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SELF-EFFICACY WITH REGARD TO THE TEACHING OF SCIENCE OF EARLY CHILDHOOD EDUCATION TEACHERS IN KOREA

A Thesis in

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ABSTRACT

The purpose of this study is to examine early childhood teachers' self-efficacy in science teaching and the related factors that may contribute to this belief. Specifically, the present study relies on a quantitative approach to investigate the predictor variables as having both direct and indirect positive effects on the science teaching self-efficacy beliefs of early childhood teachers.

The participants of this study are drawn from 263 early childhood teachers who have taught in private and public kindergartens, and private, public, and cooperative daycare centers in Korea. Three instruments were used for data collection: (1) Science Teaching Efficacy Belief Instrument modified for this study, (2) Scale of Emotional and Material Support from teachers' institutions modified for this study, and (3) Demographic Questionnaire. Analysis of data is by basic statistics, factor analysis, reliability test and Pearson's correlation using SPSS 14.0. In addition, path analysis is applied to estimate direct and indirect effects using Amos 6.0.

There are several derived conclusions from the findings of this study. These conclusions follow: First, teachers' internal factors, teachers' characteristics, preferences in teaching, teaching attitude toward early childhood science education, self-evaluation in science teaching, are key predictor in this study to impact positively teachers' self-efficacy in science teaching, because teachers' internal factors could be act on teachers' self-efficacy encouragement as a direct predictor as well as could be expected its mediated effects supported by other potential variables. Second, teachers' educational experiences are a significant predictor has a direct positive effect on science teaching

self-efficacy. Additionally, theses experiences do have an indirect positive effect on self-efficacy in teaching science when mediated by teachers' internal factors. Third, support from administrators and colleagues, and teaching resources are also important reinforcements for good practices and acknowledge, explicitly effective for instruction of science to teachers. Fourth, satisfaction with teachers' work place stimulates teachers' internal factors which influence teachers' self-efficacy in science teaching. In addition, teachers' satisfaction has a correlation with their institutional support. Therefore, teachers' satisfaction with work places is also an important predictor which has the probability of impacting teachers' self-efficacy inspiration.

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CHAPTER 1

INTRODUCTION

Learning experiences during a child's early years have lifelong consequences; therefore, providing a high-quality teaching for young children is particularly important. The quality of early childhood teachers is important rather than the philosophy or teaching strategies of the education program (Kim & Kim, 2004; Simons & Simons, 1986; Mietzitis, 1971). Thus, early childhood teachers are keys to the success of high-quality teaching, and their professionalism is critical for developing children's learning attitudes and achievement (Hsu, 2002).

Self-efficacy of teachers is how teachers feel, think, behave, and self-motivate (Bandura, 2000, 1997; Pajares, 1996). Self- efficacy is the basis of an array of studies which investigate factors that impact teachers' beliefs and their sense of confidence as it relates to their ability to be successful teachers (Tschman-Moran, Hoy, & Hoy, 1998; Wingfield & Ramsey, 1999). The strength of teachers' self-efficacy helps determine how much effort they will expend on an activity, how long they will persevere when confronted with obstacles, and how resilient they will be when faced with adversity (Bandura, 1997; Pajares, 1996).

When teachers have low self-efficacy, their teaching tends to be characterized by authoritative, teacher-centered roles with a less clear understanding of the various developmental levels of their students (Finson, Riggs & Jesunathadas, 1999). Rubeck and Enchos (1990) reported that teachers who were weak in content background tended to have significantly lower personal efficacy than did teachers with strong content backgrounds. In contrast, teachers with high self-efficacy tended to teach in ways characterized by the use of inquiry approaches, more student-centered thought, belief in their ability to help any student overcome learning problems and succeed, and maintained extensive knowledge of their students' developmental levels. One logical conclusion is that the way teachers view themselves and their roles in a science teaching context is at least partially derived from their self-efficacy (Finson, Riggs & Jesunathadas, 1999). A positive environment occurs when teachers with high self-efficacy believe they can help children learn new concepts; thus, they tend to put more time and effort into the teaching process, and this additional time and effort generally produces better outcomes.

Even though science education in Early Childhood Education (ECE) has received increased attention in recent years (Cho, 2004; Kwon, 1990; Weiss et al., 1999) much research has shown problems related to low levels of teachers' self-efficacy when teaching science in early childhood education center (Wassermann & Ivany, 1988). Most teachers still regard science education as the most difficult subject in their teaching repertoire (Choi, 2001; Han, 2004; Martin, 2001); their attitude toward science teaching is not positive compared to other subjects (Cho, 1998; Lee, 2000; Pedersen & McCurdy, 1992; Wylo, 1993).

Teachers' lack of ability in science teaching (belief) consequently develops into a dislike for science teaching (attitude). The result is teachers avoid teaching science, if at all possible (behavior). This strong interrelationship between beliefs, attitudes, and behavior dictates the inclusion of belief measurement in science teaching research (Riggs & Enchos, 1990) (Figure 1.1).

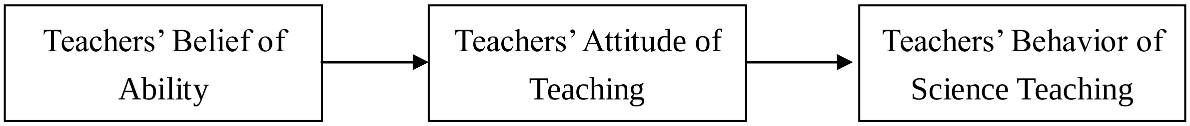


Figure 1.1: Relationships Among Belief, Attitude and Behavior of Teacher in Science Teaching.

Early childhood teachers' positive self-efficacy in science teaching, greatly excites and increases effectiveness in teaching, which in turn flow to their children's interest in scientific objects and the science learning processes (Cho, 1997; Furman, 1990; Rivikin, 1992).

Studies (e.g., Finson, Riggs, & Jesunathadas, 1999; Finson & Brewer, 1994; Riggs & Enchos, 1990; Wislon & Scharmann, 1994) have suggested possible reasons, particularly at the elementary school level, that low comfort levels toward science and/or science teaching tend to lead to the sporadic teaching of science, the teaching of science during inadequate blocks of time, or the omission of science instruction form the school day. Further, lack of resources and money, teachers' lack of knowledge, and poor preparation of teachers to teach science also create less than ideal environments (e.g., Munby, 1983; Mechling, 1984; Gauthier, 1994; Cho, 1997). Among these reasons, "teacher" and "environments in which teachers work" are considered to be major components in determining the enhancement of teachers' self-efficacy. Therefore, examinations of factors that influence science teaching-efficacy, and analysis of the predictor factors' paths that positively impact science teaching-efficacy are important keys in understanding how to motivate teachers to teach science and/or to overcome barriers in science teaching.

The overall purpose of this study is to investigate the predictor variables and those pathways which may influence early childhood teachers' self-efficacy in science teaching. Specifically, this study is to determine the predictors of the self-efficacy of early childhood teachers in science teaching and how the predictor factors influence teachers' self-efficacy beliefs about science teaching. The subjects of this study are drawn from early childhood teachers who have taught in private and public kindergartens, and private, public, and cooperative daycare centers in Korea. The instruments used in this study are the Science Teaching Efficacy Belief Instrument (STEBI-A) (Riggs & Enochs, 1991), Scale of Emotional and Material Support from Teachers' Institutions (Tschannen-Moran & Hoy, 2002) and a demographic questionnaire.

Need for the Study

In order to achieve understanding of early childhood teachers' self-efficacy in science teaching, this study addresses several needs. These needs follow:

1. The need for a study on science education at the early childhood level;
2. The need for the examination of the predictor variables of early childhood teachers which may influence their self-efficacy beliefs in science teaching;
3. The need for an investigation of the process path of the predictor variables, of early childhood teachers, and how they may influence self-efficacy beliefs in science teaching;
4. The need for research-based teacher training programs for early childhood

science education.

The rationale behind the first need is that little effort has been directed toward the investigation of early childhood science learning and teaching, despite its obvious importance. As Fleer (1993) indicated, a lack of attention has been paid to developing a teaching approach that is especially suitable for young children. As a result, most significant modifications usually arise from changes to the selected pedagogy by early childhood teachers during implementation. While some success results, many failures remain evident, thereby reducting the likelihood of science education assuming a more prominent place in the early childhood curriculum (Cho, 1997).

The attributes of young children and early childhood curricula are different from elementary school children in many respects. Approaching science education for young children from an early childhood perspective rather than from simply modifying elementary science curricula is important. Therefore, this study on early childhood teachers' self-efficacy beliefs in science teaching anticipates providing a greater understanding of the reality of science education for young children from the perspective of early childhood teachers.

The second need for the study focuses on the significance of investigation of early childhood teachers' internal factors, personal educational experiences, and contextual experiences from their work places with science teaching all of which may influence their self-efficacy in science teaching. Researchers (e.g., Desoyza et al, 2004; Ramey-Gassert et al., 1996) have consistently found that several variables encourage elementary education teachers' self-efficacy in teaching science, such as teachers' educational level, presence of science curriculum, number of college science courses (Ramey-Gassert et al., 1996; Desoyza et al, 2004), teachers' science related experiences, choosing to teach science, and the environment of teachers' work places (Ramey-Gassert et al., 1996).

Based on previous research which studied elementary level teachers, a need exists to examine predictor variables that may influence self-efficacy in science teaching of teachers who are working at the early childhood education level. An important component of the variables of early childhood teachers in this study is the interdependency or relationship that is influenced by teachers' self-efficacy in science teaching.

The third need for the study focuses on investigation of the path that those predictor variables of early childhood teachers may influence self-efficacy belief in science teaching. Research on teachers' self-efficacy in science teaching examined teachers' attitudes toward early childhood science education, teachers' previous educational experiences, and external teaching environmental factors as predictors of teachers' self-efficacy in teaching science to children. However, the predictor variables were considered as only influential, rather than causal, for the criterion variable among teachers (e.g., Desouza et.al, 2004). Previous research was recursive, indicating that the relationships among the variables were unindirectional or that only a one-way flow of influence existed in the model.

Based on the Ramey-Gasert et al.'s (1996) study, those predictor variables could also direct investigation to determine the mediating effect of teachers' self-efficacy. Their research, which reported that the predictor variables influenced teachers' self-efficacy as direct effects as well as indirect effects, relied on a qualitative approach. The current study, using path analysis of quantitative approach, bridges the gap in the literature by examining the relationships and extent to which the variables of teachers' internal factors, teachers' educational experiences, support from teachers' institutions, and satisfaction with work places predict the criterion variable of self-efficacy in science teaching.

The fifth need for the study focuses on the importance of research-based teacher training programs for early childhood science education. Most researchers, (e.g., Morrel & Carroll, 2003; Cannon, 2001; Jarrett, 1999; Plourde, 2002; Winfiled & Ramey, 1999), who studied teachers' self-efficacy in science teaching, focused on elementary teachers' teaching at the pre-service level. The researchers investigated the relationship between pre-service science courses and elementary pre-service teachers' self-efficacy beliefs in science teaching. The studies showed that pre-service teachers participating in the method course increased both interest and confidence in teaching science, as measured by the STEBI-B. Based on the research, pre-service teachers can learn science content for teaching and inquiry methods in such a way that those teaching children K-5 would feel confident, skilled, and motivated to integrate inquiry science into the curriculum as a result of a method course (Jarrett, 1999; Bleicher, 2004). Jarrett argues that the increase in science content knowledge was the most important factor in this improvement. Thus, the results indicated a positive impact of methods courses on the self-efficacy beliefs of teachers' science teaching. Authorities are convinced that undergraduate pre-service science courses predict teachers' positive self-efficacy beliefs in science teaching and effective teaching in their futures (Morrell & Carroll, 2003).

However, Harty and Enochs (1985) argued that a good pre-service science teacher training program cannot serve classroom teachers adequately in this age of rapidly changing and expanding knowledge and technology. They (Harty & Enochs, 1985) stated that only a portion of teachers' pre-service education can be deemed relevant to actual classroom experience and as having an ongoing influence on any given program of instruction (Turner, 1988). Harty and Enchos (1985) noted that more attention to science preparation is a requirement for in in-service education for teachers of young children. Spodek, Saracho and Peters (1988) identified the need for a body of research focused specifically on preparing early childhood teachers, since most of the existing literature is on elementary or secondary teaching. National Association for the Education of Young Children (NAEYC) position said: "professional development experiences are most successful when they respond to an individual's background, experiences, and the current context of their role(s)" (1993, p 74). This statement indicates that an in-service training program should match teachers' needs. Therefore, in a study on early childhood teachers' self-efficacy beliefs in science teaching, the factors contributing to the belief as well as the factors' path processing to how the factors influence the belief, would add substantially to develop teachers' self-efficacy for early childhood science education.

