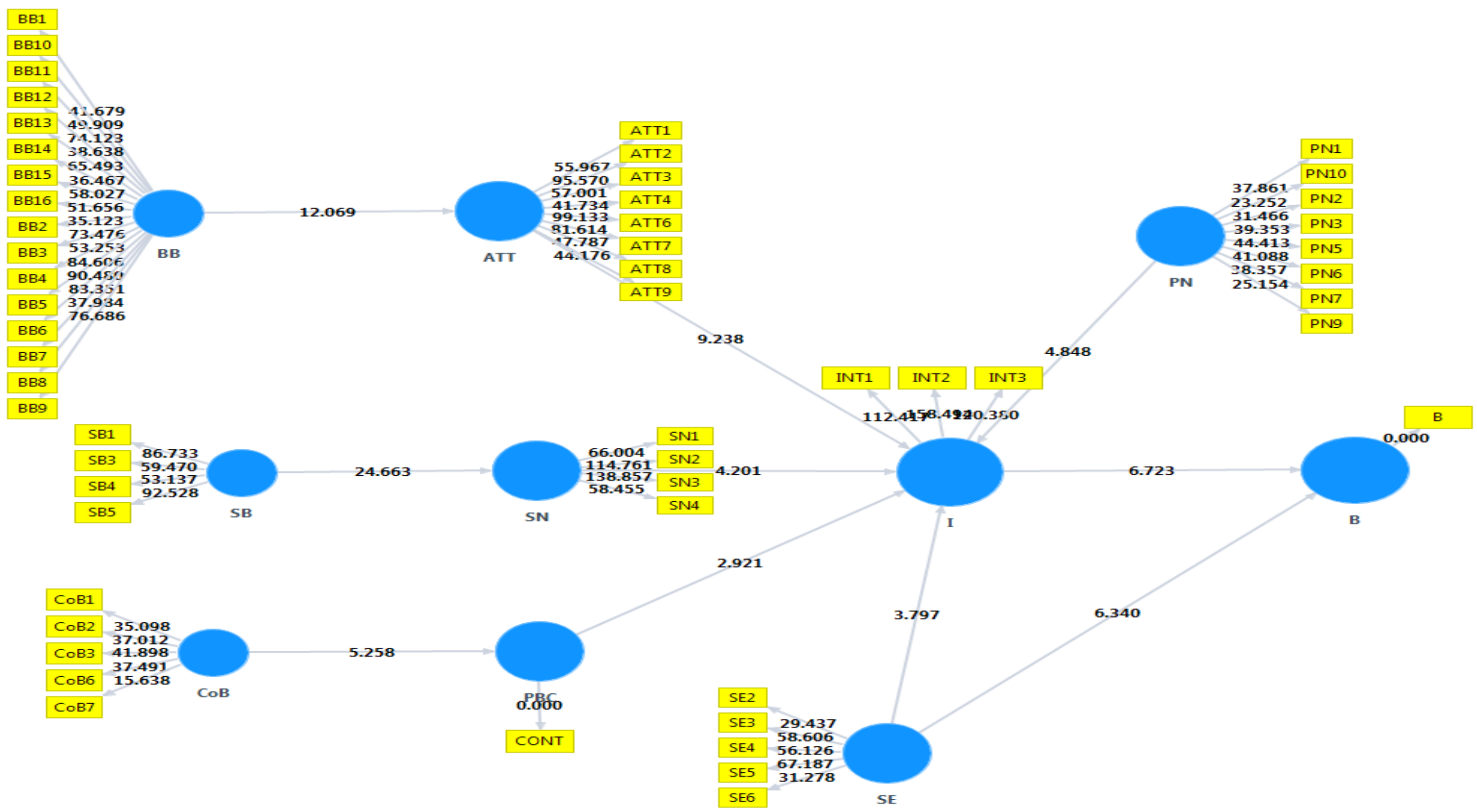


Figure 4.18 Modified model with t values

4.7 Summary of research findings

This research has designed to seek an answer for "to what extent do the TPB components and related additional variables provide a basis for predicting and explaining Early childhood teachers' science teaching intentions and actual behaviour in their classrooms?". Structural model analysis indicated that almost all variables had a significant effect on early childhood teachers' science teaching intentions directly. Firstly, there was found a significant the relationship between early childhood teachers' intent to science teaching and their actual behaviour (t =7.096, p =.000). However, teachers' behavioural intention only explained 8.7 % of the variance (R^2= .087) of their actual behaviour. On the other hand, the other variables together explained 42% of the variance (R^2 = .42) of teachers' intention to teach science. The highest relative contribution was executed by attitude toward science teaching with moderate effect size (f^2 =.29). The contribution of self-efficacy beliefs had also moderate effect size (f^2 =.18). In addition, personal norm, subjective norm, and perceived behavioural control were other predictors of teachers intention to teaching science with small effect sizes (.038, .027, and, .015, respectively). On the other hand, science content knowledge level of teachers was not significant association with their science teaching intention (t =.100, p =.921).

Secondly, behavioural beliefs (t = 12.472, p =.000), subjective beliefs (t = 26.200, p = .000), and control beliefs (t = 6.117, p =.000) regarding science teaching of teachers' were all found to be significant predictors for their corresponding constructs which were attitude toward science teaching, subjective norms, and perceived behavioural control, respectively. Their indirect effects on behavioural intention and behaviour constructs presented in mediation analyses in Table 4.17.

Lastly, it should be noted that two dimensions of scientific epistemological beliefs (source / certainty and justification) significantly predicted science content knowledge of teachers; while development dimension did not. Aforementioned, science content knowledge did not contribute any predictive value to the structural model. Thus, teachers who had better science content knowledge did not differ from teachers who had naïve science content knowledge in terms of science teaching intention.

To sum up, proposed hypothesis were all supported except for three hypotheses considering the relationship between "science content knowledge and intention", "perceived behavioural control and science teaching behaviour, and "development and science content knowledge. Therefore, it can be concluded early childhood teachers' who had favourable attitudes toward science teaching and felt themselves confident to teach science would likely teach science in their classrooms. In addition to that, if teachers had necessary equipment and resources to implement science activities, they would plan science activities for their children. However, having such opportunities was not necessarily meant that teachers would allocate time teach science. Teachers also considered the expectations of children, parents and MoNE regarding science teaching while planning their science activities. Moreover, teachers' internalized values regarding teaching science directly have an impact on their science planning and purposes. In other words, if teacher thought that science teaching is their responsibility or they feel themselves guilty if they do not teach science, they would probably try to teach science. On the other hand, teachers' level of science content knowledge was not a determinant of their planning of science activities.

CHAPTER V

DISCUSSION

This chapter starts with a discussion of the present study's findings, continues with the theoretical and practical implications of the findings, and finally presents limitations of the study as well as recommendations for future studies.

5.1 Discussion of the results

In alignment with the findings of the study, this part aims to discuss the possible explanations of the relationships founded in the structural model with a comparison to the TPB and science education literature. Recall that this research critically examined the early childhood teachers' science teaching intentions and behaviours with their immediate determinants in the framework of the TPB. In addition to the original TPB constructs, the study examined the influence of personal norms, self-efficacy beliefs, epistemological beliefs and science content knowledge in the research model. The extended TPB model employed in this study supported that the TPB is a promising framework in exploring early childhood teachers' science teaching intentions and behaviours.

As a result of the structural model analysis, the extended TPB model explained 41.2 % variance of science teaching intention, and 13.5 % variance of science teaching behaviour. With regard to the predictive power of the research model, all original TPB components, self-efficacy beliefs and personal norms directly predicted the teachers' science teaching intentions. Also, these variables indirectly predicted the teachers' science teaching behaviours through their impacts on intentions. Moreover, teachers' self-efficacy beliefs directly contributed to teachers' science teaching behaviours. Perceived behavioural control, on the other hand, only contributed to teachers' science teaching behaviours by way of its effect on science teaching intention. In the model, only science content knowledge and epistemological beliefs did not make any contribution to predicting teachers' science teaching intentions.

In particular, attitude toward science teaching made the strongest (β = .431, t = 9.431, p =.000) contribution by explaining the large part of the variance in behavioural intention. This finding implied that the more early childhood teachers hold positive attitudes towards science teaching or the more they believe that science instruction is necessary and enjoyable, the more they plan or intend to teach science in their classrooms. Therefore, in line with the assertion of Ajzen (2001) considering the TPB constructs, it can be concluded that attitudes towards science teaching was the most influential construct of early childhood teachers' science teaching intentions with medium effect size (f^2 = 0.28). Previous TPB studies in educational settings also reported similar results regarding attitude construct (e.g. Akyol, 2015; Bilim, 2015; Haney et al., 1996; Kilic, 2011; Kilic, Soran, & Graf, 2011; Lumpe et al., 1998; Salleh & Albion, 2004; Teo & Lee, 2010). Studying with science teachers, Lumpe et al. (1998) found similar relationship between attitude and behavioural intention regarding teaching Science-Technology-Society in the classroom (β = .20). Similarly, Kilic (2011) indicated that attitude was the strongest predictor of intention to teach evolution for both Turkish and German biology and pre-service biology teachers. Based on these findings, in general, educational researchers concluded that teachers' attitudes toward teaching a particular topic or an issue is the most influential factor to implement or not to implement that topic. The researchers suggested that teachers should be involved in positive experiences regarding such issues in professional development programs (e.g. Kilic, 2011; Lumpe et al., 1998). In this aspect, the present study also provided contribution for the relationship between the two major constructs of the TPB, attitude and intention. Aside from possessing direct influence on intention, attitude influenced behaviour indirectly through its effect on intention.

The explanatory power of attitude on behaviours makes this construct an important factor to study in educational research. The established correlation between attitudes and behaviours (Shrigley, 1990; Ajzen, 1988) proved that teachers' attitudes towards science teaching have an impact on their teaching practice. For instance, Erden and Sonmez (2011) found that there was a positive relationship between the frequency of science activities conducted by early childhood teachers and attitudes towards science teaching, but the relationship was very small (r = 0.06). Therefore, researchers concluded that there might be other factors influencing teachers' science teaching practice and attitude. Similarly, Faulkner-Schneider (2005) found a positive relationship between early childhood teachers' favourable attitude towards science and science teaching and the rate of science activities implemented in their classrooms.

In addition, early childhood teachers participated in this study hold fairly favourable attitudes towards science teaching for young children. This finding is consistent with many previous studies conducted in early childhood settings (e.g. Olgan et al., 2014; Cho, 1997; Unal & Akman, 2006; Levitt, 2002). For instance, Cho (1997) found that early childhood teachers' (N = 128) attitudes towards science teaching was relatively positive with a mean score of 4.0 on a 5-point Likert scale, thus, participant teachers thought that science teaching was necessary and important for young children. Similarly, Faulkner-Schneider (2005) reported that preschool teachers had a positive attitude towards science activities and so they thought science instruction was necessary for children. In addition, they found science was an enjoyable subject to teach children. Olgan et al. (2014) revealed that early childhood teachers were aware of the importance of teaching science for young children and so they had a positive attitude towards science with a higher mean value (M = 3.72) than the midpoint of the measurement scale. However, in their study, researchers reported that the participant early childhood teachers showed instability for some items such as an attitude item about teachers' eagerness of teaching science in their classrooms. Although the researchers used this item in the attitude scale, it provided clue about teachers' science teaching intentions. Thirty percent of teachers stated themselves as undecided regarding this item whilst only 21.7 % of them stated themselves as eager to teach science. This finding implied that most of the participant teachers did not want to teach science in early childhood classrooms.

After attitude toward science teaching, personal norm was the second influential construct that significantly predicted teachers' science teaching intentions. Thus, early childhood teachers had feelings of personal obligation to teach science and they considered the consequences of their choice of teaching or not teaching science. In addition, early childhood teachers' intentions accounted for by personal norms (β = .178) more than subjective norms (β = .142). Certain research studies indicated that when both subjective and personal norms were integrated into the TPB model, behavioural intention was explained by personal norms rather than subjective norms (e.g. Aertsens et al., 2009; White et al., 2015). This study also supported the assertion that personal norms are worthy to include in the TPB model in order to explain behavioural intentions. Moreover, personal norms were firstly studied in the context of teaching behaviour in this study. In this respect, the current study leads the way of including personal norms in teacher behaviour research in order to explain behavioural intention of teachers. Furthermore, previous TPB studies have indicated the contribution of personal norm construct in predicting human intentions to enact in various kinds of behaviours (Aertsens, Verbeke, Mondelaers, & Huylenbroeck, 2009; Harland et al., 1999; Nigbur et al., 2010; Rivis et al., 2009; White et al., 2015). To illustrate, as a part of a large project, Harland et al. (1999) examined the influence of personal norm in the context of environmentally related behaviour with 445 people in Netherlands. This study found that the usage of personal norms in the TPB as a predictor of pro-environmental behaviour and intention. In addition, Rivis, Sheeran, and Armitage (2009) conducted a meta-analysis to examine the impact of moral norms in the TPB models. Forty-six articles regarding moral norms were examined in the meta-analysis including variety of behaviours such as smoking, blood donation, condom use, needle sharing, or road crossing behaviour. This meta-analytic study revealed that the integration of personal norm construct in the TPB model increased the explained variance of behavioural intention by about 3%. Accordingly, the authors concluded that the personal norm is a construct having predictive value in the TPB models.

In addition to personal norm, original normative component of the TPB, that is subjective norm, was also found to be significant predictor of science teaching intention (β = 0.142, t = 4.163, p = .000). Thus, participant teachers felt social pressures at some level from their referent group such as children, the MoNE, school administration, parents, or colleagues with respect to science teaching. For instance, if their children were interested in science, they feel pressure to teach science or teachers may avoid science teaching due to the reluctant position of school administration or parents. The finding of this study regarding the influence of subjective norms was consistent with the results of the prior studies conducted with teachers in the context of science education. For instance, Ballone and Czerniak (2001) found that subjective norm had an impact on teacher intention in the context of implementation of diverse instructional strategies in science education. In another study, Paulussen, Kok, and Schaalma (1994) found that subjective norm was a significant determinant of teachers' adoption of classroom based HIV/AIDS education in Netherlands. Also, in the same context, Burak (1994) and Lin and Wilson (1998) found similar results that teachers' felt social pressure from their referents to intend to teach HIV/AIDS. Regarding subjective norm, on the other hand, some studies indicated that subjective norm was not significant agent of behavioural intention (e.g. Akyol, 2015; Bilim, 2015; Davis et al., 2002; Kilic et al., 2011; Beck & Ajzen, 1991; Lumpe et al., 1998).

Perceived behavioural control as another original component of the TPB was a significant determinant of teachers' science teaching intention although it had the lowest significant path coefficient with behavioural intention (β = .096, t = 2.819, p = .005). On the other hand, perceived behavioural control was not direct determinant of teachers' science teaching (t = 1.541, p = .123). This means that perceived behavioural control only exerted its effect on behaviour indirectly over behavioural intention. This finding implied that teachers' science teaching behaviour indirectly related with their controllability of teaching science through its effect on teacher intention. Insignificant pathway from perceived behavioural control to behaviour may be due to the fact that participant teachers felt themselves having high actual control over science teaching behaviour, and so perceived behavioural control only indirectly had an impact on their behaviour (see Ajzen & Madden, 1986). This situation was supported that participant teachers felt relatively high control of teaching science during their teaching service (M = 6.20, SD = 1.31). In addition, control beliefs used as antecedent beliefs of perceived behavioural control also endorsed that teachers' power of control on teaching science was relatively high (M = 6.48, SD = .90). Madden et al. (1992) stated that individual's perceived behavioural control over the behaviour can be higher if the requisite resources and opportunities are available and vice versa. For instance, Ballone and Czerniak (2001) found that perceived behavioural control was not significant to predict science teachers' intention to use of a variety of instructional strategies. Researchers interpreted this situation that teachers thought opportunities and available resources might not be accessible for them. That is, teachers did not have enough planning time, resources, materials, and also money to implement diverse teaching activities in their science classrooms. As well as this discussion, another possibility of the insignificant direct relationship may be due to the single-item measure of perceived behavioural control although PLS-SEM is effortless to handle single item for prediction (Afthanorhan, 2014). In their study with physical education teachers, Jeong and Block (2011) found consistent result with the present study that perceived behavioural control indirectly predicted teachers' behaviours to teach disabled children by its influence on intention. The authors concluded that it may be due to most of the physical teachers had control beliefs beyond their volition. On the other hand, unlike the TPB model, some researchers (e.g. Czerniak et al. 1999; Gorman-

Smith, 1993) did not use perceived behavioural control as a direct predictor of teacher behaviour, and used perceived behavioural control only as a direct predictor of teacher intention. Moreover, meta-analysis studies regarding the TPB revealed that perceived behavioural control significantly contributed to the TPB models. Godin and Kok's (1996) meta-analysis regarding health-related behaviours found that perceived behavioural control was significant determinant of intention in 65 analyses out of 76. In their study, addition of perceived behavioural control in the TPB model provided 13.1 % increase in average variance of intention depending on the behaviour and 12 % increase in average variance of health-related behaviours. Thus, perceived behavioural control was as important as attitude to explain behavioural intention for health-related behaviours. This was similar to findings of Van den Putte (1991) reporting that perceived behavioural control added additional 14% variance of intention and additional 4% variance of behaviour. Armitage and Conner (2001) also reported that perceived behavioural control accounted 6 % variance of intention with the multiple correlation coefficient of .43 and intention were accounted for 27 % variance of behaviour with the multiple correlation coefficient of .52 in their meta-analytic review. Thus, while perceived behavioural control found to be significant component to explain human intention in some contexts such as information system research (e.g. Chau & Hu, 2001; Yi et al., 2006), or studies considering health-related behaviours (e.g. Godin & Kok, 1996), this construct was found insignificant in some educational research context (e.g. Ballone & Czerniak, 2001).