In sum, teachers' self-efficacy beliefs in science teaching are a major factor in science learning during early childhood years. Teachers' self-efficacy forms through different experiences and has situational variable effects. Numerous studies exist on pre-service elementary teachers' self-efficacy in science teaching. However, most of these studies only investigated the general factors in relation to self-efficacy in science teaching in elementary education. Therefore, a study which investigates early childhood teachers' self-efficacy in science teaching, as well as the predictor factors influencing teachers' self-efficacy, can provide understanding of the realities in early childhood science education. Furthermore, the investigation of the path of the predictors which influence self-efficacy in science teaching of early childhood teachers can contribute significant insight into the development of teachers' self-efficacy, which directly impacts teaching science in early childhood classrooms. Such a study is necessary in the filed of early childhood education.

Purpose of the Study

Teachers' self-efficacy in teaching science positively influences the quality of children's learning and motivation in education. Although teachers' self-efficacy in teaching science to young children may have enhanced children's achievement, results from several studies suggest that this is a complex relationship (Bandura, 2000; Cannon, 2001; Cho, 2004).

The first purpose of this study is to investigate the relationships between the predictor variables and the criterion variable of teachers' self-efficacy in teaching science. Specifically, the predictor variables include: 1) teachers' internal factors related to early childhood science education (i.e., teaching preference, attitude toward early childhood science education, and self-evaluation for science teaching), 2) teachers' experiences related to early childhood science education, 3) emotional and material support from teachers' institutions (i.e., administration support, colleagues support and teaching resources support), and 4) satisfaction with teachers' work places (i.e., salary satisfaction, teaching curricula satisfaction, and teaching environment satisfaction).

The second purpose is to investigate the path process among those variables: how the predictors influence teachers' self-efficacy in teaching science by testing a path model. Previous quantitative studies have investigated the predictors of teachers' self-efficacy in science teaching. However no one has addressed the process of predictors: how the predictors influence self-efficacy in science teaching. Therefore, the path model in this study represents the ways in which, as well as how, key factors can have direct and indirect influences on teachers' self-efficacy in teaching science to young children.

Theoretical Framework for Path Model in this Study

The model of Ramey-Gassert et al. (1996) provides the theoretical framework for this study's examination of teachers' self-efficacy beliefs in science teaching and the predictor variables which influenced their belief. Ramey-Gassert et al.'s model suggests that the study of teachers' self-efficacy in teaching science involves four categories of variables: 1) teachers' internal factors, 2) teachers' previous experiences, 3) teachers' external factors, and 4) teachers' self-efficacy in science teaching. The relationships among the variables are indicated in Figure 1.2.

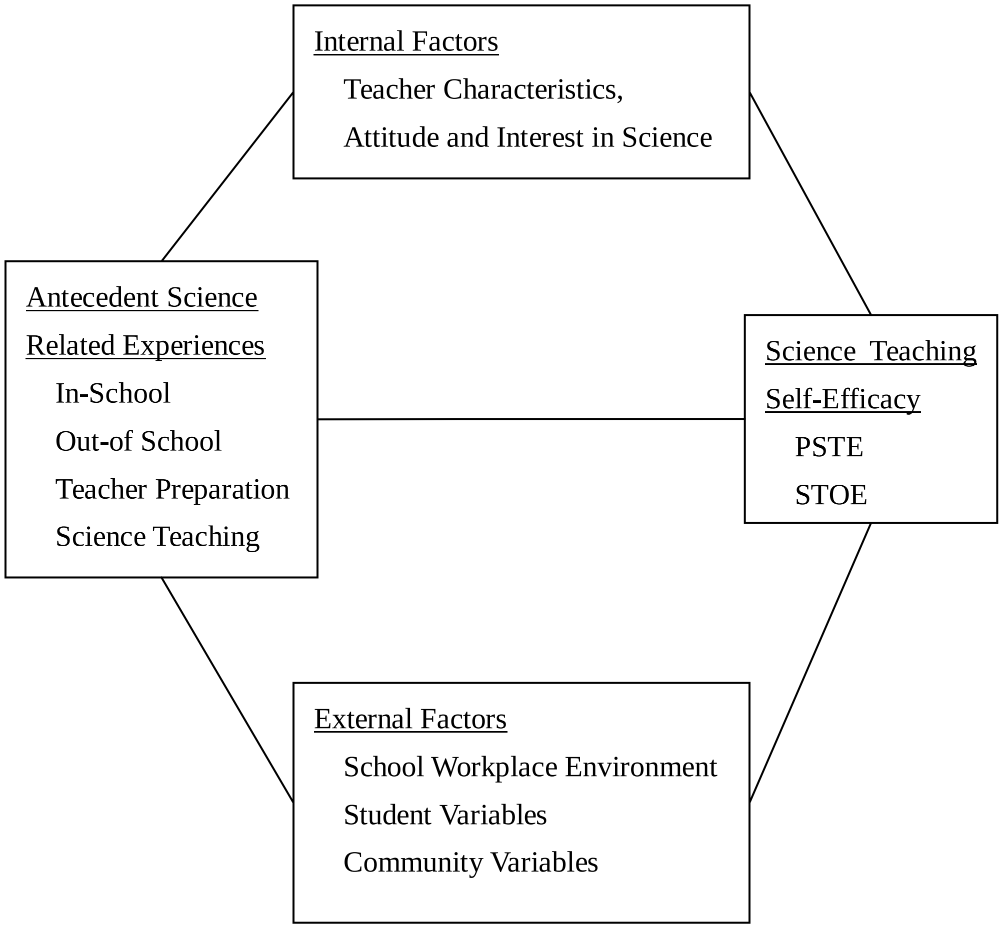


Figure 1.2: Factors Influencing Science Teaching Self-Efficacy Model (Ramey-Gassert et al., 1996)
Note: Lines indicate a relationship but do not imply direction of the relationship. Figure does not represent a path analysis.

Most previous research (e.g., Bleicher, 2001, 2002; Blieicher & Lindgren, 2002; Morell & Carroll, 2003; Tosun, 2000) has shown that the teachers' educational experiences positively associate with the formation of teachers' self-efficacy in teaching science. Educational experiences include teachers' pre-service as well as in-service experiences in teaching children. The degree to which a specific teacher achieves self-efficacy for teaching science varies according to the variety experiences such as pre-service teacher preparation, in-service teacher professional development, and science teaching experiences. The internal factors identify, as a variable, teachers' immediate or personal controls, which include the teachers' characteristics, attitude toward science education, and interest in science which is an intrinsic motivation. The external factors, defined as those beyond teachers' direct or immediate control, are, primarily, variables encompassing the environment of the school workplace (Ramey-Gassert et al., 1996). Theses variables may affect, not only the occurrences of self-efficacy in science teaching, but also relationships between the teacher's previous experiences and the self-efficacy in science teaching. The last variable product in the framework describes outcomes of teachers' science teaching self-efficacy processes. The product or outcome variable is the teaching behavior and achievement of teachers in teaching science to children in a classroom.

Ramey-Gasert et al. (1996) suggested a model in which those predictor variables also could direct investigation to determine the mediating effect on teachers' self-efficacy. Ramey-Gasert et al. (1996) indicated the mediate model among the variables which is the predictor factor influence on teachers' self-efficacy in science teaching mediated by other factor correlations which influenced teachers' self-efficacy beliefs in science teaching. Based on this model (Ramey-Gassert et al., 1996), the present study examines how the interactions of variables that exist among these variables directly or indirectly influence teachers' self-efficacy in science teaching.

Research Hypotheses

The following hypotheses are formulated based on Ramey-Gassert et al.'s (1996) "Factors influencing science teaching self-efficacy model." It is adapted to fit a model of predicting of early childhood teachers' self-efficacy beliefs.

Hypothesis 1

1. Teachers' internal factors have a direct positive effect on self-efficacy in early childhood educators' science teaching.

Hypothesis 2

2. Teachers' educational experiences in early childhood science education have direct and indirect positive effect on self-efficacy in science teaching.
   - 2-1 Teachers' educational experiences in early childhood science education have a direct positive effect on self-efficacy in science teaching.
   - 2-2 Teachers' educational experiences in early childhood science education have an indirect positive effect on self-efficacy in science teaching mediated by teachers' internal factors.

Hypothesis 3

3. The support teachers receive from their institutions has direct and indirect positive effects on self-efficacy in early childhood educators' science teaching.
   - 3-1 The support teachers receive from their institutions has a direct positive effect on self-efficacy in early childhood educators' science teaching.
   - 3-2 The support from teachers' institutions has an indirect positive effect on self-

efficacy of early childhood educators' science teaching mediated by teachers' internal factors.

3-3 The support from teachers' institutions has an indirect positive effect on self-efficacy of early childhood educators' science teaching mediated by teachers' educational experience in early childhood science education.

Hypothesis 4

4. Teachers' satisfaction with their work places has direct and indirect positive effects on self-efficacy in early childhood educators' science teaching.

4-1. Teachers' satisfaction with their work places has a direct positive effect on self-efficacy in early childhood educators' science teaching.

4-2. Teachers' satisfaction with their work places has an indirect positive effect on self-efficacy for early childhood educators' science teaching mediated by teachers' internal factors.

4-3 Teachers' satisfaction with their work places have a indirect positive effect on self-efficacy for early childhood educators' science teaching mediated by teachers' educational experience.

Limitations of the Study

Although this study has some significant needs and purposes, it also includes several limitations. The limitations of this study are:

1. This study is limited to a self-selected sample of teachers who volunteered to

participate. Especially, because this research is based on web-based survey, teachers who can not connect to the web-survey through the Internet cannot participate in this study. Therefore, the sample of early childhood teachers used in this study may not be representative of the total population of early childhood teachers in Korea.

2. The instruments are self-reporting and create the possibility for biased data.
3. The results of this study have limitation according to the reliability and validity of measurement of some predictor factors (i.e., teachers' educational experiences, teachers' internal factors, teachers' satisfaction with work places). A predictor factor consists of three to five single-item questions. These single-items undergo classification to research factors after factor analysis or testing for reliability. However, justifying a factor which could represent a generalized concept (e.g, teachers' internal factors, teachers' satisfaction with work places) is difficult when measurement occurs through analysis of several individual items.
4. This study is limited to investigation using path analysis of the created model by this researcher. Other variables not studied, could influence the dependent variable. The path model for this study is based on probabilities in early childhood teachers' science teaching. Other path analysis models, involving how predictors influence teachers' self-efficacy in science teaching, could also occur.

Delimitations of the Study

This study is delimited to participants who are in-service teachers of early childhood education. These delimitations follow:

1. Teachers who have at least one year of field experience as a full-time teacher in an early childhood education center.
2. Teachers have to teach all subjects including science to their students in a classroom.
3. Teachers have to reach the standards for Early Childhood Education Teacher Certification.

Definition of Terms

This study has several key terms. The definitions follow:

Early Childhood Education Center - Education centers for young children under five years old who enter the elementary school. In this study, early childhood education centers include approved the public and private kindergartens, or a public, private or cooperative daycare centers.

Early Childhood Science Education- The science teaching and learning that takes place in early childhood education centers (Cho, 1997).

Teachers' educational experiences- The education of a teacher as it evolves and develops into a profession in itself. Teachers' educational experiences produce highly motivated, sensitive, conscientious and successful classroom operatives who handle students effectively and professionally for better educational achievement (Lawal, 2003). This variable, in this study, is limited to the professional development experiences related to early childhood science education.

Teachers' Internal factors- Internal factors are those aspects which are within a teacher's immediate or personal control (Ramey-Gassert et al, 1996). In this study, teachers' internal factors refer to a teacher's attitude toward early childhood science education, teaching preferences for early childhood science education, and teacher's self-evaluation of early childhood science teaching.

Science Teaching Efficacy- Science teaching efficacy means teachers' belief that in the self-ability to teach science effectively and to affect student achievement. This belief includes both personal teaching efficacy and outcome expectancy in the area of science teaching (Riggs, 1988).

Personal Science Teaching Efficacy- This dimension of science self-efficacy refers to the teachers' beliefs in their abilities to perform teaching behaviors in science (Riggs, 1988).

Science Teaching Outcome Expectancy- This dimension of science teachers' self-efficacy beliefs reflects that degree to which teachers believe students can be taught science given external factors such as family background, socioeconomic status (SES), or school conditions (Riggs, 1988).

Predictor Variable – A predictor variable is a variable whose value will be used to predict the value of the target variable. It is analogous to the independent variables in a regression model.

Summary

The purpose of this study is to examine early childhood teachers' self-efficacy in science teaching and the related factors that may contribute to this belief. Specifically, the present study relies on a quantitative approach to investigate the predictor variables as having both direct and indirect positive effects on the science teaching self-efficacy beliefs of early childhood teachers.

Researchers have long been concerned about poor science teaching in early childhood and elementary classrooms, and have noted that teachers' self-efficacy in science teaching can be of major concern in facilitating science education in the early grades. However, numerous studies exist that have examined pre-service elementary education teachers' self-efficacy in science teaching. Also, discovering studies conducted from the perspective of early childhood science education is difficult. As a result, a study which provides an understanding of early childhood teachers' self-efficacy in early science teaching is a valuable addition to available education research.

This chapter presents statement of the research problems based on the purpose of the study. Definitions of specific terms to be used throughout the study are provided along with the limitations and delimitation for this study. Chapter 2 presents a review of the literature related to this study, and Chapter 3 provides the research procedure and methodology for the study. Chapter 4, reports the results of this study, and Chapter 5 contains discussions of finding, recommendations for future study, and conclusions.

CHAPTER 2

LITERATURE REVIEW

This chapter contains discussion of the foundation of this study. Researchers have considered teachers' self-efficacy in science teaching as a major factor affecting children's science learning, and they have revealed factors which contribute to teachers' beliefs which, when implemented, improve teachers' quality of science teaching.

This chapter is divided into four sections: 1) Concept of Self-efficacy, 2) Teachers' Self-efficacy, 3) Instruments of Self-efficacy in Science Teaching, and 4) Predictors Influencing Teachers' Self-efficacy in Science Teaching.

Concept of Self-Efficacy

Self-efficacy belief, as a psychological construct, has roots in a social learning theory developed by Bandura (1977, 1981, 1997, 2000). In his research with recovering heart attack victims, Bandura (1982) found that patients' beliefs in their ability to overcome phobias about exercise affected their performance. Bandura theorized that an individual's beliefs, based on previous experiences, closely link to behavior with respect to phobias and efficacy. Self-efficacy beliefs are defined as "judgments of how well one can execute courses of action required to deal with prospective situations" (Bandura, 1982, p122). Another component of Bandura's research on self-efficacy beliefs is the dimension of outcome expectancy belief. He theorized that an individual develops a generalized expectancy about action-outcome contingencies based upon life experiences and develops specific beliefs concerning the individual's own coping abilities (Ramey-Gassert, 1996).

Behavior, according to Bandura, is based on both factors. Behavior is enacted when people not only expect certain behaviors to produce desirable outcomes-- outcome expectancy, but also when they believe in their own ability to perform the behaviors-- personal efficacy belief (Raney-Gassert & Encho, 1990; Plourde, 2002; Cannon & Scharmann, 1996). Behavior may be predicted by investigating self-efficacy using both types of expectancy determinants. Bandura (1982) hypothesized that people with both high outcome expectancy and personal efficacy will act in an assured, decided manner and be persistently on-task. Low outcome expectancy paired with high personal efficacy may cause individuals to temporarily intensify their efforts, but will eventually lead to frustration. Persons with low rates of both attributes will give up more readily if the desired outcomes are not reached immediately.

Bandura (1997) concluded that the evidence across studies is consistent in showing that "perceived self-efficacy" contributes significantly to the level of motivation and performance accomplishments. Bandura (2000) embraced an integrated perspective for human performance in which social influence operates though psychological mechanisms. People are producers as well as products of social systems. By exercising self-infulence, human agency operates generatively and proactively rather than just reactively. Social structures are created by efficacious human activity. The structural practices, in turn, impose constraints and provide resources and opportunity structures for personal development and functioning (Bandura, 2000, p29).

Simply put, Bandura's theory posited that people are motivated to perform an action if they believe the action will have a favorable result (outcome expectation), and they are confident that they can perform that action successfully (self-efficacy expectation) (Bleicher, 2004).

Teachers' Self-Efficacy

In terms of teachers, teaching efficacy belief is a teacher's belief in a personal ability to teach, called personal teaching efficacy, and to have students learn, called teaching outcome expectancy, as initially described in the Rand Corporation evaluations of the Title III-funded project (Armor et al., 1976; Berman & McLaughlin, 1977; Ramey-Gassert, 1996). To repeat, personal self-efficacy in teaching is "teachers' confidence in his or her own teaching abilities" and outcome expectany as "teachers' belief that student learning can be influenced by effective teaching" (Ramey-Gassert & Enchos, 1990).

Classroom teaching behaviors reflect both dimensions of a teacher's teaching efficacy beliefs. Because, in teaching, outcome expectancy belief is the learning outcomes teachers believe possible through teaching, or a teacher's belief that students' learning can be influenced by teaching, despite external variables such as home/family environment, or socioeconomic background. Thus, teaching self-efficacy beliefs involve both outcome expectancies for students and belief in personal teaching abilities.

Self-Efficacy in Science Teaching

Bandura's (1977) theory provided a useful framework for examining the construct of science teaching self-efficacy in science education research. Because teachers' self-efficacy is a considerable predictor of teacher behavior, self-efficacy coutinues to be an important factor in effective science teaching (Canno & Scharmann, 1996; Czerniak & Waldon, 1991; Enchos &Riggs, 1990, Riggs, 1991).

Many researchers suggested that evidence showed that self-efficacy positively impacts teachers' teaching behavior, which has a relationship with effective science teaching. Aston and Webb (1986) reported that the degree to which teachers engaged in selected teaching behaviors indicated their efficacy in teaching science. Czerniak's (1990) research indicated that highly efficacious teachers have been found to be more likely to use inquiry and student-centered teaching strategies, while a low sense of efficacy in teachers is more likely to result in teacher-directed strategies, such as didactic lectures and reading from textbook. Efficacious teachers have also allowed students to solve problems on their own (Chwalisz, Altmaier, & Russell, 1992). Enchos, Scharmann, and Riggs (1995) suggested that teachers with higher self-efficacy may have a more humanistic view of classroom management and that low science teaching efficacy among teachers may result in the avoidance of science teaching. Therefore, teachers should, ideally, possess a high degree of self-efficacy involving the teaching of science in order for their students to be positively influenced toward learning science (Canno & Scharmann, 1996).

The Tshman-Moran et al. (1998) research found that a positive relationship exists between a variety of productive teacher behaviors and high self-efficay ratings. These behaviors include increased persistence with students in failure situations, tendencies toward less didactic instructional strategies, higher professional commitment, and a desire to find better ways for teaching. Teachers' efficacy influences, not only chocies of activities, but also the amount of effort expended and the level of persistence in overcoming obstacles. Thus, a clear linkage is present between a teachers' postive personal efficacy and student achivement (Wingfield & Ramsey. 1999).

Self-Efficacy Applied to Early Childhood Teachers

Teachers' sense of efficacy refers to their ability to help students learn (Ashton, 1984; Wingfield & Ramsey. 1999) as well as being related to teachers' behaviors, such as persistence on a task, risk taking, and use of innovations (Ashton, 1985; Ashton & Webb, 1986; Encho & Huinker, 2000). Teaching without self-efficacy does not create the most conducive environment for young children's education (Tschannen-Moran et al., 1998). A positive environment occurs when teachers with high self-efficacy believe they can help children learn a new concept; thus, they tend to put more time and effort into the teaching process, and this additional time and effort generally produces better outcomes.

Early childhood teachers' senses of their own efficacy can be especially influential on young children for the following two reasons: 1) The early school years are an important formative period when children's beliefs about their intellectual abilities are based on academic expectations and ability evaluations conveyed by their teachers (Bandura, 1997). The adult guides have confidence in themselves and build warm relations with children (Ashton & Webb, 1986). 2) Teachers with high self-efficacy mirror positive reflections back to the child, showing a belief that all children can learn. These positive interactions build trust, social competencies, and sense of personal confidence in the children (Bandura, 1997). The effects of teacher expectancy may be greater in the early childhood than in later years because teachers have more one-on–one interactions with children as they attempt to socialize children into their student roles (Wigfield & Harold, 1992).

Even though, the importance of early childhood science education is recognized in early childhood education departments (Cho, 2004; Weiss, Nelson, Boyd, Hudson, 1999; Kwon, 1990), science has been identified as a much neglected area in kindergarten curricula (Han, 2004; Choi, 2001; Martin, 2001). In addition, the attitude of teachers in kindergartens toward ECSE is not positive compared to other subjects (Lee, 2000; Cho, 1998; Wylo, 1993; Pedersen & McCurdy, 1992). Most teachers regard science education as the most difficult subject in their teaching repertoire (Han, 2004; Choi, 2001; Martin, 2001), and this subject is perceived as "in deficit" with respect to its scope, its confusion of purpose, and the inadequacy of methods of instruction (Wassermann & Ivany, 1988).

Teachers want to teach science effectively, but they are handicapped by inadequate preparation in professional coursework and insufficient background in science experience (Kim & Kim, 2004). Ideas about teaching science are not so easily translated into classroom practices. As a consequence, many teachers are fearful of the subject. Science became a curriculum stepchild, implicitly cast from the front-line of valued education in kindergarten due to insufficient teacher self-efficacy. Specificity is especially necessary when studying early childhood teachers' science teaching beliefs and behaviors, since early childhood teachers teach all subjects and may not be equally effective in teaching each of them. Whether or not teachers believe they have the ability to teach early childhood science is central to effective science teaching, and consequently, children's learning.

Instruments for Measuring Self-Efficacy in Science Teaching

Teachers' self-efficacy beliefs, although difficult to define conceptually from the frame-work for decision making, are the most reliable indicators of teaching behavior (Ashton et al, 1983; Pajares, 1992).

Although measuring self-efficacy of teachers, an affective construct, has been a pressing issue due to difficulty of assessment, many researchers developed measurements of the degree of teachers' self-efficacy appropriate to teachers' teaching grade-level or teachers' teaching a subject. The STEBI-A, as the instrument to measure teaching confidence and outcome expectancy, and the validity and reliability of the instrument, are assumed to be intact. To understand this study better, a review of the development of other instruments that used the STEBI-A as a model is helpful.

Instruments Developed from STEBI

The original scaled designs to determine teaching self-efficacy are based on items measuring respondents' beliefs about what they are capable of doing (Personal Teaching

Efficacy-PTE) and items measuring respondents' beliefs of what the outcome of their efforts will be (General Teaching efficacy-GTE) (Morrell & Carroll, 2003). Most current forms of teaching self-efficacy are derived from Gibson and Dembo's instrument (1984). Their instrument contained two scales. The first scale measured teachers' beliefs in their confidence to teach effectively and that they could help improve student achievement, which Gibson and Dembo called "personal teaching efficacy." The second scale measured teachers' belief that their impact on student achievement was limited by external factors, such as a student's socioeconomic backgrounds and home environments, which Gibson and Dembo called "teaching efficacy." Their instrument measured a general pedagogical self-efficacy, not specific to any content area (Bleicher, 2004; Gibson & Dembo, 1984).

Building on Gibson and Dembo's approach, Riggs (1988) and Riggs and Enochs (1990) developed an instrument designed to measure in-service science teaching self-efficacy beliefs, the Science Teaching Efficacy Belief Instrument (STEBI-A). The STEBI-A contained 25 items, measuring on two scales, with names more clearly denoting their relationships with Bandura's two-factor theory, Personal Science Teaching Efficacy (PSTE), and Science Teaching Outcome Expectancy (STOE).

Enochs and Riggs (1990) developed the STEBI-B, which modified the STEBI-A in order to measure science teaching efficacy beliefs in pre-service teachers. The STEBI-B dropped two of the original items from the STEBI-A, modified the verb tenses in the items to reflect an orientation to the future of pre-service teachers, and maintained the naming of the two scales. The STEBI-A and STEBE-B have become widely used in science education to inform educators of teachers about science beliefs of student-teachers. Both instruments have been re-written in other languages because the importance of science self-efficacy beliefs has been recognized in other countries as a critical role in teaching effectively.

Several efficacy beliefs instruments have been developed by modifying the original STEBI. Each of these instruments was subjected to specific and factorial validity tests, established by factor analysis (Smith & Huinker, 2000).