Self-efficacy beliefs as an additional variable to the TPB model were one of the significant determinants of teachers' science teaching intention (β = .118, t = 3.747, p = .000) and behaviour (t = 6.492, p = .000). The amount of relationship between self-efficacy beliefs and behaviour, and intention to teach science and behaviour was very close (β = .241, β =.247; respectively). Many researchers in the field of science have been used self-efficacy beliefs of teacher as an indicator of teacher's classroom behaviours (e.g. Lumpe et al., 2000; Brickhouse, 1994; Czerniak & Shriver, 1994;

Levitt, 2001; Lumpe et al., 2004) since teachers' self-efficacy beliefs directly have an effect on what and how teachers teach in their classrooms. For instance, Alisinanoglu et al. (2012) found early childhood teachers did not allocate time for science activities in a regular basis since planning and performing science activities were not easy tasks and many of them felt uncomfortable about this issue. This finding was parallel with the findings of study of Sigirtmac and Ozbek (2011).

In general, many research studies revealed that teachers had low or moderate level of self-efficacy beliefs to teach science (e.g. Harlen, 1997; Appleton & Kindt, 1999; Garbet, 2003, Sigirtmac & Ozbek, 2011; Olgan et al., 2014). In addition, both pre-service and in-service early childhood teachers' self-efficacy beliefs regarding science teaching were at lowest level in comparison to other subject areas. Garbett (2003) revealed that pre-service early childhood teachers felt themselves at least confident and competent in teaching science in comparison to teaching other subject areas such as English, Arts, Mathematics or Health and Physical Education. This case was similar to the present study that early childhood teachers science teaching self-efficacy beliefs was moderate (M = 3.4, SD= .68).

Moreover, while the perceived behavioural control did not have a direct influence on teachers' science teaching behaviour, self-efficacy had a considerable influence on teachers' science teaching behaviour. Self-efficacy beliefs added 5.0 % variance in to explain teachers' science teaching behaviour. This implies that self-efficacy construct is as important as behavioural intention to predict teacher behaviour. Based on this discussion, it can be concluded that the TPB with the inclusion of self-efficacy beliefs increased the explanation power of teachers' science teaching intention and behaviour. Although Ajzen (1991) discussed that self-efficacy and perceived behavioural control are synonymous, many researchers stated these two constructs are different in nature and so, should be evaluated separately (e.g. Armitage, 1997; Dzewaltowski, Noble, & Shaw, 1990; Terry & O'Leary, 1995; White, Terry, & Hogg, 1994). The TPB literature indicated that there is a clear distinction between perceived behavioural control and self-efficacy depending on the behaviour type (e.g. Manstead & van Eekelen, 1998; Terry & O'Leary, 1995). For instance, Terry and O'Leary (1995) found that self-efficacy only predicted intention to do exercise, albeit perceived behavioural control could predict exercise behaviour. In another study, Giles, McClenahan, Caims, and Mallet (2004) indicated that self-efficacy was an essential determinant of behavioural intention within the context of blood donation behaviour. In addition, Dzewaltowski et al. (1990) examined the three theories of social cognitive theory, the TRA and the TPB in the context of physical activity participation and revealed that self-efficacy, not perceived behavioural control, influenced behaviour directly.

On the other hand, the PLS structural model analysis indicated no relationship between teachers' science content knowledge and their science teaching intention (β = .001, t = .025, p =.921). In contrast to this finding, previous literature indicated that science content knowledge of teachers' directly influence science instruction (e.g. Czerniak, 1989; Garbet, 2003; Harlen, 1997; Harlen & Holroyd, 1995; Faulkner-Schneider, 2005). For instance, Faulkner-Schneider (2005) found a positive relationship between the proportion of teachers' science content knowledge and knowledge of science teaching with the frequency of science activities implemented in the classroom. In addition, literature revealed that teachers who are worried about their science content knowledge often teach less science, or only teach topics in which they feel comfortable by depending on the text and kits directly, or by expository teaching with less or no discussion (Czerniak, 1989; Harlen, 1997; Harlen & Holroyd, 1995). A possible explanation for the insignificant contribution of teachers' science content knowledge on their intention to teach science can be derived from the assertion of Nespor (1987) that teacher beliefs were more influential than teacher knowledge on teachers' decisions about their educational practices. Another possible explanation of this finding can be due to the indirect relationship between science content knowledge and science teaching behaviour.

Therefore, the direct relationship between science content knowledge of teachers and their science teaching behaviour should be examined.

Moreover, in the present study, early childhood teachers' science content knowledge level was found to be slightly higher than the average score of the test (M = 7.82, SD = 2.41). Teachers participated in this study frequently selected the one of the alternative of "I do not know" in multiple choice science concept test. For instance, alternative of "I do not know" was highly chosen by participant teachers in questions of buoyancy force, sky, and matter properties (35 %, 27.8 %, and 23.7 %; respectively). In addition, although the item discrimination and item difficulty indexes were acceptable statistical level (see Table 3.16), participant teachers could not answer correctly some questions about adaptation (35.6 %), sky (34.5 %), buoyancy force (41.5 %), matter properties (41.6 %), biodiversity (32.9 %). This implied that early childhood teachers had a very poor knowledge of science or, they may have no idea about asked science topic. This result was consisted with previous literature. For instance, Kallery and Psillos (2001) reported that science content knowledge of early childhood teachers and their conceptual understandings were limited and teachers used irrelevant scientific conceptions, which were named as alternative conceptions (e.g. misconceptions and confusing expressions) during science activities in their classrooms. Besides, Timur (2012) found that preschool teacher candidates had poor science content knowledge and this resulted in unsuccessful science activities and unfavourable attitudes towards science teaching. Consequently, preschool teacher candidates preferred to conduct art activities rather than science activities.

Furthermore, early childhood teachers' science teaching intentions was found to be significant and direct predictor of their self-reported science teaching behaviour (β = .247, t = 8.936, p = .000). In other words, early childhood teachers' intent to teach science was one of the significant indicators of the number of science activities provided in the classroom. The studies employing the TPB in the context of teachers' science instruction practices have revealed the consistent results with the present study (Jeyong & Block, 2011; Gorman-Smith, 1993; Czerniak et al., 1999; Jesus & Abreu, 1994; Bilim, 2015). To illustrate, Gorman-Smith (1993) used only teacher intention to predict teachers' usage of microcomputer science laboratory interface materials during science teaching and explained 40% variance of teacher behaviour. Similarly, Czerniak et al.(1999) used teacher intention alone to explain teacher self-reported behaviour in the context of utilising educational technology in science classrooms and accounting for 18% of variance in teacher behaviour. Moreover, in their study, Jeyong and Block (2011) found that only intention statistically significant predictor of self-reported behaviour in the context of teaching students with disabilities and 21.7 % of the variance of physical education teacher behaviour was explained. These studies concluded that teacher intention is a significant and direct indicator of teachers' classroom behaviours.

Regarding belief components of the research model, in this study, behavioural beliefs regarding early childhood teachers' science teaching behaviours were found to be significant determinant of their attitudes toward science teaching (β = .503). The path between behavioural beliefs and attitude was the second highly significant path in the model (t=12.472, p=.000). In addition, PLS structural model indicated that the sixteen behavioural belief items accounted for 25.3 % of the variance in attitude towards science teaching. This finding agrees with the results of the TPB studies reporting the relationship between behavioural beliefs and attitude towards the behaviour (e.g. Fishbein & Azjen, 1975; Armitage & Conner, 2001; Alhendal, 2013). Moreover, as proposed in the TPB, behavioural beliefs were indirectly influence behavioural intention with the mediation of attitude. Mediation analyses confirmed that full mediation model was suitable in the present model as proposed in the original model since the small change in effect size with partial mediation (see Table 4.23). According to the result of normative beliefs analysis, participant teachers considered the expectation of children mostly, and then the MoNE, school administration, parents, and lastly colleagues. As seen, teachers indicated the least consideration towards the expectation of their colleagues. Thus, early childhood teachers showed that they feel social pressure to teach science explicitly. Moreover, the relationship between normative beliefs and subjective norm constructs showed the highest path coefficient in the research model (β = 0.611) and correspondingly the highest significant path (t = 26.200, p = .000). In addition, normative beliefs were accounted for 37% of the variance of subjective norm construct. Thus, normative beliefs of teachers supported to be underlying basis of their subjective norms in the context of science teaching. Thus, the direct measurement of the TPB (i.e. SN) and indirect measurement of the TPB (i.e. NB) regarding normative beliefs were closely related as proposed in the TPB model (e.g. Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975; Ajzen, 1991). The finding of this study regarding normative beliefs was supported by prior research studies. For instance, Armitage and Conner (2001) reported an average component relationship between normative beliefs and subjective norms as .50 and normative beliefs component explained 25% of variance in subjective norms. The findings of normative beliefs indicated that the most influential referent group of teachers were children and the MoNE. On the other hand, in some other studies, administrative support was found to be significant agent of teacher behaviour (Haney, 1994; Beck, 1997; Hartzell-Ballone, 1999). In these research studies, it was revealed that teachers expected collaboration with administration regarding their activities such as peer coaching, leading, advising, providing resources or etc. (NRC, 1996; Loucks-Horsley, 1998; Loucks-Horsley, et al., 1998).

In this study, the relationship between control beliefs and perceived behavioural control was slightly lower (β = .224) than the other relationships between direct and indirect measurements (i.e. behavioural beliefs-attitude and normative beliefs-subjective norms) but still significant (t= 6.117, p=.000). In addition, control beliefs were explained only 5 % variance of perceived behavioural control. This finding therefore needs to be interpreted with caution. Since initially and in line with the TPB, it was proposed that the underlying belief of perceived behavioural control over science teaching was based upon control beliefs regarding science teaching. A possible explanation of this low relationship between control beliefs and perceived behavioural control may be due to one item measure of perceived behavioural control.

Lastly, the construct of scientific epistemological beliefs was included in the model as a predictor of science content knowledge of teachers. Unexpectedly, science content knowledge was not predicted by all dimensions of early childhood teachers' epistemological beliefs. This may be due to the fact that the science content knowledge test could be fail to accurately measure science knowledge level of teachers. On the other hand, previous literature indicated that epistemological beliefs have an impact of teacher's teaching practice (e.g. Pajares, 1992; Yang, Chang, & Hsu, 2008) and for this reason; a substantial body of research has concentrated on personal beliefs of teachers in order to explore teacher classroom behaviour (Yang et al., 2008; Richardson, 1996; Pajares, 1992; Jones & Carter, 2007; Cain, 2012). Epistemological beliefs were used in this study as a predictor variable of intention through its effect on science content knowledge. Like science content knowledge, epistemological beliefs were also unsuccessful to predict indirectly teachers' science teaching intentions. Therefore, in future studies, the impact of epistemological beliefs on teachers' science teaching intentions could be investigated directly.

5.2 Conclusions

The present research attempted to make contribution to the gap of ECE literature by addressing the factors influencing early childhood teachers' science teaching practices. An extended model of the TPB offered a practical framework to indicate relative contribution of each hypothesized factors on teacher intention and behaviour regarding science instruction in ECE classrooms. In addition to original TBP constructs, some of the additional predictors (i.e. personal norm and self-efficacy beliefs) may help to understand teachers' classroom behaviour. As a result, the findings of the present study offer support for using the TPB in investigating teachers' classroom behaviours. Besides, the findings of this study offer valuable cognisance to the contemporary early childhood science education situation in Turkey.

In the present study, all three tenets of the TPB (i.e. attitude towards behaviour, subjective norm, and perceived behavioural control) made significant contributions to the early childhood teachers' science teaching intentions. Whilst attitude toward behaviour made the greatest contribution of teachers' intention to teach science, perceived behavioural control was the weakest component to predict early childhood teachers' intentions. Teachers who had a more positive attitude towards science instruction and evaluate science as an important and useful subject for children were more likely to teach science to young children. Moreover, attitude toward behaviour, subjective norm and perceived behavioural control together accounted for 36.0 % of the variance in behavioural intention. Addition of constructs of personal norm and self-efficacy beliefs increased predictive variance of behavioural intention by 5.2 %, whilst science concept knowledge did not make any change. This finding thereby supported the previous research results indicating that teacher beliefs are key predictors of teacher classroom behaviour (e.g. Pajares, 1992; Crawley & Koballa, 1992; Czerniak, et al., 1999; Lumpe et al., 1996; DeSouza, 1994). Regarding normative component, the impact of personal norms of teachers was slightly higher than their subjective norms. This means that teachers' internal motivation to teach science was more important for teachers than the expectation of other people such as school administrator, colleagues, or children. This study has also supported the use of teachers' intent as a direct predictor of their classroom behaviour in the context of science-related teaching practices. Moreover, indirect measurements of the TPB (i.e. behavioural beliefs, normative beliefs, and control beliefs) are also included in the research model due to the fact that such beliefs indicate the underlying basis of the direct measures (i.e. attitude, subjective norm, and perceived behavioural control).

5.3 Implications of the Study

The findings of this study presented a variety of theoretical and practical implications. Following section explained these implications.

5.3.1 Theoretical implications

This study has attempted to develop a conceptual model to predict teachers' intentions and behaviour regarding science teaching. A systematic literature review provided a guideline to determine which psychological construct should be included in the research model. According to literature review, in addition to main TPB constructs (attitude, subjective norm, and perceived behavioural control), self-efficacy beliefs, personal norm, science content knowledge, and epistemological beliefs should be examined in the model. Although quite a few research studies indicated the importance of self-efficacy beliefs on teachers' educational practices, the studies concerning other additional factors (i.e. personal norm, science content knowledge, and epistemological beliefs) were scarce. By means of this endeavour, it was seen that inclusion of self-efficacy beliefs and personal norm constructs improved the explanatory power of the extended TPB model, albeit science content knowledge and epistemological beliefs did not make any change unexpectedly.

From a theoretical perspective, significance of the self-efficacy beliefs in teachers' classroom behaviour was highlighted once more since self-efficacy found to be one of the major determinants of both teachers' science teaching intention and behaviour. In addition, it was supported that self-efficacy beliefs and perceived behavioural control are separate constructs and should be examined individually as mentioned in many studies (e.g. Armitage & Conner, 2001; Terry and O'Leary, 1995; Sparks et al., 1997; Manstead & van Eekelen, 1998). In comparison, self-efficacy made a greater contribution in predicting teacher behaviour than the perceived behavioural control in the model. It was also concluded that perceived behavioural control had a less predictive value for both intention and behaviour consistent with some research findings (e.g. Manstead & van Eekelen, 1998; Armitage and Conner, 1999; Giles et al., 2004). This result raised the suggestion of that perceived behavioural control component may be substituted with the self-efficacy beliefs (Chang, 1998). Also, it should be emphasized that self-efficacy beliefs and control beliefs are conceptually different. Items measuring control beliefs included the factors impeding or facilitating science teaching behaviour such as availability of resources, materials, lack of time, or children's desire to learn science. On the other hand, self-efficacy beliefs items included teachers' own capabilities to teach science such as knowledge of science teaching, or following children during science activities.

Moreover, it was proved that the extended TPB was beneficial in exploring the teachers' science teaching intention and behaviour as well as the relationship with corresponding beliefs. The structural model indicated that attitude towards science teaching had the strongest influence on teachers' intent to teach science activities in early childhood classrooms. As a result, it is crucial to help early childhood teachers to develop positive attitudes towards science. This can be achieved by involving in positive science teaching experiences by means of in-service and pre-service training programs. Both in-service and pre-service teachers may be influenced from concrete and successful science activities.