Using the STEBI as a starting point, the STEBICHEM (Rubeck & Enochs, 1991) was created to measure teaching confidence in teaching chemistry. Likewise, the Self Efficacy Beliefs about Equitable Science (SEBEST) instrument, which measures teacher beliefs toward science teaching and learning in regard to considerations of ethnicity, linguistic minorities, gender, and socioeconomic factors were developed (Ritter, Boone, & Rugga, 2002). The SEBEST is currently being modified to include gifted and talented students in its concept of diverse learners (Ritter, Boone, & Rugga, 2002). The Mathematic Teaching Efficacy Belief Instrument (MTEBI) was developed based on the STEBI to measure both personal mathematics teaching efficacy (PMTE) and mathematic teaching outcome expectancy (MTOE) (Enochs, Smith, & Huinker, 2000). Lumpe, Haney, and Czerniak (2000) developed an instrument called the CBAT, designed to provide an assessment of context beliefs. The researchers suggested that context beliefs encompass the whole teaching environment, which includes the designed environment, the human environment, and the socio-cultural environment.

STEBI-A and Studies Using STEBI-A

STEBI-A, developed by Riggs and Enochs (1990), is a valid and reliable instrument for studying elementary teachers' beliefs towards science teaching and learning. With this instrument, a more complete perspective of elementary science teaching is possible, since it allows investigation of teacher belief systems to supplement the existing research base which includes study of teachers' attitudes and behaviors in the area of science teaching.

In the study, detailing the construction of STEBI-A (Enochs & Riggs, 1990), the data was collected for the purpose of establishing construct validity. Criteria selected were based on their established correlation with teaching efficacy beliefs or their hypothesized relationship with science teaching efficacy beliefs. An a priori expected correlation is as follows (Enochs & Riggs, 1990):

(1) Years spent teaching at the elementary level

(2) Acceptance of responsibility for science teaching (Choice of teaching science)

(3) Time teaching science

(4) Use of activity-based teaching

(5) Science teaching self rating,

(6) Subject preference as measured by the Subject Preference Inventory (Markle, 1978)

(7) Principal rating (not available for most subjects)

Several researchers (e.g., Desouza, et al., 2004; Ginns & Watters, 1999; Ramey-Gassert et al., 1996) have employed the STEBI-A to explore issues of self-efficacy of in-service elementary teachers. The total subscale scores for PSTE and STOE have been used to draw interpretations about measured changes in teaching self-efficacy of participants involved in various interventions.

The Ramey-Gassert et al. (1996) qualitative and quantitative study using data from several self-reporting instruments, including STEBI-A of 23 elementary school teachers has shown insights as to the development of PSTE and STOE. Results of the interview analysis reveal more definitive findings for the dimension of PSTE than for STOE. Themes in the data indicated that antecedent experiences influenced interest in science and science teaching. Pre-service and in-service experiences such as success in high quality science courses and workshops, access to resources and time, and supportive colleagues and administrators influence PSTE, and, to a lesser degree, STOE. Findings on experiences which influenced STOE are limited. This research implied the importance of early science experiences, teacher preparation and teacher professional development.

Ginns and Watters (1999) conducted a very detailed study of beginning elementary teachers and the effective teaching of science. The researchers focused on the behaviors and experiences of beginning teachers as they taught elementary science for the first time. Similar to the previous research, this research employed both a quantitative and qualitative approach for data collection. The design of the study was a multiple-case study approach that involved the observation and recording of teacher behaviors in science. In this research, STEBI scores of three teachers selected for the case study were presented from four time points. First of all, three female pre-service teachers were selected for a case study by the scores on a STEBI-B. After three years, in the final semester of the teacher education program, STEBI-B was administered to the participants. Reassessment of each beginning teachers' sense of self-efficacy using STEBI-A was conducted at the mid-point of the first year of teaching, and a further administration of

STEBI-A was conducted in their second year of teaching along with the completion of a questionnaire. The research concluded: 1) Pre-service teachers need to have successful experiences, and be made aware of those successful experiences, during their teacher education programs. 2) Science courses in pre-service programs must provide more authentic practice and experiences, and be the source of credible role models, for participants. And, 3) Experienced peer teachers, school principals, and teacher educators must provide continuous and positive feedback to reinforce beginning teachers' beliefs about their ability to teach science.

The Desouza, et al. (2004) study of elementary and middle school teachers in urban schools in India provided responses to the science efficacy instrument (STEBI-A). The results of analysis indicated that personal self-efficacy and outcome expectancy measures correlated highly for middle school teachers, for those who did not have a science degree and a written science curriculum. Significant predictors of self-efficacy from the study are: 1) minutes per week science is taught, 2) educational level, 3) number of days in the school year, 4) holding of a science degree, and 5) the presence of a science curriculum. This study indicated that teaching experience is important, but not necessarily enough to increase teachers' outcome expectancy beliefs.

The Predictors Influencing Teachers' Self-Efficacy in Science Teaching

A growing number of researchers have conducted studies to examine factors which have affected teachers' self-efficacy in science teaching and to build a theoretical foundation for changing teachers' self-efficacy strategies. However, most of the research has been done at the elementary level, and little at the early childhood level (Cho, 1997).

For lack of related research, although the current study focuses on examination of the predictors and those paths influencing early chidlhood teachers' self-efficacy in science teaching, the foundation for this study was research which investigated the predictors of elementary teachers' self-efficacy in science teaching. The following three predictors: 1) teachers educational experiences, 2) teachers' internal factors, and 3) teachers' external factors are classified through a review of previous research and are used as the main predictors in this study. These factors are the basis for the complex process which hypothesizes influences on teaching efficacy belief. Each is discussed the following sections.

Teachers' Internal Factors

Currently, a few studies (e.g., Cho, 1997; Gauthier, 1994) used qualitative research methodology as a means to obtain more personal and specific information regarding determining teachers' self-efficacy in science teaching.

Ramey-Gassert et al. (1996) defined teacher characteristics, attitude and interest in science as teachers' internal factors. The mean of teachers' characteristics included desire for change or improvement, desire for personal growth, and image of self- definition. The results of the research suggested evidence that teachers' internal factors impact self-efficacy in science teaching. This research has shown that teachers' attitude toward science and self-rated effectiveness for teaching science were positively correlated with teachers' PSTE. In addition, teachers' choosing to teach science was significantly associated with both PSTE and STOE (Ramey-Gassert et al., 1996).

Teachers' Educational Experiences

Bandura (1977, 1981) proposed that people develop a universal hope for events based upon previous life occurrences, and suggested that one's abilities are mediated by individual expectations. In addition, people develop definite beliefs about how to cope with different situations. According to Bandura's speculation, if one has had a negative experience with a science course; one probably will expect the next science course to be much the same based upon previous experience. A person in such a situation will likely behave and cope with the course as they have in the past (Canno & Scharmann, 1996; Czerniak & Waldon, 1991; Enchos & Riggs, 1990; Riggs, 1991). Accordingly, if teachers have initially successful experiences in teaching science, Bandura (1986; 1995) asserted that they should develop high levels of self-efficacy, thus motivating them to persist with tasks. Therefore, teachers' experiences including both pre-service teachers and in-service teachers are important predictors influencing teachers' self-efficacy beliefs.

Several research studies (Cronin-Jones & Shaw, 1992; Ginns & Watters, 1994; Morrell & Carroll, 2003) investigated the relationship between pre-service teacher education experiences and the formation of their self-efficacy beliefs. In general, content area training, by itself, has not produced increases in science teaching-efficacy. Methods instruction has shown varied results.

Tosun (2000) studied the relationship between prior science coursework and self-efficacy in 35 pre-service teachers. The study showed that, although science content knowledge should be addressed in a methods course, including enough content is difficult. Extending this idea, Bleicher (2001, 2002) and Bleicher and Lindgren (2002) examined the relationship between success in learning science and development of self-efficacy. Students were able to understand science concepts and construct connections between those concepts as they progressed in the methods course. The findings of these studies supported the development of self-efficacy and conceptual understanding as a first principle in an elementary science teaching methods course. These findings are in accordance with those of Settlage (2000), working with self-efficacy and the learning cycle, Schoon and Boone (1998) in the area of alternative conceptions, and Stevens and Wenner (1996), with science content knowledge (Bleicher, 2004).

The studies of Cannin (2001) and Winglfield and Ramey (1999) have shown that increased time in field classrooms seems to have a positive impact on science teaching self-efficacy. However, while Wingfiled and Ramey (1999) found that methods courses did not enhance self-efficacy, Cannon (2001) did not find that adding field experiences to the methods courses caused an additional impact on self-efficacy.

Bandura (1986) presented four potential sources that may impact self-efficacy: 1) mastery experiences, 2) physiological and emotional cues, 3) vicarious experiences, and 4) verbal persuasion. Mastery experiences acquired from the pre-service teacher period through the in-service teacher period are considered the most powerful source of self-efficacy information, although all may contribute significantly to perceptions of self-efficacy if presented appropriately (Bandura,1986; Tschannen-Maran et al., 1998). Impacts on teaching self-efficacy are a construct that develops over time and with experience (Henson, 2001; Morrell & Carroll, 2003).

Although some evidence exist that self-efficacy beliefs can change during pre-service teaching experiences, changes are much harder to effectuate for in-service teachers. Some research (e.g., Cho, 1997; Bitner-Corvin, 1984; Spooner et al, 1982) suggested the positive effect of in-service teacher education program for science teaching (e.g., workshop, university coursework). Studies are rare for in-service teachers' self-efficacy beliefs and attitude change strategies in science teaching. Specifically, not much is known about what kinds of experiences have the greatest effect and what those effects might be. Therefore, examination of the effects of in-service teacher education for science teaching to obtain significant information for further development of in-service teachers' self-efficacy in science teaching is necessary.

Teachers' External Factors

Researchers have noted that teachers tend to form their educational beliefs and attitudes through their interactions with the context of their workplace. This implies that school environment, either physical or social, is a significant factor influencing teachers' self-efficacy in science teaching.

Several studies (e.g., Cho, 1997; Dembo & Gibson, 1985; Gibson & Dembo, 1985;

Enchos et al., 1995; Mechling, 1984; Munby, 1983; Soodak & Podell, 1993) found that workplace environment was associated with teachers' perceptions regarding science teaching. Dembo and Gibson (1985) strongly supported a positive relationship among high teaching efficacy, supportive workplace characteristics of schools, and high academic standards. Furthermore, they observed a positive correlation between the setting of academic goals and the teaching efficacy of teachers, that is, teachers who have exhibited a high teaching efficacy have also shown a concern for low achieving students (Gibson & Dembo, 1985; Soodak & Podell, 1993). Enchos et al. (1995) suggested that teachers' concerns for science teaching are related to their pupil-control beliefs. Hands-on approaches to science might create pupil-control concerns for teachers. Therefore, the researcher claimed that teacher-child ratio could be related to teachers' self-efficacy in science teaching. Lastly, the research found that inadequate facilities and lack of resources for science education in schools were other causes of poor teachers' self-efficacy in science teaching and teaching practices (Cho, 1997; Munby, 1983; Mechling, 1984).

Summary

The major purpose of this literature review is to study the theoretical and analytical research findings associated with teachers' self-efficacy beliefs in science teaching.

Studies focusing on the relationships between teachers' teaching behaviors and self-efficacy beliefs, and on predictors which influence teachers' self-efficacy beliefs have concentrated their effects on teachers' self-efficacy in science teaching. However no one has addressed the process of predictors that is how the predictors influence self-efficacy in science teaching. In addition, most studies are related to elementary level science education for pre-service teachers, not early childhood level for in-service teachers.

The examination of predictors' paths that influence science teaching efficacy is important for understanding how to increase teachers' motivation for science teaching and to overcome barriers in science teaching. Therefore, the present study investigates the predictor variables as having both direct and indirect positive effects on science teaching self-efficacy beliefs of early childhood educators, unlike previous research. The interrelated predictors' effects are the basis of the complex process which hypothesizes an influence on teaching efficacy in science teaching of early childhood teachers. The methodology and research procedure for this proposed study are introduced in Chapter 3.

CHAPTER 3

METHODOLOGY

The overall purpose of this study is to investigate the variables and those pathways which influence early childhood teachers' self-efficacy beliefs for science teaching. Thus, this study focuses on examining which factors influence teachers' self-efficacy and subsequently the factors' correlation with self-efficacy in science teaching for early childhood teachers. In addition, using path analysis, this study examines the extent to which teachers' internal factors, teachers' educational experiences in early childhood science education, and the support and satisfaction teachers receive from their work places explains the perceptions of science teaching self-efficacy beliefs among early childhood teachers.

This chapter includes the following: 1) Research Design, 2) Study Participants, 3) Instrumentation, 4) Procedures, and 5) Data Analysis.