This research model of this study was broadened with personal norm construct of Schwartz (1977) in order to explore internal normative beliefs of teachers. The addition of predictors to the original TPB was shown to strengthen the predictive power of the resulting model. To conclude, this study provides empirical support for the usage of the TPB model with two additional constructs (i.e. personal norm and self-efficacy beliefs) in the context of teaching behaviour.

5.3.2 Methodological contribution

Although the questionnaire of the study was prepared in accordance with the TPB guideline, the questionnaire items were adapted into the study context, and then verified and checked for the reliability and validity. Although a few numbers of the items were removed from the research model, the remained items showed an acceptable level of fit indices in the structural model analysis.

In addition, this study examined the early childhood teachers' science teaching intentions and behaviours with related construct by using structural equation modelling in spite of using first generation analysis such as regression analysis. In other words, SEM has found to be useful for the developing and testing theories by using the second generation multivariate analysis technique. In addition, SEM provides formulate a theory about the relationships among variables.

Moreover, the partial least square structural equation modelling was used in this study since the distribution of data was non-normal, and negatively skewed and the model was fairly complex. PLS-SEM is evaluated as more user friendly when nonparametric analyses are needed (Hair, 2010; Hair et al., 2012a; Henseler et al., 2009; Chin, 1998). Jakobowicz (2006) stated that PLS-SEM can be applied to complex problems or small sample since its characteristics of salleable assumptions make it be advantageous over CB-SEM. To conclude, the PLS-SEM was found to be useful to test extended TPB model of the present study.

5.3.3 Practical implications

The results of this study have many implications for teacher education programs and curriculum developers. Exploring personal, contextual, and social factors that influence conducting science activities in early childhood classrooms provide insight to science education policies and in-service training programs. Prior studies showed that early childhood teachers usually do not allocate time for science activities due to various reasons such as inadequacy of science corners, lack of science content knowledge or absence of self-efficacy. This study also supported the findings of previous studies that teacher beliefs are essential factor influencing their classroom behaviours. This finding implied that teacher educators, curriculum developers and policy makers should consider the influences of teacher beliefs on their classroom practices. To achieve favourable beliefs regarding science teaching, professional development programs or workshops should be planned for in-service teachers. For instance, in in-service training or professional development programs, teachers should have opportunity to implement basic science activities and to learn how to conduct successful science activities. When teachers see the science activities were enjoyable, easy, and in hand, they will probably show more intend to teach science. This will also lead to improve teachers' self-confidence to conduct science activities. Also, in such programs, teachers should be learn the importance of informal learning environments by experiencing them. According to National Science Foundation (NSF, 1998), participating in informal science education projects result in positive attitude change toward science and related issues. Therefore, teachers can visit science-technology centers, museum, science exhibits, aquaria, biological gardens, zoological parks, and libraries (see NSF, 1998). These suggestions are also valid for teacher education programs. Early childhood teacher education program should encourage teacher candidates to form favourable attitudes and beliefs toward science teaching by providing such experiences for them.

Moreover, teachers and pre-service teachers should get involved in workshops or lessons to learn what they use as science materials or how to develop basic science materials. According to the MoNE (2013) science materials in early childhood classrooms are specified as the supplies that can be easily found in daily life such as glasses, spoons, sand, stones, seeds, buckets, or magnifying glasses. However, teachers thought that they do not have adequate materials to conduct science activities. Therefore, both in-service and pre-service programs should be designed in order to show how to conduct science activities by using simple materials.

In short, according to the finding of the present study, effective ECE program should provide enough opportunities to experience science activities, help teachers improve their self-efficacy beliefs regarding science teaching, educate teachers on how science activities successfully conducted, and encourage teachers to conduct science activities.

5.4 Limitations and Recommendations

Although this study has ensured significant contribution in teacher education literature, it has a few important limitations which should be considered in future research. First, the data were based on self-report measures for all individual questionnaires. Although it was assumed that participant teachers completed the survey accurately and seriously, self-report measures sometimes mislead the results of the study. Future studies also call for qualitative or mixed methods research to better understand teachers' actual science teaching behaviours. It is, therefore recommended for future research that classroom observation involving video recording, written assessments, clinical interviews and artifacts analysis.

Second, in this study, science content knowledge test included 14 questions after pilot study. This can not be enough to measure teachers' general science content knowledge. Therefore this test should be improved, and the number of questions should be increased for future studies. In addition, this study science content knowledge of teachers failed to explain their science teaching intentions. In other words, in the research model, the indirect relationship between science content knowledge and science teaching behaviour was examined and no relationship was found. Future studies should examine the direct relationship between science content knowledge and science teaching behaviour. In addition, the impact of epistemological beliefs on teachers' science teaching intentions could be investigated directly.

Second, the data of the present study were collected from a large number of teachers from different regional districts of Turkey; however, only public school teachers participated in the study. The recommendation is that collecting data from both public and private schools will allow researchers to compare the beliefs and science teaching applications of teachers working in different types of schools.

Third, this study did not included demographic variables such as experience of teachers, gender, age or educational experience in the research model. With this respect, another recommendation is that such variables can be used as moderators in the future research studies. Although demographic variables were collected by Demographic Information Questionnaire, descriptive analysis indicated that there was not apparent subgroups. For instance, regarding gender, 90.6 % of teachers were female, or regarding teaching experience, 52.4 % of teachers had 1 to 5 year experience, and 27.6 % of them had 6 to 10 year experience. It was believed that more apparent groups regarding teachers' characteristics would be aroused in the forthcoming years and this could be more meaningful to see the impact of teachers' characteristics.

Last, in this study some constructs had only one item (i.e. perceived behavioural control and science teaching behaviour) from the beginning of the study. These constructs should be improved in future studies to handle single item measure issue. Although the PLS-SEM analysis can handle single item issues (Afthanorhan, 2014), the reliability and validity of the single item measurements can not be calculated.

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APPENDICES

APPENDIX A

TABLE OF SPECIFICATION OF GENERAL SCIENCE CONTENT KNOWLEDGE TEST

		Knowledge	Comprehension	Application
Life and Health Science	Food chain		Q13	
	Living organisms		Q2	
	Biodiversity		Q9	
Physical Science	Matter Properties		Q8	
	Light		Q11	Q4
	Buoyancy Force			Q7
	Heat and Temperature			Q3
Earth Science	Changes in Earth	Q5	Q12	
	Atmosphere and Sky		Q6	Q14
	Recycling		Q1	
	Energy resources	Q10		

APPENDIX B

FACTOR LOADINGS FOR BEHAVIOURAL INTENTION AND DIRECT MEASUREMENTS

	Factor				
	1	2	3	4	5
PN9	.798				
PN6	.779				
PN1	.754				
PN7	.703				
PN5	.687				
PN2	.686				
PN3	.640				
PN10	.595				
PN8	.522				
PN4	.492				
ATT2		.936			
ATT7		.926			
ATT3		.908			
ATT8		.842			
ATT6		.841			
ATT9		.808			
ATT1		.661			
ATT4		.573			
ATT5		.368			
SE11			.874		
SE7			.800		
SE5			.748		
SE2			.725		
SE1			.672		
SE10			.635		
SE3			.576		
SE6			.565		
SE9			.471		
SE8			-.306		
SE4			.355		
SN2				.957	
SN1				.916	
SN3				.896	
SN4				.541	
INT1					.834
INT2					.810
INT3					.517

Note. INT intention, PN personal norm, SE self-efficacy beliefs, ATT attitude, SN subjective norm

APPENDIX C

FACTOR LOADINGS FOR INDIRECT MEASUREMENTS

	Factor		
	1	2	3
BB5	.996		
BB7	.974		
BB3	.973		
BB1	.961		
BB6	.952		
BB2	.942		
BB8	.918		
BB4	.903		
BB9	.770		
BB12	.763		
BB10	.631		
BB17	.624		
BB16	.610		
BB15	.607		
BB14	.562		
BB13	.513		
CB5		.837	
CB4		.804	
CB6		.728	
CB1		.726	
CB3		.720	
CB2		.716	
CB7		.669	
CB8		**.383**	**.312**
NB5			.805
NB4			.794
NB1			.655
NB3			.643
NB2	**.310**		**.536**

Note. BB behavioural belief, NB normative belief, CB control belief

APPENDIX D

PERMISSION OF METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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19.03.2014

Gönderilen : Prof. Dr. Ceren Öztekin
İlköğretim Bölümü

Gönderen : Prof. Dr. Canan Özgen
IAK Başkanı

İlgi : Etik Onayı

Danışmanlığını yapmış olduğunuz İlköğretim Bölümü öğrencisi Gökcen Özcan'ın "Okul Öncesi Öğretmenlerin Fen Öğretimine Yönelik Niyet ve Davranışlarının Planlanmış Davranış Teorisi ile Açıklanması" isimli araştırması "İnsan Araştırmaları Komitesi" tarafından uygun görülerek gerekli onay verilmiştir.

Bilgilerinize saygılarımla sunarım.

Etik Komite Onayı

Uygundur

19/03/2014

Prof.Dr. Canan Özgen
Uygulamalı Etik Araştırma Merkezi
(UEAM) Başkanı
ODTÜ 06531 ANKARA

APPENDIX E

PERMISSIONS OBTAINED FROM MINISTRY OF NATIONAL EDUCATION

T.C.
MİLLÎ EĞİTİM BAKANLIĞI
Yenilik ve Eğitim Teknolojileri Genel Müdürlüğü

Sayı : 81576613/605/1735734 30/04/2014
Konu: Anket Uygulama İzni

T.C.
ORTA DOĞU TEKNİK ÜNİVERSİTESİ REKTÖRLÜĞÜNE

İlgi: 18/04/2014 tarih ve 54850036-300-2055-004549 sayılı yazı.

İlgi yazı ile Genel Müdürlüğümüze göndermiş olduğunuz Üniversiteniz İlköğretim Anabilim Dalı doktora öğrencisi Gökçen ÖZCAN'ın "Okul Öncesi Öğretmenlerinin Fen Öğretimine Yönelik Niyet ve Davranışlarının Planlanmış Davranış Teorisi ile Açıklanması" konulu tezinde kullanılmak üzere oluşturduğu veri toplama araçlarına yönelik izin talebi, Genel Müdürlüğümüz tarafından incelenmiştir.

Onaylı bir örneği Bakanlığımızda muhafaza edilen, uygulama sırasında da mühürlü ve imzalı örnekten çoğaltılan veri toplama araçlarının, örneklem olarak seçilen okullarda eğitim öğretimi aksatmadan, gönüllülük esas olmak kaydıyla uygulanmasında bir sakınca görülmemektedir.

Bilgilerinizi ve gereğini rica ederim.

Mustafa KOÇ
Bakan a.
Genel Müdür

EK: Veri Toplama Aracı (12 Sayfa)

Güvenli Elektronik İmzalı
Aslı ile Aynıdır
02/05/2014

Bu belge, 5070 sayılı Elektronik İmza Kanununun 5 inci maddesi gereğince güvenli elektronik imza ile imzalanmıştır
Evrak teyidi http://evraksorgu.meb.gov.tr adresinden 5fbf-6b8d-3171-8b6d-cdf8 kodu ile yapılabilir.

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Elektronik Ağ: www.meb.gov.tr
e-posta: adsoyad@meb.gov.tr

Ayrıntılı bilgi için: Ad SOYAD Ünvan
Tel: (0 312) XXX XX XX
Faks: (0 312) XXX XX XX

APPENDIX F

VOLUNTARY PARTICIPATION FORM

GÖNÜLLÜ KATILIM FORMU

Bu çalışma, ODTÜ Eğitim Fakültesi İlköğretim Bölümünde görev yapmakta olan Prof. Dr. Ceren Öztekin danışmanlığında ve Prof. Dr. Jale Çakıroğlu eş-danışmanlığında Gökcen Özcan tarafından yürütülen, bir Doktora Tez çalışmasıdır. Çalışmanın amacı, okul öncesi öğretmenlerinin derslerinde fen eğitimine yer verme davranışını ve niyetini tahmin eden değişkenleri planlanmış davranış teorisi kullanarak incelemektir. Çalışmaya katılımda gönüllülük esastır. Katılımınız çalışmayla ilgili veri toplama araçlarını yanıtlayarak gerçekleşecek olup, bunun için öngörülen süre yaklaşık 30 dakikadır. Söz konusu veri toplama araçlarında, sizden kimliğinizi belirtecek hiçbir bilgi istenmemektedir. Cevaplarınız tamamıyla gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir; elde edilecek bilgiler bilimsel yayınlarda kullanılacaktır.

Çalışmada kullanılan veri toplama araçları, genel olarak kişisel rahatsızlık verecek soruları içermemektedir. Ancak, katılım sırasında sorulardan ya da herhangi başka bir nedenden ötürü kendinizi rahatsız hissederseniz cevaplama işini yarıda bırakıp çıkmakta serbestsiniz. Böyle bir durumda veri toplama araçlarını uygulayan kişiye, veri toplama araçlarını tamamlamadığınızı söylemek yeterli olacaktır. Uygulama sonunda, bu çalışmayla ilgili sorularınız cevaplanacaktır. Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için tez danışmanı ODTÜ İlköğretim Bölümü öğretim üyesi Prof. Dr. Ceren Öztekin (Tel: 0 312 210 41 94; e-posta: ceren@metu.edu.tr), eş-danışmanı ODTÜ İlköğretim Bölümü öğretim üyesi Prof. Dr. Jale ÇAkıroğlu (Tel: 0 312 210 40 51; e-posta: jaleus@metu.edu.tr) ya da araştırmacı öğretmen Gökcen Özcan (Tel: 0 543 776 42 10; e-posta: gokcenozcan@gmail.com) ile iletişim kurabilirsiniz.

Bu çalışmaya tamamen gönüllü olarak katılıyorum ve istediğim zaman yarıda kesip çıkabileceğimi biliyorum. Verdiğim bilgilerin bilimsel amaçlı yayımlarda kullanılmasını kabul ediyorum. (Formu doldurup imzaladıktan sonra uygulayıcıya geri veriniz).

İsim Soyad	Tarih	İmza
	----/----/-----	

APPENDIX G

DESCRIPTIVE STATISTICS

	Mean	Median	Min	Max	Standard deviation	Kurtosis	Skewness
ATT1	6.299	7.000	1.000	7.000	1.244	4.154	-2.057
ATT2	6.118	7.000	1.000	7.000	1.288	2.469	-1.642
ATT3	6.344	7.000	1.000	7.000	1.196	5.083	-2.221
ATT4	6.157	7.000	1.000	7.000	1.290	2.912	-1.774
ATT5	4.929	5.000	1.000	7.000	1.688	-0.626	-0.458
ATT6	6.164	7.000	1.000	7.000	1.303	2.357	-1.666
ATT7	6.071	7.000	1.000	7.000	1.366	1.451	-1.483
ATT8	6.156	7.000	1.000	7.000	1.321	2.780	-1.752
ATT9	6.087	7.000	1.000	7.000	1.379	2.354	-1.660
B	4.918	5.000	1.000	7.000	1.129	0.302	-0.026
INT1	6.165	7.000	1.000	7.000	1.132	3.257	-1.638
INT2	6.195	7.000	1.000	7.000	1.173	3.431	-1.784
INT3	6.178	7.000	1.000	7.000	1.157	3.509	-1.750
SN1	5.402	6.000	1.000	7.000	1.652	0.759	-1.154
SN2	5.461	6.000	1.000	7.000	1.615	1.160	-1.247
SN3	5.458	6.000	1.000	7.000	1.614	0.934	-1.184
SN4	5.463	6.000	1.000	7.000	1.584	0.812	-1.128
PBC	6.199	7.000	1.000	7.000	1.314	4.844	-2.156
PN1	6.024	6.000	2.000	7.000	0.991	0.887	-1.013
PN2	5.610	6.000	1.000	7.000	1.415	0.959	-1.091
PN3	5.997	6.000	1.000	7.000	1.227	2.839	-1.551
PN4	5.857	7.000	1.000	7.000	1.781	2.303	-1.831
PN5	6.199	7.000	1.000	7.000	1.230	4.211	-2.003
PN6	6.384	7.000	2.000	7.000	0.972	6.410	-2.265
PN7	6.216	7.000	1.000	7.000	1.163	4.237	-1.972
PN8	5.811	6.000	1.000	7.000	1.690	2.004	-1.676
PN9	6.378	7.000	1.000	7.000	0.959	5.923	-2.060
PN10	5.899	7.000	1.000	7.000	1.568	2.465	-1.738
SE1	2.729	3.000	1.000	5.000	1.409	-1.289	0.198
SE2	4.071	4.000	1.000	5.000	0.931	0.564	-0.906
SE3	3.761	4.000	1.000	5.000	0.976	-0.513	-0.397
SE4	4.098	4.000	2.000	5.000	0.899	-0.558	-0.637
SE5	3.933	4.000	1.000	5.000	0.938	0.222	-0.754
SE6	4.189	4.000	1.000	5.000	0.855	0.799	-0.997
SE7	2.761	3.000	1.000	5.000	1.443	-1.344	0.156
SE8	3.274	3.000	1.000	5.000	1.355	-1.079	-0.338

SE9	3.107	3.000	1.000	5.000	1.520	-1.400	-0.143
SE10	2.762	3.000	1.000	5.000	1.532	-1.502	0.155
SE11	2.756	3.000	1.000	5.000	1.451	-1.380	0.123
EB1	3.400	3.000	1.000	5.000	1.325	-1.097	-0.267
EB2	2.592	2.000	1.000	5.000	1.375	-1.002	0.468
EB3	4.328	5.000	1.000	5.000	0.938	2.599	-1.654
EB4	4.097	4.000	1.000	5.000	1.026	0.684	-1.099
EB5	4.547	5.000	1.000	5.000	0.782	3.480	-1.883
EB6	3.359	3.000	1.000	5.000	1.336	-1.175	-0.199
EB7	4.138	4.000	1.000	5.000	1.029	1.264	-1.276
EB8	4.186	4.000	1.000	5.000	0.962	0.897	-1.147
EB9	4.456	5.000	1.000	5.000	0.781	2.414	-1.525
EB10	3.542	4.000	1.000	5.000	1.295	-1.088	-0.344
EB11	4.531	5.000	1.000	5.000	0.736	3.257	-1.739
EB12	2.842	3.000	1.000	5.000	1.156	-0.664	0.196
EB13	2.964	3.000	1.000	5.000	1.285	-0.992	0.174
EB14	4.263	5.000	1.000	5.000	0.927	0.831	-1.173
EB15	4.523	5.000	1.000	5.000	0.769	3.537	-1.824
EB16	3.252	3.000	1.000	5.000	1.345	-1.157	-0.130
EB17	3.535	4.000	1.000	5.000	1.350	-1.064	-0.406
EB18	4.276	5.000	1.000	5.000	0.925	1.912	-1.412
EB19	3.518	4.000	1.000	5.000	1.366	-1.018	-0.462
EB20	4.342	5.000	1.000	5.000	0.879	1.693	-1.362
EB21	4.112	4.000	1.000	5.000	0.939	0.500	-0.927
EB22	4.364	5.000	1.000	5.000	0.854	2.550	-1.540
BB1	44.483	49.000	1.000	49.000	7.748	8.117	-2.507
BB2	43.133	49.000	1.000	49.000	9.480	4.606	-2.051
BB3	44.303	49.000	1.000	49.000	7.608	7.496	-2.300
BB4	44.760	49.000	1.000	49.000	7.550	8.841	-2.584
BB5	43.206	49.000	1.000	49.000	8.494	4.100	-1.808
BB6	42.821	49.000	1.000	49.000	8.830	3.545	-1.738
BB7	42.225	49.000	1.000	49.000	9.368	2.439	-1.546
BB8	42.254	49.000	1.000	49.000	9.665	2.738	-1.647
BB9	41.919	49.000	1.000	49.000	9.810	2.753	-1.630
BB10	42.455	49.000	1.000	49.000	9.192	3.540	-1.734
BB11	42.358	49.000	1.000	49.000	9.999	3.240	-1.817
BB12	38.501	42.000	1.000	49.000	12.072	0.326	-1.044
BB13	38.464	42.000	1.000	49.000	11.716	0.112	-0.944
BB14	41.021	49.000	1.000	49.000	10.397	2.049	-1.454
BB15	40.312	42.000	1.000	49.000	10.979	1.175	-1.289
BB16	40.047	42.000	1.000	49.000	11.102	1.371	-1.331
NB1	28.942	30.000	1.000	49.000	15.147	-1.095	-0.286

NB2	37.503	42.000	1.000	49.000	11.959	0.141	-0.915
NB3	32.841	35.000	1.000	49.000	13.817	-0.715	-0.547
NB4	35.014	36.000	1.000	49.000	13.950	-0.525	-0.756
NB5	32.951	36.000	1.000	49.000	14.229	-0.813	-0.543
CB1	43.307	49.000	1.000	49.000	8.704	3.866	-1.860
CB2	43.518	49.000	1.000	49.000	8.551	4.617	-1.967
CB3	38.416	42.000	1.000	49.000	10.377	0.587	-0.916
CB4	37.109	42.000	1.000	49.000	12.356	0.097	-0.909
CB5	35.663	36.000	1.000	49.000	13.046	-0.597	-0.699
CB6	42.773	49.000	1.000	49.000	9.053	3.437	-1.787
CB7	37.400	42.000	1.000	49.000	11.654	0.323	-0.952
CB8	32.727	35.000	1.000	49.000	13.987	-0.770	-0.538

APPENDIX H

DEMOGRAPHIC INFORMATION SCALE

A. KİŞİSEL BİLGİLER

1. Cinsiyetiniz:
❑ Kadın ❑Erkek

2. En son mezun olduğunuz okul türü:
□ Ön lisans
□ Lisans (Üniversite)
□ Yüksek lisans
□ Doktora

3. Fen öğretimi/eğitimi ilgili eğitimler (hizmet içi, kurs, seminer, vs.**) aldınız mı?**

□ Evet □ Hayır.

4. Kaç yıldır öğretmenlik yapıyorsunuz?
.. ……

5. Fen bilimleri ilgili yayınları ne sıklıkta takip ediyorsunuz?

□ Hiçbir zaman
□Ara sıra
□Sık sık
□ Her zaman

6. Sınıfınızdaki çocukların ay aralığı nedir?

1.□ 37-66
2.□48-66
3. Diğer: ……..

7. Çalıştığınız okul türünü işaretleyiniz.
1.□ Devlet bağımsız anaokulu
2.□Özel anaokulu-kreş
3.□ Devlet anasınıfı
4.□ Özel anasınıfı
5.□Uygulama sınıfı

8. Fen / Bilim ile ne kadar ilgilisiniz?
□ Çok ilgili □ Biraz
□ Çok az ilgili □ İlgisiz

9. Fen / Bilim ile ilgili, genel olarak, ne kadar bilginiz olduğunu düşünüyorsunuz?
□ Çok fazla □ Yeteri kadar
□ Biraz □ Bilgim yok

10. Üniversite eğitiminiz sırasında fen ile ilgili kaç ders aldınız?
□ 1 □ 2
□ 3 □ Hiç ders almadım

11. Fen öğretimi konusunda kendinizi yeterli hissediyor musunuz?
□ Çok fazla □ Biraz
□ Çok az □ Hiç

12. Fen konuları, diğer konuların (aritmetik, okuma-yazma gibi) öğretimi kadar önemli midir?

□ Çok önemlidir □ Biraz önemlidir
□ Çok az önemlidir □ Önemli değildir

13. Çalıştığınız il/ilçe:

14. Çalıştığınız okul:

APPENDIX I

EARLY CHILDHOOD TEACHERS SCIENCE TEACHING INTENTION AND BEHAVIOUR QUESTIONNAIRE

B. FEN ÖĞRETME NİYETİ VE DAVRANIŞI ANKETİ

Değerli öğretmenim,

Bu çalışma, sizlerin "**fen öğretimine yer verme**" davranışınız ile ilgili görüşlerinizi belirlemeyi amaçlamaktadır. Lütfen her cümleyi dikkatle okuduktan sonra, size en uygun gelen seçeneği mutlaka işaretleyiniz. **Bu ankette bazı sorular diğerlerine benzemektedir**, bu konuda endişelenmeyin.

Bu soruların doğru veya yanlış cevabı bulunmamaktadır ve bizim için sizin kişisel görüşünüz önemlidir. Bir ifadeye **kesinlikle KATILIYORSANIZ 7 sayısını**; **kesinlikle KATILMIYORSANIZ 1 sayısını**, işaretleyiniz. Eğer bir ifadeye daha fazla veya daha az katılıyorsanız, 1 ile 7 arasında sizin düşüncenizi en iyi ifade eden sayıyı işaretleyiniz.

Benim için, öğretmenlik hizmetim sırasında fen öğretimine yer vermek…								
	7	**6**	**5**	**4**	**3**	**2**	**1**	
Gereklidir								Gereksizdir
İyidir								İyi değildir
Faydalıdır								Faydasızdır
Eğlencelidir								Sıkıcıdır
Kolaydır								Zordur
Önemlidir								Önemsizdir
Değerlidir								Değersizdir
Zaman kaybı değildir								Zaman kaybıdır
Çaba kaybı değildir								Çaba kaybıdır

Öğretmenlik hizmetiniz sırasında fen öğretimine ne sıklıkta yer veriyorsunuz?	He zaman 7	6	5	4	3	2	Hiç yer vermiyorum 1

Öğretmenlik hizmetim sırasında fen öğretimine yer verirsem çocuklar,	Kesinlikle Katılıyorum 7	6	5	Kararsızım 4	3	2	Kesinlikle Katılmıyorum 1
1. Çevrelerindeki doğal olayları daha iyi anlar.							
2. Eleştirel düşünme yeteneği kazanır.							
3. Çevrelerinde gerçekleşen olaylara karşı daha ilgili olur.							
4. Gözlem yapmayı öğrenir.							
5. Çevrelerinde gerçekleşen olaylar ile ilgili tahminlerde bulunur.							
6. Çevrelerinde gördükleri nesne ve olayları karşılaştırabilir.							
7. Çevrelerinde gördükleri nesne ve olayları sınıflandırabilir.							
8. Günlük hayatta karşılaştıkları problemleri daha kolay çözer.							
9. Fen kavramlarını daha iyi anlar.							
10. Fen etkinliklerine ve deneylerine ilgi duyar.							
11. Erken yaşta araştırmacı bir kimlik geliştirebilir.							
12. Fen bilimlerinin okuma-yazma, resim, müzik gibi diğer alanlardan farkını anlar.							
13. Bilimsel bilginin özelliklerini anlar.							
14. İlkokula hazırlanır.							
15. Fen –Teknoloji-Toplum-Çevre etkileşimini anlar.							
16. Bilimsel okuryazar bireyler olarak yetişir.							

Aşağıdaki durumlar sizin için ne derece önemlidir? **Çocukların,**	Çok önemli 7	6	5	Kararsızım 4	3	2	Hiç önemli değil 1
1. Çevrelerindeki doğal olayları daha iyi anlaması							
2. Eleştirel düşünme yeteneği kazanması							
3. Çevrelerinde gerçekleşen olaylar ile ilgili merak uyandırması							
4. Gözlem yapmayı öğrenmesi							
5. Çevrelerinde gerçekleşen olaylar ile ilgili tahminlerde bulunması							
6. Çevrelerinde gördükleri nesne ve olayları karşılaştırabilmesi.							
7. Çevrelerinde gördükleri nesne ve olayları sınıflandırabilmesi							
8. Günlük hayatta karşılaştıkları problemleri daha kolay çözmesi							
9. Fen kavramlarını daha iyi anlaması							
10. Fen aktivitelerine ve deneylerine ilgi duyması							
11. Erken yaşta araştırmacı bir kimlik geliştirmesi							
12. Fen bilimlerinin okuma-yazma, resim, müzik gibi diğer alanlardan farkını anlaması							
13. Bilimsel bilginin özelliklerini anlaması							
14. İlkokula hazırlanması							
15. Fen –Teknoloji- Toplum - Çevre etkileşimini anlaması							
16. Bilimsel okuryazar bireyler olarak yetişmesi							

Aşağıdaki ifadelere ne derecede katılıyorsunuz?	Kesinlikle Katılıyorum 7	6	5	Kararsızım 4	3	2	Kesinlikle Katılmıyorum 1
Bu öğretim dönemi içinde fen öğretimine yer vermeye **çalışacağım.**							
Bu öğretim dönemi içerisinde fen öğretimine yer vermeyi **amaçlıyorum.**							
Bu öğretim dönemi içinde fen öğretimine yer vermeyi **planlıyorum.**							

Aşağıdaki ifadelere ne derecede katılıyorsunuz?	Kesinlikle Katılıyorum 7	6	5	Kararsızım 4	3	2	Kesinlikle Katılmıyorum 1
1. Öğretmenlik kariyerim için önemli olacağını düşündüğüm **kişiler** benden fen öğretimine yer vermemi **beklerler.**							
2. Öğretmenlik kariyerim için önemli olacağını düşündüğüm **kurumlar** benden fen öğretimine yer vermemi **beklerler.**							
3. Öğretmenlik kariyerim için önemli olacağını düşündüğüm **kişiler** benden fen öğretimine yer vermemi **desteklerler.**							
4. Öğretmenlik kariyerim için önemli olacağını düşündüğüm **kurumlar** benden fen öğretimine yer vermemi **desteklerler**.							

Aşağıda belirtilen kişi ya da kurumlar öğretmenlik hizmetim sırasında fen öğretimine yer vermemi beklerler:	Kesinlikle Katılıyorum 7	6	5	Kararsızım 4	3	2	Kesinlikle Katılmıyorum 1
1.Meslektaşlarım							
2. Çocuklar							
3.Veliler							
4.Milli Eğitim Bakanlığı							
5.Okul idaresi							

Aşağıda belirtilen kişi ya da kurumların beklentileri öğretmenlik hizmetiniz sırasında sizin için ne derece önemli olur?	Çok önemli 7	6	5	4	3	2	Hiç önemli değil 1
1.Meslektaşlarım							
2. Çocuklar							
3.Veliler							
4.Milli Eğitim Bakanlığı							
5.Okul idaresi							

Sizce öğretmenlik hizmetiniz sırasında fen öğretirken, aşağıdaki koşulların/durumların gerçekleşmesi ne derece mümkün olur?	Kesinlikle mümkün 7	6	5	4	3	2	Hiç mümkün değil 1
1.Çocuklar fen öğrenmeye istekli olur.							
2. Çocuklar fen etkinliklerine ilgi gösterir.							
3. Yeterli zaman olur.							
4. Lisans sırasında aldığım okul öncesinde fen eğitimi bilgileri bana yardımcı olur.							

5. Tecrübeli meslektaşlarım bana yardımcı olurlar.							
6. Çocuklar farklı fen aktivitelerine katılmada istekli olurlar.							
7. Fen hakkında bilgi edinebileceğim çok sayıda kaynak olur.							
8. Yeterli malzeme ve materyaller (kitap, dergi, belgesel CD'leri, mercek, pusula, mikroskop vb.) bulunur.							

Öğretmenlik hizmetim sırasında aşağıdaki durumların/koşulların sağlanması fen öğretimine yer vermemi kolaylaştıracaktır:	Kesinlikle Katılıyorum 7	6	5	Kararsızım 4	3	2	Kesinlikle Katılmıyorum 1
1.Çocukların fen öğrenmeye istekli olması							
2. Çocukların fen etkinliklerine ilgi göstermeleri							
3. Yeterli zamanın olması							
4. Lisans sırasında aldığım okul öncesinde fen eğitimi bilgilerinin bana yardımcı olması							
5. Tecrübeli meslektaşlarımın bana yardımcı olmaları							
6. Çocukların farklı fen aktivitelerine karşı istekli olmaları							
7. Fen hakkında bilgi edinebileceğim çok sayıda kaynağın olması							
8. Yeterli malzeme ve materyallerin (kitap, dergi, belgesel CD'leri, mercek, pusula, mikroskop vb.) bulunması							

Aşağıdaki ifadelere ne derecede katılıyorsunuz?	Kesinlikle Katılıyorum 7	6	5	Kararsızım 4	3	2	Kesinlikle Katılmıyorum 1
İstediğim takdirde öğretmenlik hizmetim sırasında fen öğretimine yer vermek benim kontrolümdedir.							