Research Design

This descriptive, correlational, quantitative study examines the relationships and extent to which the predictor variables explain the criterion variable of teachers' self-efficacy beliefs in teaching science to young children in Korea. The predictor variables include teachers' internal factors which motivate the teachers, teachers' educational experiences in early childhood science education, institution support for early childhood science education, and teachers' satisfaction with their work. Teachers' internal factors include teachers' science teaching preferences and attitudes, and self-evaluation. The teachers' educational experiences in early childhood science education include self- study, conferences and workshops, teacher education programs, university course work, and other experiences. The emotional and material support for teachers by their institutions from administration, colleagues, and resources provide evaluation levels. The satisfaction criteria for teachers' work consist of salary, education curriculum, and environment.

A correlational research design, using path analysis, is the method of choice for determining if relationships exist between variables (Tabachnick & Fidell, 2001) and whether a given independent variable has an affect on the dependent variable (Mailloux, 2003; Munro, 2001). This design is congruent with the theoretical framework of a study which depicts relationships among the variables. The path model clarifies ideas of the relationships among the variables (Tabachnick & Fidell, 2001), and is useful in displaying the a priori hypothesized structure among the variables examined (Mailloux, 2003; Munro, 2001).

Previous research (e.g., Cannon, 2001; Morrel & Carroll, 2003; Plodure, 2002; Ramey-Gassert et al., 1996; Winfiled & Ramey, 1999) on teachers' self-efficacy in science teaching examined several predictor variables (e.g. teachers' previous educational experiences, teachers' attitudes toward early childhood science education, and external teaching environmental factors) influence on teachers' self-efficacy in teaching science to children. However, previous research examined only the influence of the variables rather than examining whether the data fit a causal model (e.g., Desouza et al., 2004), or indicated that the relationships among the variables are unidirectional or that only a one-way flow of influence existed in the model. However, those predictor variables could also be used to examine the mediating effect on teachers' self-efficacy. Ramey-Gasert et al. (1996) indicated the mediation model among the variables influenced teachers' self-efficacy beliefs in science teaching. Their qualitative research indicated that the predictor variables influenced teachers' self-efficacy as direct effects as well as indirect effects.

Qualitative research provides the opportunity to develop a descriptive, rich understanding and insight into individuals' attitudes, beliefs, concerns, motivations, aspirations, lifestyles, cultures, behaviors, and preferences (Schwandt, 2001). However, a frequent limitation of qualitative research is that the findings often cannot directly be generalized to a larger population. Therefore, the present study relies on a quantitative approach to investigate the independent variables direct and indirect effects on the dependent variable of science teaching self-efficacy beliefs of early childhood educators. As part of this research, the two dimensions of self-efficacy beliefs, which are personal self-efficacy and outcome expectancy, resulted from a calculation of the participants' scores on the Science Teaching Self-Efficacy Belief Instrument (STEBI-A) (Riggs & Enochs, 1991).

Study Participants

The participants for this study include 263 in-service teachers in early childhood education centers in Korea, including public and private kindergartens, as well as public, private and cooperative daycare centers. Because this study uses a web-based survey, an e-mail list of 1500 teachers from 308 web-sites of early childhood education centers formed the basis for identifying potential participants.

Teacher participation in this study was voluntary. Teachers could withdraw from this research at any time by choosing to not answer the questions in the web survey. If a teacher did not click the “Send” button, those questions already answered would not be recorded. The 263 teachers participating completed a demographic questionnaire and the science teaching self-efficacy belief scale.

Instrumentation

In order to examine the research questions in this study, three instruments were used for data collection: (1) Science Teaching Efficacy Belief Instrument modified for this study, (2) Scale of Emotional and Material Support from teachers’ institutions modified for this study, and (3) Demographic Questionnaire.

Science Teaching Efficacy Belief Instrument (STEBI-A)

Description

Based on Bandura’s work, Riggs and Enochs (1990) postulated that two factors, personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE), might affect science teaching behavior. The factors derive from a quantitative research study into elementary teachers’ self-efficacy beliefs designed to validate the Science Teaching Efficacy Belief Instrument (STEBI-A). The two factors identified by

Riggs and Enochs (1990), and domain specificity of those factors, are in accord with Bandura's (1986) definition of self-efficacy. Riggs and Enochs (1990) reported that the items in the self-efficacy scale and outcome expectancy scale had high reliability (Cronbach's Alpha of PSTE = .92, STOE = .77)

Scoring

The STEBI – A used a 5-choice, 25 item Likert-type response scale for in-service teachers. Of the 25 items in the instrument, 13 items focus on in-service teachers' levels of belief that they can teach science, and 12 items address teachers' beliefs that their teaching has a positive effect on their students. The response categories were "strongly agree, agree, uncertain, disagree, and strongly disagree." Items intended to produce a negative response have reverse scoring (i.e., 1=5, 2=4, etc.) An example is Item #3, "Even when I try very hard, I don't teach science as well as I do most subjects."

Item scores, summed for each dimension, calculate two separate scale scores for each respondent. High scores on the PSTE indicate a strong belief in one's ability to teach science. Scores can theoretically range from 13 to 65. High scores on the STOE indicate high expectations in regard to the outcomes of science teaching. Scores on this scale can range from 12 to 60.

Modification of the STEBI-A for Korean Early Childhood Teacher Research

The STEBI-A instrument, as originally designed, targeted in-service elementary school teachers, for science education in the United States. STEBI-A is appropriate for kindergarten teachers in the United States because K-grade is part of elementary school compulsory education, whereas K-grade is separate from elementary school in the Korean education system. Therefore, instrument modification was necessary for science teaching to kindergarteners. Several items needed appropriate changes in the wording due to the differences in educational structures in the United States and Korea. For example, the word "student," in all items, became "children." In addition, the item, "I understand science concepts well enough to be effective in teaching elementary science" was altered to apply to early childhood teachers. "I understand science concepts well enough to be effective in teaching early childhood science education," and "I do not know what to do to turn students on to science" were modified to read, "I do not know what to do to motivate children to study science."

Before implementing the modified survey instrument, a panel, composed of a group of faculty members representing areas of science education and early childhood education in Korea, judged the survey's content validity. The collected, independent feedback from the panel provided a means for revising the survey's items.

Two steps established the content validity of the instrument modification:

1) Modification forwarded to appropriate Korean teachers for K-graders' science curriculum.
2) Review by Korean experts: The participants using this instrument would be Korean in-service teachers; therefore, Korean experts had to determine the instrument's appropriateness for an ECE setting in Korea.

Three phases of "Back to Back Translation" ensured correct translations between English and Korean versions. These phases are:

(1) Phase 1A: Researcher's translation of English to a Korean version

1B: Completing Korean Translators' and two Korean Early Childhood

Science Education (ECSE) experts' cross-checks

(2) Phase 2A: Back-translation, Korean to English version by outside Korean Early Childhood Education (ECE) Ph.D student

2B: Comparison of the original English version and the back translated English version by the researcher, two Korean ECSE experts and an outside, Korean, ECE Ph.D student

(3) Phase 3: Completion of Korean version by the researcher, two Korean ECSE experts, and outside Korean ECE Ph.D student

Scale of Emotional and Material Supports from teachers' institutions

Description

Tschannen-Moran and Hoy (2002) developed this scale to rate the quality of the support received in five areas: teaching resources, interpersonal support provided by the administration of schools, interpersonal support provided by colleagues, parental support and involvement in classrooms, and community support provided for classrooms. Sample items include: "Rate the teaching resources (materials) provided for you at your school" and "Rate the interpersonal support provided by your colleagues at your school."

Scoring

This measure consisted of five items, assessed along a 9-point continuum with anchors at 1 -Nonexistent, 3 - Poor, 5 - Adequate, 7 - Good, and 9 – Excellent. The basis for scoring is the average of the total number of responses for support as perceived by an in-service teacher in an early childhood education center. The average of the five items calculated a “Support Index.”

Modification for This study

In this research, since this study does not examine any variable related to children’s parents and community, two of five items removed, related to parental support and involvement in classrooms, and community support provided for teachers’ classrooms.

In addition, the scale modified the normal nine-point Likert scale to five-points, because other all variables had a 5-point Likert scale design. Therefore, three items, that is, support from teachers’ administration, and colleagues, and teaching resources support have measurement by a five-point Likert scale: “1-Strongly Disagree” to “5-Strongly Agree.” Higher scores indicate the early childhood teachers have enough support, including emotional, as well as material from their institutions. While lower scores indicate the teachers have a limited or unsatisfied level of support from their institutions.

Demographic Data

The demographic questionnaire provides information about early childhood teachers and early childhood education centers in which they work. Development of a demographic questionnaire allowed understanding of the participants’ background and investigating the relationship between early childhood teachers’ self-efficacy in teaching science and related variables. The items (e.g., teachers’ experiences of teacher educational programs for early child science education, teachers’ attitudes toward early childhood science education, and satisfaction with teachers' work places) were chosen for inclusion, since previous studies (e.g., Desouza et al, 2004; Ramey-Gasert et al., 1996) identified them as significant predictor variables of teachers' self-efficacy in teaching science (See, Appendix C).

Procedures

Dividing the procedures for this study created two phases. These phases are: (1) Pilot Study Procedures and (2) Study Procedures. The following sections explain each phase.

Pilot Study Procedures

The pilot-study's purpose is to investigate the results of five in-service teacher responses to the questionnaire proposed for the main survey. After receiving approval to conduct the pilot study from The Pennsylvania State University Office of Regulatory Compliance for Human Subject Research, selection of participants began. Selected pilot-study participants were five in-service teachers, two from kindergartens and three from daycare centers. The procedure for selecting participants was by purposive sampling in which the representativeness of the sample is based on an evaluation by the researcher. Purposive sampling, as a method of data collection, is one in which the researcher uses expert judgment to choose respondents, and picks only those who meet the purpose of the study (Cox, 1979).

These five in-service teachers for the pilot study should represent the whole community of participants for this study, as well as Korean in-service teachers who teach at early childhood education centers. This led, based on the researcher’s judgement, to choosing five in-service teachers who are teaching at each five representative early childhood education centers in Korea. The selected kindergarten teachers for the pilot study instruct at private and public centers which are the two representative types of kindergartens in Korea. Three daycare center teachers work at public, private and cooperative centers that are also three representative samples of daycare centers in Korea. Sending an e-mail to the possible candidates, identified by colleagues’ introduction, the pilot-study proceeded after receiving agreement to allow participation. These five completed surveys are not part of the main study.

Study Procedures

Dividing the procedures for main study created two steps. These phases are: (1) Preparation for Web-survey and (2) Data Collection. The following sections explain each step.

Preparation for Web-survey

After review of participants' responses to the pilot study, through a URL system provided by the Pennsylvania State University (PSU), a web-based survey form was created. Further collection of data, over four months, resulted in compiling 1500 teachers' e-mail addresses to be used as a basis for identifying participants. These teachers of early childhood education centers, including kindergartens and daycare centers in Korea, received correspondence which contained an introductory letter and an informed consent form.

A teacher became a participant by clicking the “I agree” button on the web site consent form. If the teacher did not want to participate in this study, the teacher chose the “I don’t agree” button, and then the researcher could not collect their source information. In addition, the teacher could cease responding to the web survey at anytime, and if the “Send” button at the end of the survey was not clicked, any answered questions were not recorded.

Data Collection

Distribution and collection of web-survey occurred during the Spring and Summer semesters in 2006.

Through e-mail, an agreement form and a web-based designed questionnaire went to 1500 candidate participants individually. During a two-semester period, 322 questionnaires, a 21.5% response rate, arrived at the Penn State web-mail system. Inappropriate responses resulted in discarding two of the 322 questionnaires. One questionnaire was incomplete, and the other was rated on an uncertain interval for all 25 items. As a result the Static Package for the Social Science (SPSS) program coded a total of 320 questionnaires for this study. Even though the total response was 320, by established criteria for participants to be included in the sample, 57 of 320 in-service teachers’ responses were eliminated from use. For the elimination, three questions were designed in Questionnaire Part I.

The criteria and reasons for selecting research participants follow:

1) At least one year of field experience as a full-time teacher.

In most cases, a beginning teacher enters a kindergarten or daycare center as an assistant to a main teacher. During the first year of teaching as an assistant, new teachers rarely have an opportunity to consider major issues in their fields. Beginning teachers, who have less than one year teaching experience have had limited exposure, insufficient for understanding student learning and teaching in a real kindergarten setting and for taking in-service teacher's education for professional development for effectively improving teaching strategies. Therefore, teacher influenced classroom management occurs after at least one year of teaching experience. For this research, the participants needed at least one or more years of experience in teaching children as an in-service teacher.