Aşağıda belirtilen ifadelere ne derecede katılıyorsunuz? **Öğretmenlik hizmetim sırasında,**	Kesinlikle Katılıyorum 5	4	Kararsızım 3	2	Kesinlikle Katılmıyorum 1
1. Genellikle fen konularını etkili bir şekilde **öğretemiyorum.**					
2. Fen öğretirken kullanacağım basamakları biliyorum.					
3. Fen öğretirken sürekli yeni yöntemler buluyorum.					
4. Fen öğretirken çocukları yeterince takip edebiliyorum.					
5. Etkili bir şekilde öğretecek kadar fen kavramlarını biliyorum.					
6. Çocukların fen konusundaki sorularını genellikle cevaplarım.					
7.Ne kadar çok çaba harcasam da, fen konularını diğer konular gibi iyi **öğretemiyorum.**					
8. Fen öğretmek için gerekli becerilere sahip olup olmadığımı merak ediyorum.					
9. Eğer seçim hakkı verilirse, fen öğretirken okul müdürünü ya da müfettişleri beni değerlendirmesi için dersime **çağırmam.**					
10. Çocukların fen konularına dikkatlerini çekmek için ne yapmam gerektiğini **bilmiyorum**.					
11. Fen kavramlarını anlamada zorlanan çocuklara nasıl yardımcı olacağımı **bilmiyorum.**					

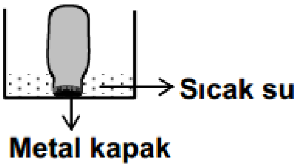
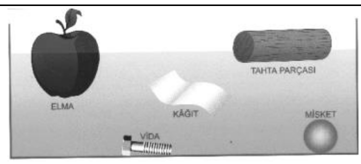
Aşağıda belirtilen ifadelere ne derecede katılıyorsunuz?	Kesinlikle Katılıyorum 5	4	Kararsızım 3	2	Kesinlikle Katılmıyorum 1
1. Tüm insanlar, bilim insanlarının söylediklerine inanmak zorundadır.					
2. Bilimde tüm soruların bir doğru yanıtı vardır.					
3. Bilimsel deneylerdeki fikirler, olayların nasıl meydana geldiğini merak edip düşünerek ortaya çıkar.					
4. Günümüzde bazı bilimsel düşünceler, bilim insanlarının daha önce düşündüklerinden farklıdır.					
5. Bir deneye başlamadan önce, deneyle ilgili bir fikrinizin olmasında yarar vardır.					
6. Bilimsel kitaplarda yazanlara inanmak zorundasınız.					
7. Doğru yanıta ulaşmak bilimsel çalışmaların en önemli parçasıdır.					
8. Bilimsel kitaplardaki bilgiler bazen değişir.					
9. Bilimsel çalışmalarda düşüncelerin test edilebilmesi için birden fazla yol olabilir.					
10. Fen etkinliklerinde, öğretmenin söylediği her şey doğrudur.					
11. Olayların nasıl meydana geldiği hakkında yeni fikirler bulmak için deneyler yapmak, bilimsel çalışmanın önemli bir parçasıdır.					
12. Bilimsel kitaplardan okuduklarınızın doğru olduğundan emin olabilirsiniz.					
13. Bilimsel bilgi her zaman doğrudur.					
14. Bilimsel fikirler bazen değişir.					

15. Sonuçlardan emin olmak için, deneylerin birden fazla tekrarlanmasında fayda vardır.					
16. Bilimde neyin doğru olduğundan sadece bilim insanları emin olur.					
17. Bilim insanlarının bir deneyden elde ettiği sonuç, o deneyin tek sonucudur.					
18. Bilimdeki, parlak fikirler sadece bilim insanlarından değil, herhangi birinden de gelebilir.					
19. Bilim insanları bilimde neyin doğru olduğu konusunda her zaman hemfikirdirler.					
20. İyi çıkarımlar, birçok farklı deneyin sonucundan elde edilen kanıtlara dayanır.					
21. Bilim insanları, bilimde neyin doğru olduğu ile ilgili düşüncelerini bazen değiştirirler.					
22. Bir şeyin doğru olup olmadığını anlamak için deney yapmak iyi bir yoldur.					

Aşağıdaki ifadelerde ne derecede katılıyorsunuz?	Kesinlikle Katılıyorum 7	6	5	Kararsızım 4	3	2	Kesinlikle Katılmıyorum 1
1. Fen öğretmek için fazladan çaba göstermeye istekliyim.							
2. Fen öğretimine yeterince zaman **ayırmazsam** kendimi suçlu hissederim.							
3. Kendimi çocuklara karşı sorumlu hissettiğim için fen öğretimine zaman ayırırım.							
4. Fen öğretimine zaman **ayırmamak** bence **yanlıştır.**							
5. Fen öğretimine zaman ayırmak her okul öncesi öğretmeninin sorumluluğudur.							
6. Fen öğretimine yer verdiğim zaman kendimi mutlu hissederim.							
7. Fen öğretimine yer verdiğimde çalışma motivasyonumu arttırmış olurum.							
8. Fen öğretimine yer vermemek benim öğretmenlik anlayışımla **uyuşmaz**.							
9. Fen öğretimine yer vermem gerektiğini hissediyorum.							
10. Fen öğretimine zaman ayırmamak benim iş ahlakımla **bağdaşmaz.**							

FEN BİLİMLERİ TESTİ

Aşağıdaki soruları cevaplayınız.

1	**Geri dönüşümün başlıca nedeni aşağıdakilerden hangisidir?** A) Daha dayanıklı plastik maddeler üretebilmek. B)Ormanları korumak. C) Atık miktarını azaltmak. D Hava kirliliğini azaltmak. E) Bilmiyorum	5	**Gece ve gündüz nasıl oluşur?** A) Güneşin dünya etrafında dönüşü ile B) Dünyanın güneş etrafında dönüşü ile C) Ayın dünya etrafında dönüşü ile D) Dünyanın kendi ekseni etrafında dönüşü ile E) Bilmiyorum
2	**Aşağıdakilerden hangisi çölde yaşayan canlıların adaptasyonları arasında yer almaz?** A) Bitkilerde yaprakların dikensi yapıda olması B) Hayvanların uzun kulak yapısına sahip olması C) Bitkilerde gözeneklerin yaprağın alt tarafında yoğunlaşması D) Hayvanların kalın post yapısına sahip olmaları E) Bilmiyorum	6	**Gökyüzünün mavi görünmesinin nedeni aşağıdakilerden hangisidir?** A) Denizin mavisi, gökyüzüne yansır B) Mavi ışık havadaki parçacıklar tarafından saçılıma uğrar C) Gökyüzü mavi ışığı soğurur D) Güneşten gökyüzüne sadece mavi renk ışık gelir E) Bilmiyorum
3	**Yandaki şekilde, cam**  **kavanozun metal kapağı açılmayınca kavanoz ters çevrilip sıcak suya daldırılır ve bir süre sonra kavanozun kapağı açılır. Bu olayın sebebi aşağıdakilerden hangisidir?** A)Cam kavanoz, ters çevrilince basıncın etkisi ile kapak kendini bırakır. B) Sıcak su metal kapağı bir miktar eritir. C) Metal kapağın genleşmesi, camınkinden büyüktür. D) Sıcak su maddelerin iç yapısını bozar. E) Bilmiyorum	7	 **Yukaridaki şekilde bir kaptaki su içine serbest bırakılan cisimlerin dengede kalma durumları verilmiştir.** **Bu şekille ilgili olarak,** I. Elma, vida ve misketten daha hafif olduğu için batmamıştır. II. Kağıdın özkütlesi elmadan büyüktür. III. En ağır cisim miskettir. **yargılarından hangisi ya da hangileri doğrudur?** A) Yalnız I B) Yalnız II C) I ve III D) I ve II E) Bilmiyorum

4	**Aşağıdaki saatlerden hangisinde gölge boyu en uzun olur?** A) 08:00 B) 09:00 C) 10:00 D)11:00 E) Bilmiyorum	8	**Aşağıdakilerden hangisi daha ağırdır?** A) 20 litre buz B)20 litre su C) 10 kg demir D)10 kg pamuk E) Bilmiyorum
9	**Hayvan türlerinin nesillerinin tükenmesinin en yaygın sebebi nedir?** A)Pestisitlerin (tarım ilaçlarının) kullanılması B)Yaşam alanlarının insanlar tarafından yok edilmesi C)Avcılığın artması D)İklim değişiklikleri E) Bilmiyorum	12	**Ozon, atmosferin üst katmanlarında koruyucu bir tabaka oluşturur. Ozon bizi aşağıdakilerden hangisinden korur?** A)Asit yağmurlarından B) Küresel ısınmadan C) Sıcaklıktaki ani değişimlerden D) Zararlı, kansere neden olan güneş ışığından E) Bilmiyorum
10	**Aşağıdakilerden hangisi yenilenebilir bir kaynaktır?** A) Petrol B) Demir Madeni C) Ağaçlar D) Kömür E) Bilmiyorum	13	**Bir besin zincirini oluşturan aşağıdaki canlılardan hangisi bu zincirin ilk halkasında olabilir?** A) Kurt B) Dut yaprağı C) Tırtıl D) Serçe E) Bilmiyorum
11	**Aşağıdakilerden hangisi gökkuşağı oluşumunu açıklar?** A) Güneş ışınlarının yağmur taneleri ile buluşma noktasında oluşan kuşaktır B) Yağmurdan sonra çıkan Güneş havayı ısıtır ve gökkuşağı oluşur C) Gökkuşağı yağmur sonrasında oluşan bir göz yanılgısıdır D) Güneş ışınları yağmur damlaları içinde yansıyarak kırılır ve gökkuşağı oluşur E) Bilmiyorum	14	**Atmosferde karbondioksit, metan gibi gazların ve su buharı miktarının artması aşağıdaki olayların hangisi ya da hangilerine sebep olur?** I. Ozon tabakasının delinmesi II. Sera etkisi III. Sıcaklığın artması A) Yalnız I B) II ve III C) I ve II D) I ve III E) Bilmiyorum

APPENDIX J
CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name: Özcan-Ermiş, Gökcen
Nationality: Turkish (TC)
Date and Place of Birth: 9 October 1985, Kırıkkale
Marital Status: Married
email: gokcenozcan@gmail.com

EDUCATION

Degree	**Institution**	**Year of Graduation**
BS-Major	METU Elementary Science Education	2008
BS-Minor	METU-Biology	2008
High School	Nuh Mehmet Küçükçalık Anadolu High School, Kayseri	2003

WORK EXPERIENCE

Year	**Place**	**Enrollment**
2012-Present	Ministry of National Education	Science Teacher
2010-2012	Sakarya University-Education Faculty	Research Assistant
2007-2009	Private Education Institute	Science Teacher

FOREIGN LANGUAGES

Advanced English, Intermediate French

PUBLICATIONS

1. Özcan, G. & Tekkaya C. (2010). Fen Bilgisi Öğretmen Adaylarının Sosyobilimsel Konuların Fen Bilgisi Müfredatında Yer Almasına Yönelik Algıları. IX. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, p. 164.

2. Graf, D., Tekkaya, C., Kılıç, D. S. & Özcan, G. (2011). Alman ve Türk Fen Bilgisi Öğretmen Adaylarının Evrim Öğretimine Ilişkin Pedagojik Alan Bilgisinin, Tutumlarının ve Pedagojik Alan Kaygılarının Araştırılması. International Conference on New Trends in Education and Their Implications (ICONTE), p. 418 -425.

3. Özcan, G. & Tekkaya C. (2011). Exploring Pre-service Science Teachers´ Pedagogical Content Knowledge and Concerns in the Context of Evolution. European Conference on Educational Research (ECER).

4. Özcan, G., Tekkaya, C. & Çakıroğlu, J. (2012). Early Childhood Teachers' Intentions to Teach Science: Initial Findings. Applied Education Congress (APPED), p. 279-280.

5. Coşkun-Keskin, S., Özcan, G., Topsakal, Ü. U., & Öztuna-Kaplan, A. (2013). Students' Cognitive Awareness about the Reasons of Environmental Problems. *World Applied Sciences Journal, 283* ,pp. 378 - 381 DOI: 10.5829/idosi.wasj.2013.28.03.765

HOBBIES

Indoor and outdoor cycling, jogging, bowling, swimming, aerobics.

APPENDIX K

TURKISH SUMMARY

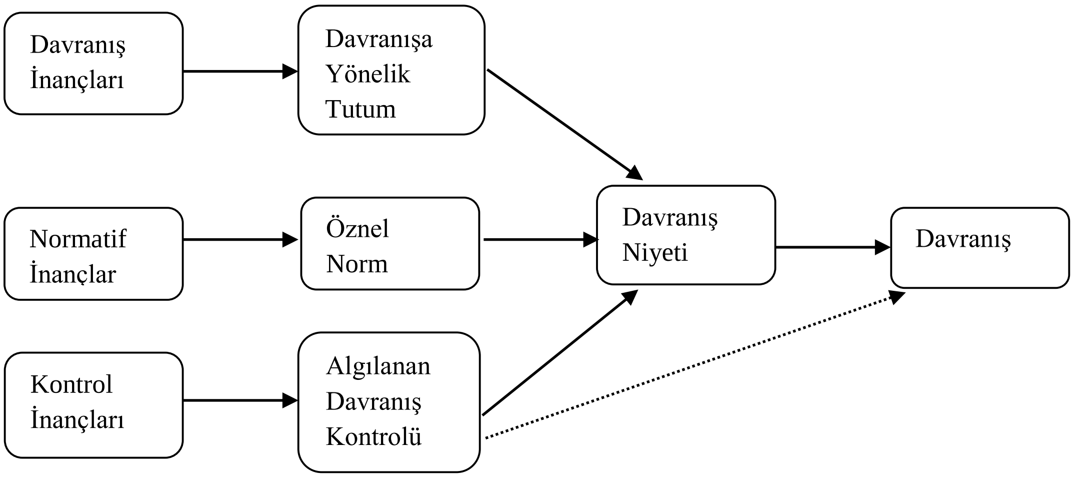
Okul Öncesi Öğretmenlerinin Fen Öğretimine Yönelik Niyet ve Davranışlarının Planlanmış Davranış Teorisi ile Açıklanması

Giriş

Erken çocukluk eğitiminin önemi hem ulusal hem de uluslararası kaynaklarda sıkça vurgulanmaktadır (bk. Bredekamp ve Copple, 1997; Lind, 2005, Milli Eğitim Bakanlığı [MEB], 2013, National Association for Education of Young Children [NAECYC], 1992). Erken çocukluk döneminde verilmesi planlanan eğitimlerden biri de fen eğitimidir. Çünkü erken çocukluk döneminde verilen fen eğitimi, çocukların bilimsel süreç becerilerini erken yaşta kazanmalarını, çevrelerinde gerçekleşen olayları daha iyi anlamalarını, fen bilimlerine karşı meraklı ve ilgili olmalarını sağlar (ör. Bredekamp ve Copple, 1997; Worth, 2010). Ayrıca erken yaşta verilen fen eğitimi, çocukların gelecekteki bilimsel anlayışlarını, yaratıcı düşünme becerilerini ve fen öğrenmeye karşı olumlu tutumlar geliştirmesini sağlar (Harlan ve Rivkin, 2004). Ancak araştırmalar, fen eğitiminin, erken çocukluk döneminde sınırlı bir yere sahip olmasıyla birlikte, öğretmenler tarafından soyut, zor ve teorik olarak değerlendirildiğini ortaya çıkarmıştır (Johnson, 1999; Seefeldt ve Galper, 2002). Benzer şekilde, bazı çalışmalar da, öğretmenlerin fen etkinliklerini yaparken endişeli olduklarını ve fen etkinliklerine yer vermekten kaçındıklarını ortaya koymuştur (ör. Chaille ve Britain, 2003; Conezio ve French, 2002; Ginsburg ve Golbeck, 2004; Sackes, Trundle, Bell, ve O'Connell, 2011).

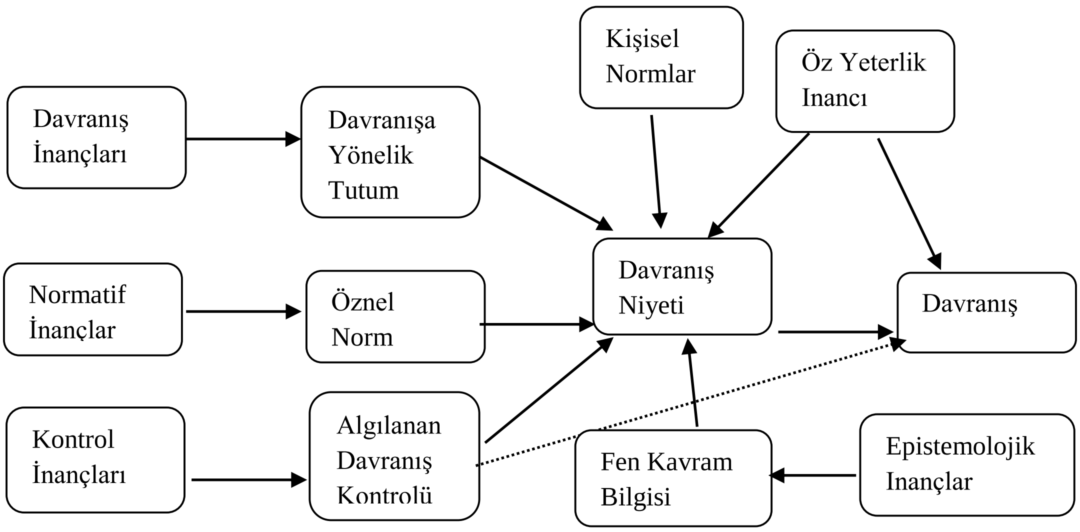
Hsu (2002)' ya göre okul öncesi öğretmenleri kaliteli bir öğretim süreci için ve çocukların hem öğrenmelerinde hem de olumlu tutum geliştirmeleri açısından çok önemlidir. Ancak öğretmenler öğretim hizmetleri sırasında birçok faktörden etkilenirler. Çünkü öğretim; bireysel felsefelerin, inançların ve dış faktörlerin de içine karıştığı karmaşık bir süreçtir (Levitt, 2001; Pajares, 1992). Diğer bir deyişle, birçok içsel (ör. öz-yeterlik inancı, tutumlar, ya da inançlar) ve dışsal (ör. okul atmosferi, kaynak ve materyaller, öğretim programı, öğrenci sayısı) faktör öğretmenlerin öğretim hizmetlerini etkilemektedir. Örneğin, bazı çalışmalar öğretmenlerin bilimsel algıları ve fen öğretme özgüvenleri arasında bir ilişki kurarken (ör. Nilsson, 2008) , bazı çalışmalar öğretmenlerin yetersiz ya da eksik bilimsel fikirlerinin veya kavram bilgilerinin fen öğretimini etkilediğini savunmuştur (bk. Harlen, 1997; Kallery, Psillos ve Tselfes, 2009).

Bu çalışmada, okul öncesi öğretmenlerinin, fen bilimlerine karşı çocuklarda oluşturulacak ilk izlenimlerin anahtar rolü ve erken yaşta verilen fen eğitiminin çocuğun eğitim hayatına katkısı düşünülerek, okul öncesi öğretmenlerinin fen öğretme niyetini ve fen öğretimine yer verme davranışını (sıklığını) etkileyen faktörler planlanmış davranış teorisi (PDT; Ajzen, 1985, 1991, 2005) kapsamında incelenmiştir. Planlanmış davranış teorisi, bireylerin davranışlarını üç farklı faktör (davranışa yönelik tutum, öznel norm ve algılanan davranış kontrolü) ile açıklamak için tasarlanmış bir teoridir. Bu teoriye göre, bireyin davranışının altında yatan üç tür inanç vardır: davranış inançları, normatif inançlar ve kontrol inançları. Bu inançların, sırasıyla, davranışa yönelik tutum, öznel norm ve algılanan davranış kontrolünü açıkladığı ve bu üç faktörün (davranışa yönelik tutum, öznel norm ve algılanan davranış kontrolü) de davranış niyetini oluşturduğu düşünülmektedir. Ayrıca, planlanmış davranış teorisine göre, davranış niyeti, davranışı açıklayan en önemli faktördür. Sekil 1' de planlanmış davranış teorisinin şematik gösterimi verilmiştir.



Sekil 1. Planlanmış davranış teorisi (Ajzen, 2005' ten uyarlanmıştır)

Araştırmacılar, planlanmış davranış teorisinin yeterli olamadığı durumlarda bazı değişkenlerin (öz yeterlik inançları, kişisel normlar, vb.) teoriye eklenmesi gerektiğini savunmuşlardır (Aizen, 1991; Conner & Armitage,1998; Beck & Aizen, 1991). Okul öncesi öğretmenlerinin fen öğretme davranışlarını etkileyebileceğini düşündüğümüz değişkenler planlanmış davranış teorisi modeline eklenerek Şekil 2'deki araştırma modeli oluşturulmuştur.



Sekil 2. Araştırma modeli

Araştırmanın soruları da aşağıdaki şekilde belirlenmiştir:

1. Okul öncesi öğretmenlerinin fen öğretme davranışına yönelik olan tutumları, öznel normları, algılanan davranış kontrolü, kişisel normları, öz yeterlik inançları ve fen kavram bilgileri, fen öğretme niyetleri ve fen öğretme davranışları nelerdir?

2. Okul öncesi öğretmenlerinin davranış inançları, normatif inançları, kontrol inançları ve epistemolojik inançları sırasıyla tutum, öznel normlar, algılanan davranış kontrolü ve fen kavram bilgileri ile nasıl ilişkilidir?

3. Okul öncesi öğretmenlerinin fen öğretimine yönelik tutumları, öznel normları, algılanan davranış kontrolü, kişisel normları, öz yeterlik inançları ve fen kavram bilgileri fen öğretme niyetleri ile nasıl ilişkilidir?

4. Okul öncesi öğretmenlerinin fen öğretme niyetleri, algılanan davranış kontrolü ve öz yeterlik inançları, fen öğretme davranışları ile nasıl ilişkilidir?

Araştırmanın önemi

Birçok araştırmacı çocuk eğitiminin temeli sayılan okul öncesi dönemde temel fen kavramlarıyla birlikte fen bilimlerine karşı ilk tutumun oluşmaya başladığını belirtmektedir (Aktas-Arnas, 2002; Eshach ve Fried, 2005). Fen eğitiminin erken yaşlarda sunulmasının çocukların çevrelerinde gerçekleşen olayları tanıması, bilimsel süreç ve yaratıcı düşünme becerilerini kazanmasını sağlayacağı önemle vurgulanmaktadır (bk. Bredekamp ve Copple, 1997; Chalufour ve Worth, 2003; Yoon ve Onchwari, 2006). Yapılan araştırmalar, okul öncesi dönemde öğretmenlerin fen öğretimine daha az yer verdiklerini ortaya çıkarmıştır (ör. Chaille ve Britain, 2003; Ginsburg ve Golbeck, 2004; Sackes, Trundle, Bell, ve O'Connell, 2011). Literatürde, öğretmenlerin fen öğretimini etkileyen faktörleri inceleyen araştırmalar olmasına rağmen, araştırmacılar öğretmenlerin fen öğretim uygulamalarını inceleyecek çalışmalara halen ihtiyaç olduğunu belirtmektedirler (ör. Inan, Trundle, & Kantor, 2010; Tu, 2006; Olgan, Guner-Alpaslan, & Oztekin, 2014).

Sınıfta gerçekleşecek etkinliklerin planlayıcısı ve eğitim kalitesini belirleyecek en önemli etkenlerden biri olan öğretmenlerin, erken çocukluk döneminde fen eğitimine yer verme niyetlerini ve davranışlarını etkileyecek faktörleri ortaya çıkarmanın, bu alanda öğretmen adaylarına ve öğretmenlere verilecek eğitimlere ışık tutması ve okul öncesi öğretmenliği programlarının etkililiğiyle ilgili fikir vermesi açısından çok önemlidir. Diğer bir deyişle, öğretmenlerin fen öğretimine yönelik inançlarını, tutumlarını, kişisel değerlerini ve bakış açılarını ortaya koymaya çalışan bu çalışmanın sonuçları hem okullarda halen görev yapmakta olan öğretmenler için hazırlanacak hizmet içi programlarına yön verecek hem de okul öncesi öğretmenliği programlarında fen öğretiminin geliştirilmesine katkı sağlayabilecektir.

Bununla birlikte, bu çalışma ile Türkiye bağlamında erken çocukluk döneminde fen öğretme niyetini ve davranışını etkileyen faktörlerle ilgili planlanmış davranış modelinin genişletilmiş bir şekli olarak bir model ortaya konmuştur. Planlanmış davranış teorisi insan davranışlarını ve davranışı gerçekleştirme niyetlerini incelemesi açısından birçok farklı alanda şimdiye dek kullanılmasına rağmen, öğretmen davranışını inceleyen çalışmalarda sınırlı sayıda kullanılmıştır (bk. Akyol, 2015; Kilic, 2011; Kilic, Soran ve Graff, 2011; Lumpe, Haney, ve Czerniak, 1998; Ballone ve Czerniak, 2001). Ek olarak, sahip olduğum en iyi bilgiye göre, okul öncesi öğretmenlerinin fen öğretme niyetlerini ve davranışlarını araştırmada, planlanmış davranış teorisi modeli ilk defa bu çalışmada kullanılmıştır.

Bu çalışmanın diğer bir katkısı da önerilen modeldeki değişkenlere ait bilgilerin toplanması için, bu çalışma kapsamında *Okul Öncesi Öğretmenlerinin Fen Öğretme Niyeti ve Davranışı Anketi'nin* geliştirilmiş olmasıdır. Bu anketin geçerlilik ve güvenirlik çalışması Türkçe olarak yapılmıştır. Bu çalışma, öğretmen eğitimi literatürüne okul öncesi öğretmenlerinin fen öğretme davranışını ve onu etkileyen faktörleri inceleyen geçerli ve güvenilir bir anket sunmaktadır.

Araştırma yöntemi

Bu araştırmada, okul öncesi öğretmenlerinin fen öğretimi niyet ve davranışlarını etkilen faktörler yapısal eşitlik modeli kullanılarak belirlenmesi amaçlanmıştır. Bu doğrultuda bu çalışma nicel araştırma yöntemlerinden bir korelasyon araştırmasıdır. Tabachnick ve Fidell (2001) e göre, korelasyon çalışmalarında değişkenler arasındaki ilişki, değişkenlere herhangi bir müdahale edilmeden araştırılır. Veri toplama yöntemi olarak da nicel araştırma yöntemlerinde sıkça kullanılan tarama modeli kullanılmıştır (Fraenkel, 2012).

Evren ve örneklem

Bu çalışmanın evrenini Türkiye'de çalışan okul öncesi öğretmenleri oluşturmaktadır. Bu sebeple, çalışma verileri, Türkiye genelinde Milli Eğitim Bakanlığı'na bağlı devlet okullarında çalışan 893 okul öncesi öğretmeninden toplanmıştır. Çalışmaya sadece devlet okullarında çalışan, üniversite mezunu okul öncesi öğretmenleri dahil edilmiştir. Gönüllük esasına göre, öğretmenler çalışmaya katılmışlardır. Katılımcı öğretmenlerin özellikleri (cinsiyet, mesleki deneyim, fen ile ilgili bilgi, fen bilimlerine olan ilgi, hizmet içi eğitim durumları ve üniversitede fen bilimleri ile ilgili alınan ders sayısı) Tablo 1' de verilmiştir.

Tablo 1.

Katılımcıların özellikleri

	Frekans	Yüzde (%)
Cinsiyet		
Erkek	72	8.1
Kadın	809	90.6
Cevapsız	12	1.3
Deneyim (yıl)	Frekans	Yüzde (%)
1-5	448	52.8
6-10	235	27.6
11-15	99	12
16-20	25	2.9
20-30	43	4.9
Cevapsız	42	4.7
Fen ile ilgili bilgi	Frekans	Yüzde (%)
Hiç	19	2.1
Biraz	394	44.1
Orta	426	47.7
Çok	28	3.1
Cevapsız	24	2.7
Fen bilimlerine karsı ilgi	Frekans	Yüzde (%)
Hiç	74	8.3
Biraz	356	39.9
Orta	349	39.1
Çok	90	10.1
Cevapsız	24	2.7

Tablo 1

(devamı)

Üniversitede fen bilimleri ile ilgili alınan ders sayısı	Frekans	Yüzde (%)
0	34	3.8
1	392	43.9
2	302	33.8
3	97	10.9
Cevapsız	38	4.3
Hizmet içi eğitim	**Frekans**	**Yüzde (%)**
Evet	141	15.8
Hayır	501	58.3
Cevapsız	231	25.9

Ayrıca örneklemin, evreni temsil edilebilirliği, farklı istatistiki bölge birimlerinden öğretmenleri çalışmaya dahil ederek sağlanmıştır. Türkiye İstatistik Kurumu'nun (TÜİK) 2013 yılı verilerine göre Türkiye'de 12 istatistiki bölge bulunmaktadır. Bu bölgelere göre örneklemin dağılımı Tablo 2'de verilmiştir.

Tablo 2.

İstatistiki Bölgelere Göre Örneklem Dağılımı

Bölge	Şehirler (sadece çalışmaya katılanlar)	Okul öncesi öğretmen sayısı (N=52,985)	Çalışmaya katılan öğretmen sayısı (N=893)
Kuzeydoğu Anadolu	Erzurum, Erzincan, Ağrı, Ardahan	1786	42
Ortadoğu Anadolu	Malatya, Elazığ, Muş, Bitlis, Bingöl	3229	55
Güneydoğu Anadolu	Gaziantep, Şanlıurfa, Şırnak, Diyarbakır	6096	68
İstanbul	İstanbul	9211	76
Batı Marmara	Kırklareli, Balıkesir, Edirne	2099	34
Ege	İzmir, Aydın, Afyon, Kütahya, Muğla	7040	72
Doğu Marmara	Bursa, Eskişehir, Kocaeli, Sakarya, Düzce, Bolu	4706	42
Batı Anadolu	Ankara, Konya	6510	103
Akdeniz	Antalya, Isparta, Adana, Mersin, Hatay	7516	36
Orta Anadolu	Kırıkkale, Kırşehir, Kayseri Sivas, Yozgat	2686	212
Batı Karadeniz	Samsun, Amasya, Tokat	3199	77
Doğu Karadeniz	Trabzon, Gümüşhane, Rize, Artvin	1805	76

Veri toplama araçları

Çalışma için gerekli veriler, araştırmacılar tarafından planlanmış davranış teorisi doğrultusunda geliştirilen "Okul Öncesi Öğretmenlerinin Fen Öğretme Niyeti ve Davranışı Anketi'' ve "Demografik Bilgi Anketi" aracılığıyla toplanmıştır.

Demografik Bilgi Anketi

Bu bölümde, öğretmenlerin fen öğretme davranışlarını etkileyebileceği düşünülen çeşitli değişkenler bulunmaktadır. Bu değişkenleri; cinsiyet, hizmet içi eğitimler, mesleki deneyim, fen ile ilgili bilgi, fen bilimlerine karşı ilgi, üniversitede fen bilimleri ile ilgili alınan ders sayısı oluşturmaktadır.

Okul Öncesi Öğretmenlerinin Fen öğretme Niyeti ve Davranışı Anketi

Okul Öncesi Öğretmenlerinin Fen Öğretme Niyeti ve Davranışı Anketi Ajzen ve Fishbein (1980) ve Ajzen (2002, 2006)'nin önerileri doğrultusunda, görüşme sonuçları da dikkate alınarak hazırlanmıştır. Hazırlanan sorular, ilköğretim fen bilimleri ve okul öncesi öğretmenliği bölümünde görev yapmakta olan 3 öğretim üyesi tarafından değerlendirilmiştir. Anket, Ajzen (2002)'nin önerileri doğrultusunda 7'li Likert tipte maddelerden oluşmaktadır. Fakat modele sonradan eklenen iki ölçeğin (öz yeterlik algısı ve epistemolojik inançlar) özgün hali korunmuş olup 5'li Likert tiptedir. Ankette, hem doğrudan (tutum, öznel normlar, algılanan davranış kontrolü ve fen kavram bilgisi) hem de dolaylı (davranış inançları, normatif inançları, kontrol inançları ve epistemolojik inançları) değişkenler ölçülmüştür. Aşağıdaki bölümde anketlerin oluşturulması açıklanmaktadır.

Dolaylı ölçüm maddelerinin oluşturulması

Ajzen (1985)' e göre planlanmış davranış teorisinin inançlar bölümü görüşmeler yapılarak oluşturulmalıdır. Bu doğrultuda, Ankara ili devlet okullarında görev yapan

8 okul öncesi öğretmenlerinin fen öğretimine yönelik görüşleri yarı-yapılandırılmış görüşmelere aracılığıyla alınmıştır. Görüşmeler sonucunda öğretmenlerin fen öğretimine yönelik genel inançları ortaya çıkmıştır ve anketin inançlar kısmı bu doğrultuda hazırlanmıştır. Buna göre, inançlar kısmının boyutlar ve madde sayıları şu şekilde oluşturulmuştur: Davranışın olası sonuçları (16 madde), sonuçların değerlendirilmesi (16 madde), algılanan beklentiler (5 madde), beklentilerin önemi (5 madde), algılanan koşullar/durumlar (8 madde) ve kolaylaştıran koşullar/durumlar (8 madde) olarak oluşturulmuştur. Ajzen (1991)'in önerileri doğrultusunda her bir inanç yapısı (davranış inançları, normatif inançlar ve kontrol inançları) kendisi ile bağlantılı olan iki faktörün çarpımlarından elde edilmiştir.