2) Teaching Science.

In this study, teachers have to teach all subjects including science to their students in a classroom. If a teacher teaches only a specific subject, or does not teach a specific subject, that excluded the teacher as a participant of this study. Some private early childhood education centers and daycare centers employ teachers for teaching specific subjects such as physical exercise, English lessons, instrument lessons (e.g. piano, violin), and science experimentation. Teachers for only specific subjects were not participants of this study.

3) Reaching Standards for Early Childhood Education Teacher Certification.

Most early childhood education centers establish their own criteria for hiring teachers. However, in most cases, as full-time educators, a second level degree kindergarten teacher or daycare center certification is the likely requirement for employment as a teacher in a public eduacation center.

The teacher certification for early childhood education, including public and private of kindergartens and daycare centers, has its basis in Korean Ministry of Education standards. To receive the certification, the teacher must hold at least a two-year college degree or certification from a daycare center teacher education program, and, in some cases, a bachelor's degree, master's degree or doctoral degree realted to an early childhood education program. In addition, public kindergarten teachers must pass the Korea Ministry of Education examination.

Based on the above criteria for selection of participants, only 263 questionnaires, 17.5% of usable questionnaires returned, became the data for the study’s analysis.

Data Analysis

Data evaluation includes completeness and inclusion criteria. Data analyses consist of three phases. The first phase is the analysis of teachers’ demographic information, used to understand the early childhood teachers’ backgrounds. The second phase is the analysis of the relationships among the study variables. The third phase reports the results of hypotheses testing using path model analysis, which addressed each hypothesis separately. The data analyses used SPSS 14.0 which employs basic statistics, factor analysis, reliability test, Pearson’s correlation and path analysis from Amos 6.0. The alpha level for all significant tests is .05.

Demographic Data Analysis

Information obtained from the demographic data provided descriptive findings concerning the variables used in this study.

To analyze demographic information, the questions are of three types which are classified as the ordinal, interval, and categorical data. The ordinal data has order, but the intervals between scale points may be uneven (Urdan, 2001). The ordinal data in this study (i.e., effectiveness for better science teaching) takes the form of assigning a high score of five to positively worded items, “strongly agree,” to a low score of one for “strongly disagree.” Interval data is continuous where differences are interpretable, but where no “natural” zero is present (Urdan, 2001). The analyzed interval data of this study are the number of teaching experience years, ratio of teacher to children, experiences in teacher education for science teaching. The last type of data for this study is categorical data and falls into distinct categories such as type of center and location of center. Ordianl and interval data anlyses the descriptive statistics of mean, standard deviation, and range, and categorical data analyses use frequencies and valid percent.

Analyses of Study Variables

The five primary study variables are: 1) teachers' internal factors, 2) teachers' educational experiences for early childhood science education, 3) institution support for early childhood science education, 4) satisfaction with work place, and 5) teachers' self-efficacy in science teaching. These five study variables are examined using mean, standard deviation, and range. In addition, analysis of those variables' relationships occurs through Pearson's correlation analysis for the path model. Examining the correlation matrix helps determine whether or not multicollinearity has a porential presence (Munro, 2001). Multicollinearity potentially exits when predictor variables intercorrelate very highly (r= ± .8 or higher). Chapter 4 reports the results of correlation among the five study variables.

Following is a description of the five study variables used in the path model;

Teachers' Internal Factors

The internal factors included three items which intrinsically motivate teachers: 1) teachers' preference in science teaching, 2) teachers' attitudes toward early childhood science education, and 3) teachers' self-evaluation of teaching science. Measurement of these three items was on a five-point Likert response scale, from "1-strongly disagree" to "5-strongly agree." To justify combining these three items into an unobserved, "internal factors," with similar characteristics, required a reliability test.

Experiences of In-service Teacher Education in Early Childhood Science Education

To measure in-service teacher education experience for early childhood science education, participants responded to questions in five areas: self-study, conferences and workshops, teacher education programs, university coursework, and other experiences. This measure consisted of five items assessed along teachers' account of an average one-year experience within the past five years. The sum of five items represents teachers' educational experiences in early childhood science education.

Institution Support for Early Childhood Science Education

The data for institution support for teachers was examined with a factor analysis of the three items: support from administration, colleagues, and science teaching resources. A five point–Likert resposne scale, from "1-Strongly Disagree" to "5-Strongly Agree" measured these three items. The principal components model of factor analysis with varimax rotation supported using these three items to represents one factor. In addition, a reliability scale test determined the Cronbach's alpha and item-total correlations for the three items related to emotional and material support from teachers' institutions.

Teachers' Satisfaction with Work Place

To measure the level of satisfaction with teachers' work place, three items: 1) the teachers' satisfaction with salaries, 2) institution curricula, and 3) working environments were part of the research design.

A five point –Likert response scale, from "1-Strongly Disagree" to "5-Strongly Agree" measured these three items. Justification of these items relating to teachers' satisfaction with their work places, used the principal components model of factor analysis with varimax rotation. In addition, Cronbach's alpha assesses internal consistency.

Teachers' Self-Efficacy in Teaching Science

The STEBI-A instrument measured teachers' self-efficacy in science teaching. The STEBI-A used a five-choice, 25 item- Likert response scale for in-service teachers. The instrument design used 13 items determining personal science teaching efficacy (PSTE), and 12 other items addressed teachers' science teaching outcome expectancies (STOE), and 12 negative items were reverse scored. Therefore, a higher summated score represents a teacher who perceived more positive self-efficacy in teaching science.

Hypothesis Analysis

A constructed path model examines the direct and indirect effect of independent variables on teachers' self efficacy in science teaching (Figure 3.1). Multiple independent variables of: 1) teachers' internal factors, 2) teachers' educational experiences for early childhood science education, 3) institution support for early childhood science education, and 4) satisfaction with work places were entered into a path analysis model with the respective criterion variables of the science teaching efficacy belief of each teacher.

In Amos (Version 6.0, 2006), path analysis allows estimating direct and indirect effects. Direct effect path coefficients indicate how much the standard value of the criterion value would be expected to change if the standard value of the predictor variable changed by one unit and all the other variables were held constant (Munro, 2001). Indirect paths occur when another present variable compounds the path. The total of the direct and indirect effects of one variable on another represents the total effect of the independent variable.

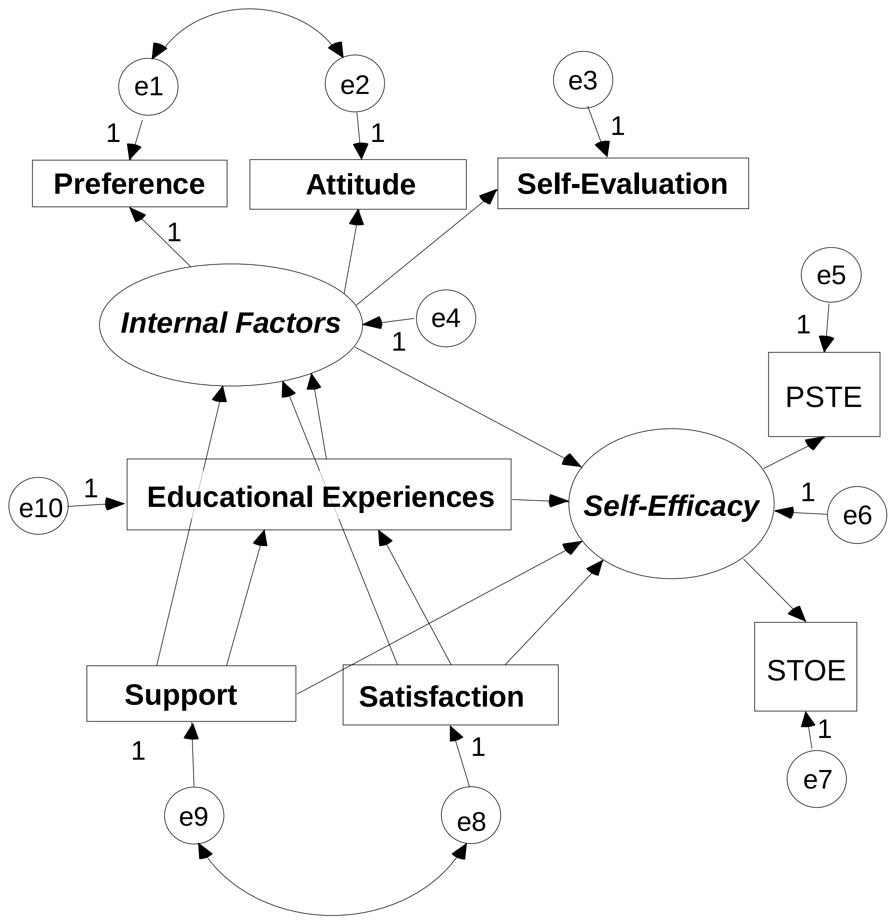
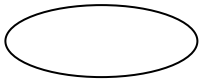
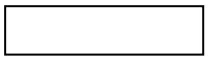
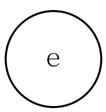


Figure 3.1: Path Analysis Model of the Study (Continued)

	Unobserved, endogenous, latent variable that underlie and explain the observed correlations.
	Observed, measured endogenous variable
	Single-headed arrow represents liner dependencies, which is a causal relationship between two variables. Use of a single-headed arrow in a path diagram assumptions that a change in the variable at the tail of the arrow will result in a change in the variable at the head of the arrow, all else being equal.
	The double-headed arrows in the path diagram connect variables that may be correlated with each other
1	Error must have a fixed weight of one in the prediction of variable.
	The variable error is enclosed in a circle because it is not directly observed exogenous variables. Error represents much more than random fluctuations in the variable due to measurement error. Error also represents a composite of teachers' educational experiences, internal factors, support from teachers' institutions, satisfaction with teachers' work places, and anything else on which teachers' self-efficacy in teaching science may depend but which was not measured in this study. As with nearly all empirical data, the prediction will not be perfect. Therefore, the latent variable "error" serves to absorb random variation in the variable and systematic components for which no suitable predictors were provided. This variable is essential because the path diagram is supposed to show all variables that affect teachers' self-efficacy in teaching science scores.

Source from: Amos 6.0 user guide, p75.

Figure 3.1: Path Analysis Model of the Study

Testing the significance of a path effect is the same as testing the significance of the regression coefficient corresponding to that direct effect. The t-test with corresponding p value determines the significance of the path effect. The advantage of using multiple linear regression analyses versus path analysis in AMOS is that the diagnostic analysis (e.g., tolerance, residuals) of the model is more easily accomplished. Multiple regression also allows examination of the combined effect of the independent relations among predictor variables and the dependent variable. The disadvantage is that the indirect and total effect had to be calculated manually. Multiple regression in SPSS give estimates for direct effect only.

The present study design is that the independent variables test as having direct as well as indirect effects on the dependent variable of teachers' belief of self-efficacy in science teaching. Path analysis using Amos in this study indicates both effects through diagrams for better understanding. The results of the path analysis using Amos appears in Chapter four.

Summary

In sum, this chapter describes the methodology and research procedure for the proposed study on early childhood teachers' self-efficacy beliefs in science teaching and the factors that may have influenced that belief. Specifically, using path analysis, this study examines the extent to which the predictor variables of teachers' internal factors, teachers' educational experiences in early childhood science education, and the support and satisfaction teachers receive from their work places, explain the perceptions of science teaching self-efficacy beliefs among early childhood teachers.

Sampling and data collection procedures describe the use of the three instruments: (1) Science Teaching Efficacy Belief Instrument (STEBI-A) (Riggs & Enochs, 1990), (2) Scale of Emotional and Material Supports from teachers' institutions

(Tschannen-Moran & Hoy, 2002), and (3) Demographic questionnaire, designed for this study. Analysis of data is by basic statistics, factor analysis, reliability test and Pearson's correlation using SPSS 14.0. In addition, path analysis is applied to estimate direct and indirect effects using Amos 6.0. Chapter 4 describes relationships among the predictor variables and the criterion variable and pathways of the predictor variables influence on early childhood teachers' self-efficacy in teaching science.

CHAPTER 4

ANALYSES AND RESULTS

This chapter presents the results of statistical analyses used to describe the early childhood teachers in Korea and to address the research hypotheses. Chapter 4 has three sections: The first section presents the results from the survey including demographic characteristics and background related to science teaching using descriptive statistics including the mean, minimum, maximum values, valid percent and standard deviation (*SD*). The second section describes the five primary study variables used in path analysis, and the correlation among the variables. The results of hypotheses analyses are in the third section of this chapter. The purpose of this study is to investigate the relationships among predictor variables of teachers' internal factors, teachers' educational experiences in early childhood science education, emotional and material support from teachers' institutions, and satisfaction with teachers' work place and the criterion variable of early childhood teachers' self-efficacy in teaching science. In addition, this study examines the extent to which the predictor variables influence the criterion variable of early childhood teachers' self-efficacy in teaching science in Korea.

Demographic Characteristics of Early Childhood Teachers

Of the total of 1500 e-mails requesting participation in the study, 322 teachers replied for a response rate of 21. 5%. Review of returned responses determined completeness of the surveys and compliance with inclusion criteria. Two questionnaires had inappropriate responses; one of them was incomplete; the other was rated on an uncertain interval for all 25 items, and 57 questionnaires did not satisfy eligibility criteria, such as less than 1 year teaching experience (See, pp.48-49). Therefore, useable questionnaires were 17.5%, yielding a sample of 263 early childhood teachers who could be subjects for investigation for this study.

Tables 4.1 and 4.2 report demographic characteristics of the study's respondents.

Of all the early childhood teachers in the sample, 67.19% held a general kindergarten teacher certification (second level degree), and 57.23 % held a second level degree of daycare center teacher certification. About one-fifth of the teachers (20.91%) reported that they held first degree kindergarten teacher certification. The data on present teaching level revealed that 25.3% of teachers teach three-year old children, 19.9% teach four-year old children, 30.3 % teach five year old children, and another 24.5% teach a mixed-age group or infants/toddlers. Over one-half of the teachers (53.6%) work in daycare centers, 17.5% in private daycare centers, 23.2% in public daycare centers, and 12.9% in cooperative daycare centers. Other responses from early childhood education centers included teachers in home daycare center, corroborated daycare centers and so on. A home daycare center has one or two teachers instructing a small number of children at the near childrens' home. A corroborated daycare center has several parents who create a community for their children's caring and education. The distribution of location in which teachers work were: rural (39.1%), urban (32.2%), sub-urban (19.9%), and capital city (8.8%).

Table 4.1: Demographic Characteristics among a Sample of Teachers in Early Childhood Education Center I

Characteristic	Frequency	Percent
Type of Teacher Certification (Multiple responses possible)		
1st degree kindergarten teacher	55	20.91
2nd degree kindergarten teacher	172	67.19
public kindergarten teacher	5	1.9
1st degree daycare center teacher	140	53.23
2nd degree daycare center teacher	24	9.13
President of kindergarten	2	0.76
President of daycare center	16	6.08
Teaching Target age		
Age 3	66	25.3
Age 4	52	19.9
Age 5	79	30.3
Other (e.g., mixed-age group, infants/toddlers)	64	24.5
Type of Center		
Private kindergarten	73	27.8
Public kindergarten	43	16.3
University lab kindergarten	3	1.1
Private daycare center	46	17.5
Public daycare center	61	23.2
Corporation daycare center	34	12.9
Other (e.g., Home dayacare)	3	1.1
Change Cycle of Science Section		
Year	11	4.5
Semester	20	8.2
Month	63	25.8
Week	36	14.8
Teacher’s need	88	36.1
Children’s interest	26	10.7
Location of Center		
Rural	102	39.1
Suburban	52	19.9
Urban	84	32.2
Capital city	23	8.8
Hobby Related Science		
Yes	40	16.9
No	196	83.1
Highest Level of Education		
Teacher Education Program for Daycare Center Teacher	22	8.5
Junior College Education	119	46.1
Bachelor’s Degree in ECE related program	94	36.4
Master’s Degree in ECE related program	20	7.8
Doctoral Degree	3	1.2

Table 4.2: Demographic Characteristics among a Sample of Teachers in Early Childhood Education Center II

Characteristic	Unit	*N*	*M*	*SD*	Min.	Max.
Months of Teaching	Months	248	76.30	3.94	12	306
Ratio of Teacher to Child	Number of children per teacher	243	15.66	7.13	1	40
Ratio of Science Teaching Time to Preparation	Minutes	213	1.20	.914	.125	6
Experience of In-service Teacher Education (Multiple responses possible)	(hours per year) Self Study	102	11.76	19.88	0	120
	Conference and Workshop	35	2.09	6.37	0	40
	Teacher Education Program	84	7.68	16.04	0	100
	University Coursework	32	4.74	14.38	0	93
	Other experiences	16	2.44	24.66	0	320
	Sum	170	28.71	46.79	0	454
Effectiveness for Better Teaching Science (Response scale for each item 1=Strongly disagree 2=Disagree 3=Moderate 4=Agree 5=Strongly Agree)	Pre-service teacher education	253	3.45	.89	1	5
	Internship Program of Pre-service Teacher		3.44	.89		
	In-service Teacher Education		3.65	.91		
	Observation of Other Teachers' Teaching		3.57	.91		
	Understanding of Teaching Subject		3.46	.67		
	Experience of Teaching Subject		3.73	.92		
	Advice or Evaluation about My Teaching		3.57	.87		
	Emotional and Material Supports for Teaching from Kindergarten/Daycare Center		3.47	.93		
Salary	Korean Man-won (1 Mon-won=$ 9.5 US)	162	132.15	45.74	70	350

The majority of the early childhood teachers (83.1%) do not have a hobby related to science. In the sample, 46.1% of teachers graduated from junior college and 36.4% had a bachelor's degree from an early childhood education related program.

The sample's mean total months of teaching is 76.30, that is, 6.36 years (*SD*=3.94), with a range of 12 month (1 year) to 306 months (25.5 years). The mean child to teacher ratio is 15.66 (*SD*=7.13) with a range of 1 to 40, and teaching time to preparation time for early childhood science education is 1.20 (*SD*=.914).

Measurement of the experiences of in-service teacher education for early childhood science education is measured by the sum of the five items (self-study. conference & workshop, teacher training program, university coursework, and other experience). The hours devoted to in-service teacher education ranges from 0 to 454 hours per one year within an average of the past five years. The total hours' mean is 28.71 (*SD*=46.79), and the mean representing the majority of teachers who had acquired their knowledge through self-study is 11.76 hours (*SD*=19.88). Other experiences in teacher education included in teachers' responses are teachers' meetings with colleagues for science class, classroom observations for science education, and demonstrations of science experiments for science class.

The most effective strategy for better science teaching is the experience of the teaching subject (*M*=3.73), and then, in-service teacher education is the second most effective strategy (*M*= 3.65) with a range of 1 to 5. The monthly average salary of the teachers is 132 Korea man-won, ($ 1,255 US).

Study Variables in Path Model

The following is a description of the five study factors used in the path analysis. These five study factors consist of three, factor-analytic summated Likert scales, a sum of five categorized items, and a sum of three single-item variables, with coefficient alpha reliability test. A recursive path analysis model, developed according to previous research results, was formulated for this study.

Table 4.3: Study Variables in Path Model

Study Variables	Sub-item	*N*	*M*	*SD*	Min.	Max.
Educational Experience (time)		170	28.71	46.79	0	454
Internal Factor		248	2.99	.59	1.33	4.67
	Preference-ECSE	256	3.07	.82	1	5
	Importance- ECSE	254	3.13	.75	1	5
	Teacher' Self-Evaluation	255	2.75	.75	1	5
Support						
	Support1-Administration	252	2.78	.90	1	5
	Support2-Colleagues	251	2.74	.90	1	5
	Support3-Sources	250	2.72	.93	1	5
	Sum of Support	250	2.75	.81	1	5
Satisfaction						
	Salary Satisfaction	255	2.70	.99	1	5

	Curriculum satisfaction	254	3.40	.75	1	5
	Environment Satisfaction	259	3.38	.79	1	5
	Sum of Satisfaction	246	3.16	.65	1.33	4.67
Self-Efficacy		248	6.41	.63	4.15	8.61
	PSTE	248	3.17	.42	1.92	4.69
	STOE	248	3.24	.33	1.92	4.25

Teachers' Educational Experiences in Early Childhood Education

To measure in-service teacher education experience in early childhood science education, participants responded to questions in five areas: self-study, conferences and workshops, teacher education programs, university coursework, and other experiences. The total of the five items calculates teachers' educational experiences. After the descriptive distribution examination, the range of time for teachers' educational experiences has an extreme positive skew.

Table 4.4: Square-Root Transformation of Teachers' Educational Experiences

(N=170)

	M	*SD*	Min.	Max.	Skewness	Kurtosis
Teacher Education Experience	28.71	46.79	0	454	5.42	46.61
1st square-root transformation	4.44	3.00	.00000	21.31	1.87	5.96
2nd square-root transformation	2.00	.68	.00000	4.62	.413	1.56

Therefore, correction for the skew is by transforming the variable using the square-root transformation. However, the transformed variable still shows high degree of skew, because the variable included natural 0 (i.e., reporting 0 hour on in-service teacher education for early childhood science education). Therefore, the square-root variable was subject to a further transformation using square-root (Afifi, Clark & May, 2004) (Table 4.4).

Internal Factors

The internal factors include three items which intrinsically motivate the teachers: 1) teachers' preference in science teaching, 2) teachers' attitudes toward early childhood science education, and 3) teachers' self-evaluation of teaching science. To justify combining these three items into unobserved, latent, "internal factors," with similar characteristics, a reliability test was undertaken. The result of the reliability test showed a Cronbach's alpha of .65. Because the internal factors are a latent variable that underlay and explain the observed correlations, factor analysis is not requirement. The average mean of the three items is 2.99, and the *SD* is .59.

Support from Teachers' Institutions

Data for support from teachers' institutions consist of three items. Using a factor analysis establishes that these three items actually represent one factor. The principal components for models of factor analysis and varimax rotation were employed for the preceding task. In addition, a reliability scale test determined the Cronbach's alpha which represents the item-total correlations for the items of support from teachers' institutions. This variable, justified by the factor analysis (Table 4.5), has high reliability (Cronbach's alpha = .86). The explained proportion of variance is 78.30 %.

Table 4.5: Factor Loading of Support from Teachers' Institutions

Item		Component
		Alpha if Item Deleted
Support 1	Interpersonal Support Provided by Administration	.866
Support 2	Interpersonal Support Provided by Colleagues	.895
Support 3	Teaching Resources	.893

Satisfaction with Teachers' Work Places

To measure the level of teachers' satisfaction with work place, three items request information. Among the variables, the Cronbach's alpha of reliability was .69. The result of the principal components model of factor analysis and varimax rotation explains 62.72% of the proportion of variance.

Table 4.6: Factor Loading of Satisfaction with Teachers' Work Place

Item		Component
		Alpha if Item Deleted
Satisfaction 1	Satisfaction with Your Salary	.595
Satisfaction 2	Quality of Education Curriculum	.850
Satisfaction 3	Satisfaction with Working Environment	.897

Teachers' Self-Efficacy in Science Teaching

The criterion variable, teachers' self-efficacy, measured by the STEBI-A, used a 5-choice, 25 item Likert-type response scale for in-service experience of teachers. Of the 25 items in the instrument, 13 items apply to Personal Science Teaching Efficacy (PSTE), and other 12 items address teachers' Science Teaching Outcome Expectancy (STOE). The responses from early childhood teachers to each item in the STEBI-A appear in Table 4.7.

Table 4.7: Descriptive Statistics of Teachers' Self-Efficacy (*N*=263)

Measure	Item	*M*	*SD*
PSTE	STEBI 2	3.30	.805
	STEBI 3	3.03	.824
	STEBI 5	2.99	.820
	STEBI 6	3.07	.773
	STEBI 8	3.26	.766
	STEBI 12	3.08	.792
	STEBI 17	3.13	.798
	STEBI 18	3.09	.735
	STEBI 19	2.81	.730
	STEBI 21	3.07	.751
	STEBI 22	3.44	.777
	STEBI 23	3.47	.828
	STEBI 24	3.41	.831
Total Scale Alpha =. 78	PSTE	3.17	.420
STOE	STEBI 1	3.62	.845
	STEBI 4	3.49	.817

	STEBI 7	2.87	.806
	STEBI 9	3.59	.793
	STEBI 10	2.90	.790
	STEBI 11	3.33	.776
	STEBI 13	2.94	.728
	STEBI 14	3.30	.735
	STEBI 15	3.37	.728
	STEBI 16	3.37	.753
	STEBI 20	3.29	.722
	STEBI 25	2.81	.783
Total Scale Alpha =. 69	STOE	3.24	.330

Note : Response scale for each item
1=Strongly disagree
2=Disagree
3=Moderate
4=Agree
5=Strongly Agree

The internal consistency examination investigated how well each item relates independently to the remaining items on the scale, and how they relate overall, to. Cronbach's alpha. This measures participants' responses to questions on a scale to determine internal consistency, and the alpha can range between 0 and 1 (Urdan, 2001).

If a scale has an alpha above .60, it is usually considered to be internally consistent (http://www.teachRDE.com**).** The result of internal consistency of the modified STEBI-A, in this research, is that PSTE produces an alpha of .78, and the other subscale, STOE is .69 indicating a high degree of internal consistency among the items in the scale. This score is relatively comparable to the previous research of Riggs and Enochs (1990) which reported that the two subscales (PSTE and STOE) had high reliability (Cronbach's alpha = .92 and .77, respectively), and Ramey-Gassert et al. (1996) which indicated that an alpha of PSTE of .89 and STOE of .77 were acceptable. Thus, the coefficients suggest that the STEBI is an internally consistent measure of early childhood teachers' self-efficacy in teaching science.

Correlation Matrix of Study Variables

Prior to hypothesis testing, the data underwent examination for significant relationships based on the literature.

Data analysis uses the Pearson's *r* correlation statistic. Except for correlations between two variables, all of the variables have a significant correlation. The variable of teacher educational experience has no significant relationship with teachers' attitude of early childhood science education (*r*= .123) which is an item of the internal factors. Also, no significant relationship appears between teachers' education experience and satisfaction with their institutions (*r*= .064) (Table 4.8).

The study determined relationships among the predictor variables (e.g., teachers' educational experiences, teachers' internal factors, support from teachers' institutions and

Table 4.8: Correlation Matrix of Study Variables

	Educational Experiences	Internal Factors			Support	Satisfaction	Self-Efficacy in Teaching Science	
		Preference-ECSE	Attitude- ECSE	Self-Evaluation			PSTE	STOE
Educational Experiences	1							
Preference-ECSE	.235**	1						
Attitude- ECSE	.123	.369**	1					
Self-Evaluation	.223**	.474**	.295**	1				
Support	.205**	.352**	.234**	.552**	1			
Satisfaction	.008	.342**	.178**	.367**	.411**	1		
PSTE	.356**	.336**	.252**	.549**	.450**	.289**	1	
STOE	.168*	.228**	.267**	.212**	.141*	.175**	.418**	1

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

satisfaction with teachers' work places) on self-efficacy in science teaching, PSTE and STOE. All of the correlations are significant within the two dimensions of teachers' self-efficacy, PSTE and STOE. That is, teachers' self-efficacy positively relates to teachers' in-service educational experiences for early childhood science education, to the preference for teaching science, to the attitude of early childhood science education, to the self-rated effectiveness in science teaching, to the emotional and material support from institutions, and to the satisfaction with their work places.

Hypotheses Testing

In order to achieve the purpose of the study, this study investigates four main hypotheses with sub hypotheses. The analyses results of hypotheses are follows:

Hypothesis Test

This study has four main research hypotheses with several sub-hypotheses. Results for each test follow.

Hypothesis 1

Teachers' internal factors have a direct positive effect on self-efficacy in early childhood educators' science teaching.

This hypothesis was tested using path analysis. An internal factor is an unobserved (latent) or exogenous factor which does not exist in reality. The factor's three observed items (e.g, teaching preference of early childhood science education, teaching attitude toward early childhood science education, self-evaluation of teachers), forms a single question representing teacher's "internal factors" in teaching science to children. These three items total one, "internal factors" (Cronbach's alpha= .65).

Inspection of the model results indicate that teachers' internal factors are significant in explaining teachers' self-efficacy in science teaching to young children ($\beta = .57$, $p < .001$) (Figure 4.1). As a result, the hypothesis is supported. The teachers' internal factors do have a direct positive effect on science teaching self-efficacy.

Hypothesis 2

Teachers' educational experiences in early childhood science education have a direct and indirect positive effect on self-efficacy in science teaching.

2-1. Teachers' educational experiences in early childhood science education have a direct positive effect on self-efficacy in science teaching.

This hypothesis was tested using path analysis. The results indicate that the model containing teachers' educational experiences are a significant predictor for teachers' science teaching self-efficacy (β =. 22, $p < .01$) (Figure 4.1). The result of the analysis indicates that the hypothesis is supported. The direct effect of teachers' educational experiences in science teaching is significant for self-efficacy in teaching science.

2-2. Teachers' educational experiences in early childhood science education have an indirect positive effect on self-efficacy in science teaching mediated by teachers' internal factors.

To examine this hypothesis, the indirect effect was calculated based on the path model. The indirect effect of teachers' educational experiences mediated though teachers' internal factors are significant (β = .15, $p < .05$) (Figure 4.1). Therefore, this hypothesis is supported in this study. Teachers' education experiences for early childhood science education do have an indirect positive effect on self-efficacy in teaching science when mediated by teachers' internal factors.

Hypothesis 3

Support teachers receive from their institutions has a direct and indirect positive effect on self-efficacy in early childhood educators' science teaching.

3-1. Support from teachers' institutions has a direct positive effect on self-efficacy in early childhood educators' science teaching.

Testing for this hypothesis used path analysis. The variable of emotional and material support from institutions is the sum of three items identified by factor analysis (% of variance =78.30) and reliability test (Cronbach's alpha= .86). The indirect effect of the support from teachers' institutions is not significant (β = .01) (Figure 4.1). The analysis does not support this hypothesis. The support from institutions that teachers received does not have a statistically significant direct positive effect on teachers' teaching self-efficacy in early childhood science education.

3-2. Support from teachers' institutions has an indirect positive effect on self-efficacy of early childhood educators' science teaching mediated by teachers' internal factors.

The indirect effect calculation is based on the path model. The indirect effect of teachers' external factors mediated through teachers' internal factors is significant (β = .51, $p < .001$) (Figure 4.1). The result of path analysis supports that the hypothesis. The teachers' external factors have indirect positive effect on teachers' self-efficacy in teaching science when mediated by teachers' internal factors.

3-3. Support from teachers' institutions has an indirect positive effect on self-efficacy of early childhood educators' science teaching mediated by teachers' educational experience for early childhood science education.

The hypothesis is supported when using the path analysis. The indirect factor (support from teachers' institutions) mediated through the efficacy of teachers' experience in education are significant (β = .26, $p < .01$) (Figure 4.1). As a result, the hypothesis is supported. The institutions' support for teachers have an indirect positive effect on self-efficacy in science teaching mediated by teachers' educational experiences in early childhood science education.

Hypothesis 4

Teachers' satisfaction with their work place has a direct and indirect positive effect on self-efficacy in early childhood educators' science teaching.

4-1. Teachers' satisfaction with their work places has a direct positive effect on self-efficacy in early childhood educators' science teaching.

Testing this hypothesis uses path analysis. Teachers' satisfaction with their work places was measured through the sum the total of salary, curriculum and working environment satisfaction. After reliability testing, the three items create a variable of satisfaction. The result of path analysis shows the hypothesis was not supported.

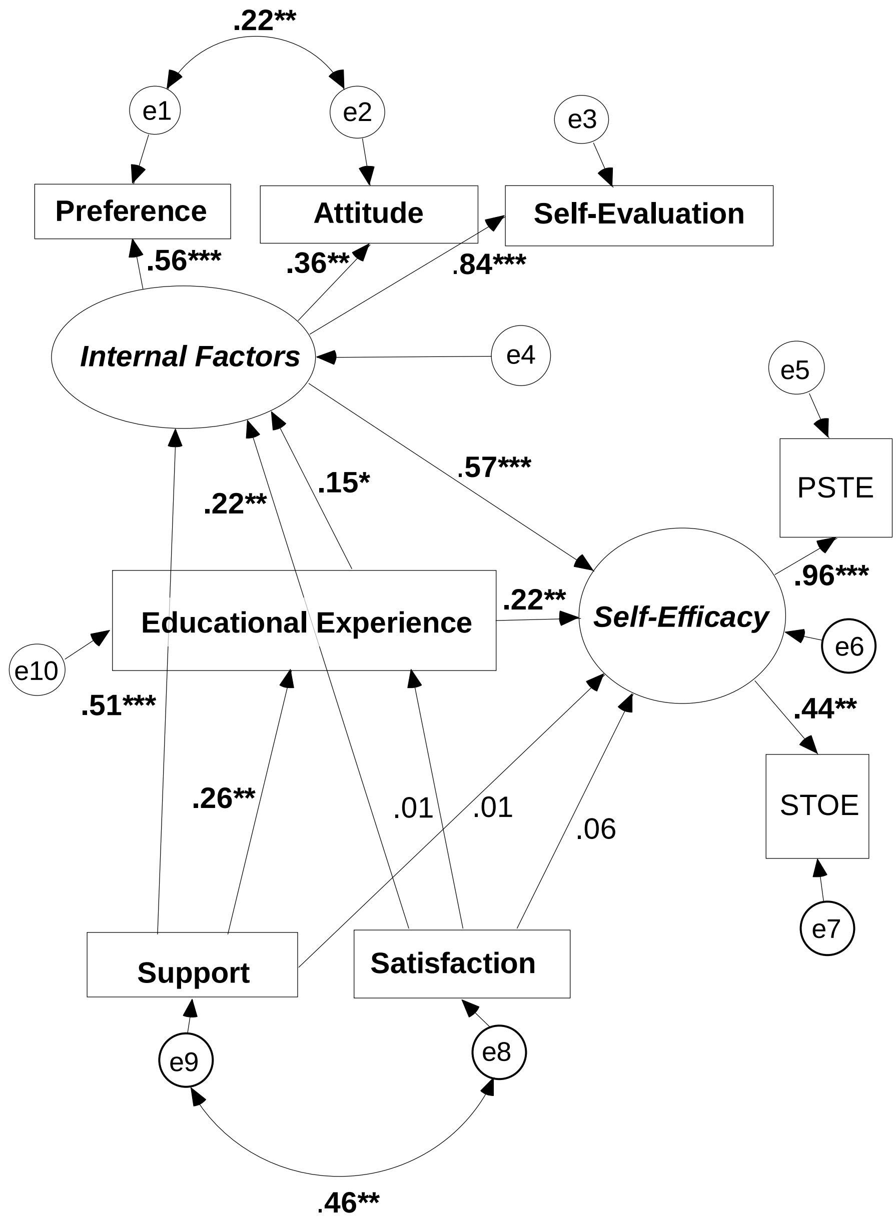
Teachers' satisfactions with their working places have no direct effect on self-efficacy in science teaching (β= .06) (Figure 4.1).

4-2. Teachers' satisfaction with their work places has an indirect positive effect on self-efficacy for early childhood educators' science teaching mediated by teachers' internal factors.

This hypothesis is supported when tested using path analysis. The indirect effect of teachers' satisfactions mediated though teachers' internal factors is significant ($\beta = .22$, $p < .01$) (Figure 4.1). Therefore, this hypothesis is supported. Teachers' satisfaction with their work places does have an indirect positive effect on self-efficacy in science teaching mediated by teachers' internal factors.

4-3. Teachers' satisfaction with their work places have a indirect positive effect on self-efficacy for early childhood educators' science teaching mediated by teachers' educational experience.

This hypothesis tested the indirect effect and calculation is based on the path analysis model. The indirect effect of teachers' satisfaction with their institution mediated through teachers' educational experiences is not significant ($\beta = .01$) (Figure 4.1). The hypothesis is not supported. Teachers' satisfaction with their work places do not have an indirect positive effect on their self-efficacy in teaching science when mediated by teachers' educational experiences.



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

Figure 4.1: Initial Model of Early Childhood Teachers' Self-Efficacy in Teaching Science with Estimated Standardized Path Coefficients

In sum, the teachers' internal factors do have a direct positive effect on science teaching self-efficacy. The direct effect of teachers' educational experience for science teaching is found to be significant on self-efficacy in teaching science. In addition, teachers' educational experiences do have an indirect positive effect on self-efficacy in teaching science when mediated by teachers' internal factors. Although support from institutions do not have a statistically significant direct positive effect, it does have an indirect positive effect on teachers' self-efficacy in teaching science when mediated by teachers' internal factors and experiences in early childhood science education. Teachers' satisfaction with their work places has no direct effect on self-efficacy in science teaching. However, teachers' satisfaction with their work places does have an indirect positive mediated by teachers' internal factors, and do not have an indirect positive effect on their self-efficacy in teaching science when mediated by educational experiences.

The model of early childhood teachers' self-efficacy in teaching science with the estimated path coefficients is standardized in Figure 4.1. This figure is a summary of the standardized path coefficients from path analysis using the AMOS program.

Fit Test