Tablo 3. Görüşme Soruları ve Öğretmenlerden Gelen Cevaplar

Görüşme soruları	Öğretmenlerden gelen cevaplar
Öğretmenlik hizmetiniz sırasında fen öğretimine yer vermeni kolaylaştıracak ya da yardımcı olacak faktörler / şartlar neler olabilir?	Ders planı, müfredat Kurum (MEB, okul) Gerekli materyaller/malzemeler İstekli olmak Bilgili olmak Fiziksel koşullar Bilinçli olmak Aldığımız eğitimler Çocukların öğrenmeye istekli olması Öğretmenin öğretmeye istekli olması Fen doğa ve matematik köşesinin olması Geniş alanın olması
Öğretmenlik hizmetiniz sırasında fen öğretimine yer vermenizin herhangi bir sakıncası olacağını düşünüyor musun? Sizin açınızdan/ Öğrenciler açısından? Dezavantaj vs. örneklerle açıklar mısınız?	Fen zor olduğu için çocuklar anlayamaz. Deney hazırlamak çok vakit alır. Fen aktiviteleri çok vakit alır. Deney yaparken sorun çıkabilir. Çocukların kafası karışabilir. Tehlikeli olabilir. Maddi açıdan zor olur.

Öğretmenlik hizmetiniz sırasında fen öğretimine yer vermenizin çocuklara ne tür katkısı olur? Avantajları vs.	Etkinlikler arası geçiş sağlar. Farklı aktivitelere yön verir Psikomotor becerileri gelişir. Okuma-yazma etkinlikleri olarak kullanılır. Duyuşsal becerileri gelişir. Günlük hayatı daha iyi anlarlar. Gelecek yıllarda göreceği fen derslerinin temelini oluşturulur. Araştırma yapmayı, neden sorusuna cevap bulmaya çalışarak düşünmeyi sağlar. Merak duygusunu geliştirir. İlköğretime hazırlar. Zaman eğlenceli geçer. Çocuklarda çevre bilinci gelişir. Çocuklar doğayı keşfeder. Çevresindekileri analiz eder ve değerlendirir. Yaşadığı dünyaya anlam verir. Problem çözmeyi öğrenir. Kendine ve çevresindeki varlıklara farklı gözle bakabilmeyi öğrenir. Çevre sevgi kazanır. Kendisini ve çevresini tanımasına olanak sağlar. Zihinsel gelişimi destekler. Çocuklar okula başladıklarında bazı kavramları tanıyor olurlar. Merak ettikleri konular hakkında aydınlanırlar. Günlük hayatta kullanabilecekleri şeyleri öğrenirler.
Öğretmenlik hizmetiniz sırasında fen öğretimine yer vermenizi onaylayan/isteyen/bekleyen kişiler var mıdır? Varsa bu kimlerdir?	Çocuklar Müfettiş Veliler Müdür Okul öncesi eğitim ile ilişkili kişiler (öğretim üyeleri vs.)
Öğretmenlik hizmetiniz sırasında fen öğretimine yer vermeni zorlaştıracak	Bilgi eksikliği Materyal eksikliği Etkinlik yapacak alan olmaması

ya da engelleyecek faktörler/şartlar neler olabilir?	Elverişsiz fiziksel koşullar Zaman kısıtlaması Plan kısıtlaması İdarenin kısıtlaması (etrafı kirleten ya da materyal gerektiren uygulamalarda) Öğretmenin isteksiz olması Mesleki yılgınlık Hava şartları, Öğretmenin psikolojisi Çocukların seviyesi Fen, doğa ve matematik köşesinin olmayışı Maddi imkânsızlıklar Teknik yetersizlik ve alta yapı yetersizliği Okul öncesi müfredatı/programının yetersiz olması
Öğretmenlik hizmetiniz sırasında fen öğretimine yer vermenizi engelleyebilecek/karşı çıkabilecek kişiler var mıdır? Varsa bu kimlerdir?	Müdür Veliler
Öğretmenlik hizmetiniz sırasında fen öğretimine yer vermenizi onaylayan/isteyen/bekleyen kurumlar var mıdır? Varsa bu kurumlar hangileridir?	MEB

Bu değişkenlere ek olarak, epistemolojik inançlar da dolaylı ölçüm araçlarından birisidir. Epistemolojik inançların, davranış niyeti üzerindeki etkisi fen kavram bilgisine etkisi üzerinden araştırılmıştır. Çalışmada kullanılan "Bilimsel Epistemolojik İnanç Ölçeği'', Conley, Pintrich, Vekiri ve Harrison (2004) tarafından geliştirilmiş, Özkan(2008) tarafından Türkçe'ye adapte edilmiştir. 5' li Likert tipi ölçek olup 26 maddeden oluşmaktadır. Bilginin kaynağı ve kesinliği, bilginin gelişen doğası ve bilginin doğrulanması olmak üzere 3 alt boyuttan oluşmaktadır.

Doğrudan ölçüm maddelerinin oluşturulması

Bu çalışmada planlanmış davranış teorisinin doğrudan ölçüm yapılarına (davranışa yönelik tutum, öznel norm, algılanan davranış kontrolü, davranış niyeti) ek olarak kişisel normlar, öz-yeterlik inançları ve fen kavram bilgisi yapıları eklenmiştir. Bu ölçülen yapılardaki madde sayıları ve bu maddeleri oluştururken kullanılan kaynaklar Tablo 4'de verilmiştir.

Verilerin toplamada, veri analizinde ve sonuçların değerlendirilmesinde Ajzen (2002) tarafından geliştirilen planlanmış davranış teorisi kullanılacaktır. PDT yapılarına ek olarak, öğretmenlerin kişisel normları, öz yeterlik inançları, fen kavram bilgileri ve bilimsel epistemolojik inançları gibi faktörlerin önerilen modele nasıl katkı sağladıkları açıklanmaya çalışılacaktır. Çalışmaya katılan öğretmenlerin fen öğretimi davranışlarını ve niyetlerini etkileyen faktörler arasındaki ilişki Yapısal Eşitlik Modeli (YEM) kullanılarak açıklanacaktır.

Pilot çalışma

Pilot çalışmaya Orta Anadolu illerinde (Kayseri, Kırıkkale, Kırşehir, Yozgat ve Sivas) görev yapmakta olan 110 okul öncesi öğretmeni katılmıştır. Verilerin geçerlik ve güvenirlikleri hesaplandıktan sonra anketlere son şekli verilmiş ve asıl çalışma için hazır hale getirilmiştir. Pilot analiz sonrasında epistemolojik inançlar ölçeğinden 4 madde çıkarılmış ve geriye 22 madde kalmıştır. Davranış inançları ölçeğinden yalnızca 1 madde çıkartılmış ve geriye 16 madde kalmıştır. Ayrıca fen kavram bilgisi testinden, madde analizine göre ayırt ediciliği ve zorluk derecesi uygun olmayan 6 soru çıkarılmış ve 14 soru asıl çalışmada kullanılmıştır.

Pilot çalışmadan sonra veriler, 2013-2014 eğitim öğretim yılı bahar dönemi ve 2014-2015 eğitim öğretim yılı güz döneminde toplanmıştır. Çalışmadaki veri toplama araçlarının uygulanması, öğretmenlerin yaklaşık 30-40 dakikasını almıştır.

Tablo 4.

Ölçülen Yapılar, Kullanılan Kaynaklar ve Madde Sayıları

Ölçülen yapılar	Sorular hazırlanırken kullanılan kaynaklar	Madde sayısı
Davranışa yönelik tutum	Ajzen, 2006; Conner, Norman, ve Bell, 2002; Mummery ve Wankel, 1999.	9 madde
Öznel norm	Fishbein ve Ajzen, 2010; Ajzen, 2006; Davis ve ark., 2002	4 madde
Algılanan davranış kontrolü	Ajzen, 2006; Davis ve diğ., 2002	1 madde
Davranış niyeti	Ajzen (2006)	3 madde
Davranış	Ajzen (2006)	
Kişisel normlar	Vining ve Ebreo, 1992; Harland, Staats, ve Wilke, 1999	10 madde
Öz-yeterlik inancı	Enochs ve Riggs, 1990; Riggs ve Enochs, 1990	11 madde
Fen Bilimleri Testi	MNE (2013), MNE Science and Technology textbooks	20 çoktan seçmeli soru

Araştırmanın sonuçları

Bu çalışmada çocukların okul ortamında bir plan çerçevesinde ilk kez fen öğrenme deneyimlerinde anahtar role sahip olan okul öncesi öğretmenlerinin, fen öğretme niyetlerini ve davranışlarını etkileyen faktörler planlanmış davranış teorisi kapsamında incelenmiştir. Araştırma soruları doğrultusunda, çalışma sonuçları üç kısımda rapor edilmiştir: Betimleyici istatistikler, ölçüm modeli sonuçları ve yapısal model analiz sonuçları.

Betimsel istatistikler

Bu çalışmanın birinci araştırma sorusu "Okul öncesi öğretmelerinin fen öğretme davranışına yönelik olan tutumları, öznel normları, algılanan davranış kontrolü, kişisel normları, öz yeterlik inançları ve fen kavram bilgileri, fen öğretme niyetleri ve fen öğretme davranışları nelerdir?" olarak belirlenmiştir. Betimsel istatistik verileri ile bu araştırma sorusu cevaplandırılmıştır. Araştırma modelinde kullanılan tüm ölçüm yapılarının ortalama, standart sapma, gerçek ve olası değer aralığı bulguları Tablo 5'de verilmiştir.

Tablo 5' de görüldüğü üzere, en yüksek ortalama değerine okul öncesi öğretmenlerinin fen öğretimi için gerekli koşulların kolaylaştırıcı ya da zorlaştırıcı etkisine dair inançları sahiptir (*Ort*= 6.48, *Ss* =.90). Bu yapıyı ise fen öğretme davranışının olası sonuçları (*Ort* = 6.37, *Ss* = 1.02) ve sonuçların değerlendirilmesi (*Ort* = 6.41, *Ss* = .91) takip etmiştir. En düşük ortalama değer ise epistemolojik inançların bilginin kaynağı ve bilginin kesinliği boyutunda görülmüştür (*Ort* = 2.97, *Ss* = 1.24). Bu verilerden öğretmenlerin fen öğretmek için gerekli olan koşulların sağlanmasının, onlar için en önemli faktörlerden biri olduğu anlaşılabilir. Ayrıca öğretmenler fen öğretimine yer verirler ise çocukların kazanımlarına ve bu kazanımların olası sonuçlarına oldukça önem vermektedirler. Yani öğretmenler fen öğretimine karşı oldukça olumlu tutuma sahiptir. Diğer taraftan, katılımcı öğretmenler fen öğretimine yönelik kişisel beklenti ve değerlerine önem verdikleri ölçüde başkalarının fen öğretimine dair onlardan beklentilerine de önem vermektedirler. Epistemolojik inançlar açısından bakıldığında ise, *bilginin kaynağı ve bilginin kesinliği* boyutunun aksine *bilginin doğrulanması* ve *bilginin gelişen doğası* boyutlarında öğretmenlerin daha sofistike inançlara sahip oldukları görülmüştür. Öğretmenlerin fen kavram bilgilerinin ise ortalama seviyede olduğu görülmüştür.

Tablo 5.

Betimsel İstatistik Bulguları

Ölçülen yapılar	Ortalama	Standart Sapma	Gerçek değer aralığı	Olası değer aralığı
Davranışa karşı tutum	6.03	1.15	1-7	1-7
Öznel normlar	5.45	1.47	1-7	1-7
Algılanan davranış kontrolü	6.20	1.31	1-7	1-7
Kişisel normlar	6.06	0.95	1-7	1-7
Fen öğretme niyeti	6.18	1.09	1-7	1-7
Fen öğretme davranışı	4.91	1.13	1-7	1-7
Davranışın olası sonuçları	6.37	1.02	1-7	1-7
Sonuçların değerlendirilmesi	6.41	0.91	1-7	1-7
Algılanan beklentiler	5.58	1.57	1-7	1-7
Algılanan beklentilerin önemi (motivasyon)	5.65	1.64	1-7	1-7
Algılanan koşullar	5.88	1.24	1-7	1-7
Koşulların kolaylaştırıcı /zorlaştırıcı etkisi	6.48	0.90	1-7	1-7
Öz yeterlik inancı	3.40	0.68	1-5	1-5
Epistemolojik inançlar	3.68	1.05	1-5	1-5
Bilginin kaynağı ve bilginin kesinliği	2.97	1.24	1-5	1-5
Bilginin gelişen doğası	4.12	.95	1-5	1-5
Bilginin doğrulanması	4.19	.90	1-5	1-5
Fen kavram bilgisi	7.82	2.41	1-12	0-14

Model analizleri

Bu çalışmada ölçüm ve yapısal model analizleri Yapısal Eşitlik Modeli kullanılarak yapılmıştır. Çalışma verilerinin normal olmayan dağılıma sahip olması ve araştırma modelinin çok değişkenden oluşan karmaşık bir yapıya sahip olması gerekçeleriyle bu çalışmada *kısmi en küçük kareler yapısal eşitlik modellemesi* (bk. Hair ve ark. 2012; Hair, Sarstedt, Ringle, ve Mena, 2012; Lee, Petter, Fayard, ve Robinson, 2011; Ringle, Sarstedt, ve Straub, 2012; Sosik, Kahai, ve Piovoso, 2009) ve bilgisayar yazılımı olarak da SmartPLS 3 (Ringle, Wende, ve Will, 2005) kullanılmıştır.

Ölçüm modeli (dış model) sonuçları

Doğrulayıcı faktör analizi aracılığıyla ölçüm modelinin güvenirlik ve geçerlilik araştırması bu aşamada yapılmıştır. Bu kapsamda bileşik güvenirlik (CR) ve açıklanan ortalama varyans (AVE) değerleri kullanılmıştır. Madde yükleri ve bileşik güvenirlik değerleri göz önüne alınarak bazı maddeler (EB11, EB12, SE1, SE7, SE8, SE9, SE10, ve SE11) modelden çıkartılmıştır. Bu maddeler çıkartıldıktan sonra yenilenen doğrulayıcı faktör analizi sonuçlarına göre, modelin güvenirlik ve geçerlilik değerleri en az beklenen değerlerden daha yüksektir.

Tablo 6

Araştırma Modeli Güvenirlik ve Geçerlik Değerleri

	Bileşik güvenirlik (CR)	Açıklanan ortalama varyans (AVE)
Davranışa karşı tutum	.972	.810
Öznel normlar	.949	.822
Algılanan davranış kontrolü	1.000	1.000
Kişisel normlar	.923	.602
Öz yeterlik inancı	.904	.654
Fen kavram bilgisi	1.000	1.000
Fen öğretme niyeti	.967	.906
Fen öğretme davranışı	1.000	1.000
Davranış inançları	.976	.720
Normatif inançlar	.913	.725
Kontrol inançları	.920	.699
Bilginin doğrulanması	.841	.516
Bilginin kaynağı ve bilginin kesinliği	.899	.559
Bilginin gelişen doğası	.807	.585

Kısacası, tüm ölçüm yapılarının kabul edilebilir geçerlilik ve güvenirlik değerlerine sahip olduğu görülmüştür. Bileşik güvenirlik değerinin .70'den büyük olması (Hair ve diğ., 1998) beklenirken, açıklanan ortalama varyans değerinin .50'den yüksek olması beklenmektedir (Chin ve Newsted, 1999).

Yapısal model (iç model) analiz sonuçları

Yapısal yani iç modelin kalitesini test etmek için bazı parametreler kullanılmıştır. Bunlar, açıklanan varyans (R^2), etki büyüklüğü (f^2), *bootstrapping* ve *blindfolding* teknikleridir. Bootstrapping tekniği ile regresyon katsayılarının anlamlı olup olmadıkları (t ve p değerleri), blindfolding tekniği ile de *kestirimsel uygunluk* (cross validated redundancy, Q^2), kestirimsel kommünaliti (cross validated communality, H^2), ve uyum derecesi (goodness of fit, GoF) hesaplanmıştır (bk. Tablo 7).

Açıklanan varyans değerleri (R^2) incelendiğinde en yüksek değere fen öğretme niyetinin sahip olduğu görüldü (R^2 = . 41.2). Yani, davranışa karşı tutum, öznel ve kişisel normlar, algılanan davranış kontrolü ve öz yeterlik inancı hep birlikte % 41.2 oranında fen öğretme niyetini açıklamıştır. Daha sonra sırasıyla, dolaylı ölçüm yapılarından normatif inançlar, öznel norm yapısının % 37.3 'ünü ve diğer bir dolaylı ölçüm yapısı olan davranış inançları da davranışa karşı tutumun % 25.3' ünü açıklamıştır. Fen öğretme davranışı ise % 13.5 oranında açıklanan varyansa sahiptir.

Bootstrapping tekniği ile ölçüm yapıları arasındaki regresyon katsayılarının anlamlı olup olmadığı incelenmiştir. Kritik değer olarak % 99 güven aralığında (α =.01), *t değerinin* 2.58' in üzerinde olması beklenmiştir. Modeldeki 14 regresyon katsayısından sadece 3'ünün anlamlı olmadığı bulunmuştur. Bunlar *bilginin gelişen doğası ve fen kavram bilgisi, fen kavram bilgisi ve fen öğretme niyeti ve algılanan davranış kontrolu ve fen öğretme davranışı* arasındaki ilişkilerdir.

Blindfolding tekniği ile de *kestirimsel uygunluk* (Q^2), kestirimsel kommünaliti (H^2) değerleri hesaplanmıştır (Chin, 1998; Lohmöller, 1989; Geisser, 1975). Q^2 testi gizil değişkenlerin modele tahmini uygunlukları araştırılmıştır. Q^2 değerinin pozitif ve 0'dan büyük olması modelin tahmini uygunluğa sahip olduğunun bir göstergesidir. Yapısal modeldeki gizil değişkenlerin tahmini uygunlukları ve büyüklükleri Tablo 7'de görülmektedir. Algılanan davranış kontrolü ve fen kavram bilgisi yapılarının tahmini uygunluk seviyeleri çok düşüktür.

Tablo 7.

Yapısal modelin R^2, H^2 ve Q^2 değerleri

Ölçüm yapıları	R^2	H^2	Q^2
Davranışa karşı tutum	0.253	0.734	0.203
Davranış inançları		0.687	
Kontrol inançları		0.536	
Bilginin gelişen doğası		0.184	
Fen öğretme niyeti	0.412	0.762	0.369
Bilginin doğrulanması		0.257	
Normatif inançlar		0.529	
Algılanan davranış kontrolü	0.049	1.000	0.047
Kişisel normlar		0.482	
Fen öğretme davranışı	0.132	1.000	0.124
Fen kavram bilgisi	0.037	1.000	0.027
Öz yeterlik inancı		0.469	
Bilginin kaynağı ve bilginin kesinliği		0.396	
Öznel normlar	0.372	0.693	0.304
Ortalama	0.208	0.521	0.179
GoF	**0.329**		

Bu çalışmada modelin uyum derecesi Tenenhaus ve diğ. (2004)' nin öneri doğrultusunda hesaplanmıştır. Yapısal modelin % 33 oranında uyum derecesine sahip olduğu görülmüştür. Bu seviyenin düşük olma sebebi de modelde anlamlı olmayan ilişkilerin varlığı olarak görülmektedir.

Yapısal modele bağlı hipotezlerin açıklanması

Bu araştırmanın ikinci sorusu "Okul öncesi öğretmenlerinin davranış inançları, normatif inançları, kontrol inançları ve epistemolojik inançları sırasıyla davranışa yönelik tutum, öznel normlar, algılanan davranış kontrolü ve fen kavram bilgileri ile nasıl ilişkilidir?" olarak belirlenmiştir. Yapısal model analizi; davranış inançları, normatif inançlar ve kontrol inançları ile sırasıyla tutum, öznel normlar ve algılanan davranış kontrolü arasında güçlü bir ilişki olduğunu göstermiştir. Okul öncesi öğretmenlerinin fen öğretim açısından davranış inançları fen öğretimine karşı tutumunu önemli bir şekilde belirlediği tespit edilmiştir (β = .503, t =12.472, p = .000). Ayrıca, PLS yapısal modeli; öğretmenlerin fen öğretimine karşı davranış inançlarının, fen öğretimine karşı tutumlarının % 25.3'ünü açıklamıştır. Normatif inançlar ve öznel norm yapıları arasında ilişki modeldeki en yüksek regresyon katsayısını (β = 0.611) ve buna bağlı olarak en yüksek anlamlı değeri göstermiştir (t = 26.200, p =.000). Bunun yanında, normatif inançlar öznel norm yapısının veryansının %37'sini açıklamıştır. Böylece, planlanmış davranış modelinin de önerdiği üzere, normatif inançların öznel normları açıklayan temel neden olduğu desteklendi. Kontrol inançları ve algılanan davranış kontrolü arasında ilişki diğer doğrudan ve dolaylı ölçümlere göre (davranış inançları-davranışa karşı tutum ve normatif inançlar-öznel normlar) daha düşük olmasına rağmen (β = .224) yine de anlamlı bulunmuştur (t = 6.117, p =.000). Ayrıca, kontrol inançları sadece % 5 oranında algılanan davranış kontrolü varyansını açıklamıştır.

Son olarak, bilimsel epistemolojik inançların iki boyutu (bilginin kaynağı - bilginin kesinliği ve bilginin doğrulanması) öğretmenlerin fen kavram testinden aldıkları puanları açıklamaya katkı sağlarken, *bilginin gelişen doğası* boyutu modele her herhangi bir katkı sağlamamıştır.

Bu çalışmanın üçüncü araştırma sorusu "Okul öncesi öğretmenlerinin fen öğretimine yönelik tutumları, öznel normları, algılanan davranış kontrolü, kişisel normları, öz yeterlik inançları ve fen kavram bilgileri fen öğretme niyetleri ile nasıl ilişkilidir?" olarak belirlenmiştir. Yapısal model analizine göre davranış niyetinin varyansını büyük bir kısmını açıklamada davranışa karşı tutumun en büyük katkıyı sağladığı ortaya çıkmıştır (β = .431). Bu bulgu, okul öncesi öğretmenlerinin fen öğretimine pozitif bir yaklaşım sergiledikçe, yani; fen öğretiminin gerekli, önemli ya da eğlenceli olduğuna inandıkça ders planlarında fen aktivitelerine daha fazla yer vereceklerini ya da fen aktivitelerini daha fazla öğretme eğilimi içinde olacaklarını göstermiştir. Bu nedenle, Ajzen (2001)'in önerisine paralel olarak, planlı davranış teorisinin yapıları düşünüldüğünde fen öğretimine yönelik yaklaşımların, okul öncesi öğretmenlerin niyetlerinin orta düzey etki büyüklüğü ile ($f^2 = 0.28$) açıklayan en etkili yapısı olduğu sonucuna varılabilir. Öznel normlar ile davranış niyeti arasındaki ilişki ($\beta = 0.142$) de anlamlı olarak bulunmuştur ($t = 4.163$, $p = .000$). Bu demek oluyor ki, çalışmaya katılan öğretmenler, diğer kişi ve kurumların kendilerinden fen öğretimini beklediklerini düşündükleri oranda, fen aktivitelerini planlamakta ve yapmak istemektedirler. Diğer taraftan, algılanan davranış kontrolü ile fen öğretme niyeti arasındaki ilişki çok düşük olsa da ($\beta = .096$), hala okul öncesi öğretmenlerinin fen öğretimi niyetlerinin anlamlı bir belirleyicisidir ($t = 2.819$, $p = .005$).

Özgün planlanmış davranış teorisi modeline sonradan eklenen kişisel normlar ölçüm yapısı da öğretmenlerin fen öğretimi niyetlerinin güçlü bir belirleyicisi olarak bulunmuştur ($t = 4.862$, $p = .000$). Bu sonuca göre, okul öncesi öğretmenleri, öğretim tercihlerinin çocukları etkileyebileceğini düşünür ya da fen öğretiminin kendi sorumluluğunda olduğuna inanır ya da kendini fen öğrettiğinde daha iyi hisseder ise fen öğretimine daha fazla zaman ayırmak isteyebilir ve planlarında fen aktivitelerine daha çok yer verebilirler. Ayrıca, kişisel normlar gibi, PDT modeline sonradan eklenen öz-yeterlik inançlarının da okul öncesi öğretmenlerinin fen öğretim niyetlerini tahmin etmede önemli bir role sahip olduğu görülmüştür ($t = 3.747$, $p = .000$). Buna göre, fen öğretmek için kendisini rahat ve yeterli hisseden okul öncesi öğretmenlerinin ders planlarında fen aktivitelerine daha çok yer verdikleri anlaşılabilir. Diğer taraftan doğrudan ölçüm aracı olarak PDT modeline sonradan eklenen fen kavram bilgisinin öğretmenlerin fen öğretme niyetleri üzerinde beklendiği etkiyi göstermediği görülmüştür (β = .003, t = .100, p =.921). Bu sonuca göre öğretmenlerin, fen kavram testinde daha çok ya da daha az soruyu doğru şekilde cevaplamalarının onların fen öğretme niyetlerine herhangi bir etkisi olmadığı söylenebilir.

Özetle, çalışmaya katılan okul öncesi öğretmenlerinin fen öğretme niyetleri; fen öğretimine karşı tutum, öznel ve kişisel normlar, algılanan davranış kontrolü ve öz yeterlik inançları ile açıklanmıştır. Bu değişkenler hep birlikte öğretmenlerin fen öğretme niyetlerinin % 42 oranında varyansını açıklamışlardır. Ayrıca modele sonradan eklenen kişisel normlar ve öz-yeterlik inançları önemli ölçüde modele katkı sağlamışlardır.

Bu araştırmanın dördüncü ve son araştırma sorusu ise "Okul öncesi öğretmenlerinin fen öğretme niyetleri, algılanan davranış kontrolü ve öz yeterlik inançları, fen öğretme davranışları ile nasıl ilişkilidir?" olarak belirlenmiştir. Bu çalışmada, okul öncesi öğretmenlerinin fen öğretim davranışlarını doğrudan etkilediği düşünülen üç yapı incelenmiştir: öğretmenlerin fen öğretim niyetleri, fen öğretimine karşı algılanan kontrolleri ve fen öğretimine dair öz yeterlik inanışları. Planlı Davranış Teorisi ile uyumlu olarak, okul öncesi öğretmenlerinin fen öğretim niyetlerinin, fen öğretim sıklıklarının (davranışının) en önemli ve doğrudan belirleyicisi olduğu tespit edilmiştir (t=8.936, p =.000). Bu nedenle, okul öncesi öğretmenlerinin fen öğretim niyetleri, sınıfta yapılan fen aktivitelerinin sıklığını anlamak için önemli bir belirleyicidir. Öğretmenler fen aktivitelerine yer vermek için ne kadar istekli ve niyetli iseler, o sıklıkta fen aktivitelerini gerçekleştireceklerdir. Fen aktivitelerinin sıklığını açıklayan diğer önemli bir etken de öğretmenlerin fen öğretimine yönelik öz yeterlik inanışlarıdır (t = 6.492, p=.000). Üstelik öz yeterlik inançları ve fen öğretimi davranışı arasındaki ilişki derecesi ile fen öğretme niyeti ve fen öğretme davranış arasındaki ilişki birbirine çok yakın olarak bulunmuştur (β = .241, β=.247; sırasıyla). Diğer taraftan, okul öncesi öğretmenlerinin fen öğretimine karşı algılanan davranış kontrolleri, öğretmenlerin fen öğretimi davranışında anlamlı bir belirleyici olarak bulunmamıştır (t= 1.541, p=.123). Planlanmış davranış teorisinin öne sürdüğünün aksine, çalışmaya katılan öğretmenlerin fen öğretim davranışları, onların fen öğretimini yürütmede kontrolün kendilerine bağlı olup olmamasına bağlı değildir. Bu durumda, okul öncesi öğretmenlerinin fen öğretimi davranışları üzerinde güçlü bir kontrole sahip oldukları sonucuna ulaşılabilir ve bu nedenle algılanan davranış kontrolü onların davranışları üzerine herhangi bir etki yapmadığı düşünülebilir. Bu sonuç, katılımcı öğretmenlerin çoğunlukla öğretim hizmetleri süresince fen öğretiminin kendi kontrolleri altında olduğunu desteklemektedir (M = 6.20, SD = 1.31). Bu sonucun diğer bir ihtimali ise, yapısal eşitlik modelinin tek maddeyi ele almada başarılı olduğu düşünülse de (bk. (Afthanorhan, 2014), algılanan davranış kontrolü için kullanılan tek madde ölçümünün yetersizliğinden kaynaklanabilir. Özetle, öğretmenlerin fen öğretim davranışını doğrudan ölçen üç değişkenden sadece ikisi (öz yeterlik inançları ve fen öğretme niyeti) anlamlı bulunmuş olup, davranışın %13.5 oranında varyansını açıklamıştır.

Sınırlılıklar ve öneriler

Bu çalışma yöntem ve sonuçlar açısından öğretmen eğitimi literatürüne önemli katkılar sağlamasına rağmen halen bazı sınırlılıklara sahiptir. Öncelikle, bu çalışmada kullanılan bütün veriler katılımcı öğretmenlerin öz değerlendirmelerinden (self-report) oluşmaktadır. Bazen öz değerlendirme verileri tepki yanlılığından dolayı (response bias) araştırmacıyı yanıltabilir. Bu sebeple, gelecekte yapılacak çalışmalar, öğretmen davranışlarına ait veriler sınıf gözlemleri ya da video kayıtlar ile, öğretmen niyetlerine dair veriler de ders planları incelenerek toplanabilir. Ayrıca bu çalışmada demografik veriler araştırma modeline dahil edilmemiştir. İleriki zamanlarda yapılacak çalışmalar bu tür verileri (cinsiyet, yaş, deneyim vb.) moderator değişken olarak modele etkisini inceleyebilir.

Araştırma sonuçlarına göre, okul öncesi öğretmenlerinin fen öğretimine yer verme niyetlerini en çok etkileyen faktör, öğretmenlerin fen öğretimine karşı tutumlarıdır.

Bu sonuç göz önüne alındığında, okul öncesi öğretmenlerinin fen öğretimine karşı olumlu tutumlar içinde olması önem kazanmaktadır. Bu sebeple, halen görev yapmakta olan öğretmenler için fen etkinliklerini sevmelerini sağlayacak hizmet içi eğitimler düzenlenmelidir. Bu eğitimlerin içerisinde öğretmenlerin kendilerinin katıldığı kolay, temel ve eğlenceli fen aktivitelerine yer verilerek öğretmenlerin fen eğitimine karşı olumlu tutum kazanmalarına yardımcı olunabilir. Ayrıca, öğretmenlerin okul dışı öğrenme ortamlarında fen etkinliklerine katılmalarına olanak sağlanmalıdır. Çünkü bu tür ortamlar fen eğitimine karşı olumlu tutum geliştirmektedir (NSF, 1998). Okul dışı öğrenme ortamlarına örnek olarak bilim tarihi müzeleri, fen ve teknoloji merkezleri, akvaryumlar, ormanlar, doğal yaşam ortamları, hayvanat bahçeleri, bahçeler ve kütüphaneler verilebilir. Öğretmenler bu tür ortamlara aşina olarak oralarda ne tür aktiviteler yürütebileceklerini öğrenebilirler.

Öğretmenlerin fen eğitimine yer verme niyetlerini etkileyen diğer önemli faktörler kişisel ve öznel normlar, öz-yeterlik inançları ve algılanan davranış kontrolleridir. Bu doğrultuda öğretmenlerin normatif algılarının, fen öğretmeye yönelik özgüvenlerinin ve kontrol inançlarının önemli olduğu söylenebilir. Bu sebeple, öğretmenler için hazırlanacak hizmet içi programlarında olumlu tutum geliştirmenin yanında öz-yeterlik inançlarının gelişmesine katkı sağlayacak ortamlar oluşturulmalıdır. Ayrıca okul programlarında, seminerlerde ve öğretmen çalıştaylarında, öğretmenlerde okul öncesi dönemde fen öğretimine yer vermeleri beklendiği sıklıkla vurgulanmalı ve onların fen öğretimine yer vermelerini kolaylaştıracak faktörlerin sayısı arttırılmalıdır. Örneğin, öğretmenlerin sıklıkla şikâyetçi oldukları materyal, kaynak ve zaman eksikliği problemlerini nasıl çözebilecekleri uygulamalı olarak anlatılmalıdır. Aslında etkili bir fen öğretimi için günlük hayatta sıklıkla kullanılan araç-gereçlerin, okul bahçesinin, mutfak malzemelerinin yeterli olabileceği örnek etkinliklerle anlatılmalıdır. Öğretmen adaylarının da, öğretmenlik mesleğine geçmeden önce bu tür eğitimleri tamamlamaları için gerekli çalışmalar lisans eğitimlerinde yapılabilir.

APPENDIX L

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü

Sosyal Bilimler Enstitüsü

Uygulamalı Matematik Enstitüsü

Enformatik Enstitüsü

Deniz Bilimleri Enstitüsü

YAZARIN

Soyadı : ÖZCAN
Adı : Gökcen
Bölümü : İlköğretim

TEZİN ADI (İngilizce) : Early Chıldhood Teachers' Science Teaching Intentions And Behaviours: An Applıcation of The Theory of Planned Behaviour

TEZİN TÜRÜ : Yüksek Lisans Doktora

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir.
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir.
3. Tezimden bir bir (1) yıl süreyle fotokopi alınamaz.

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: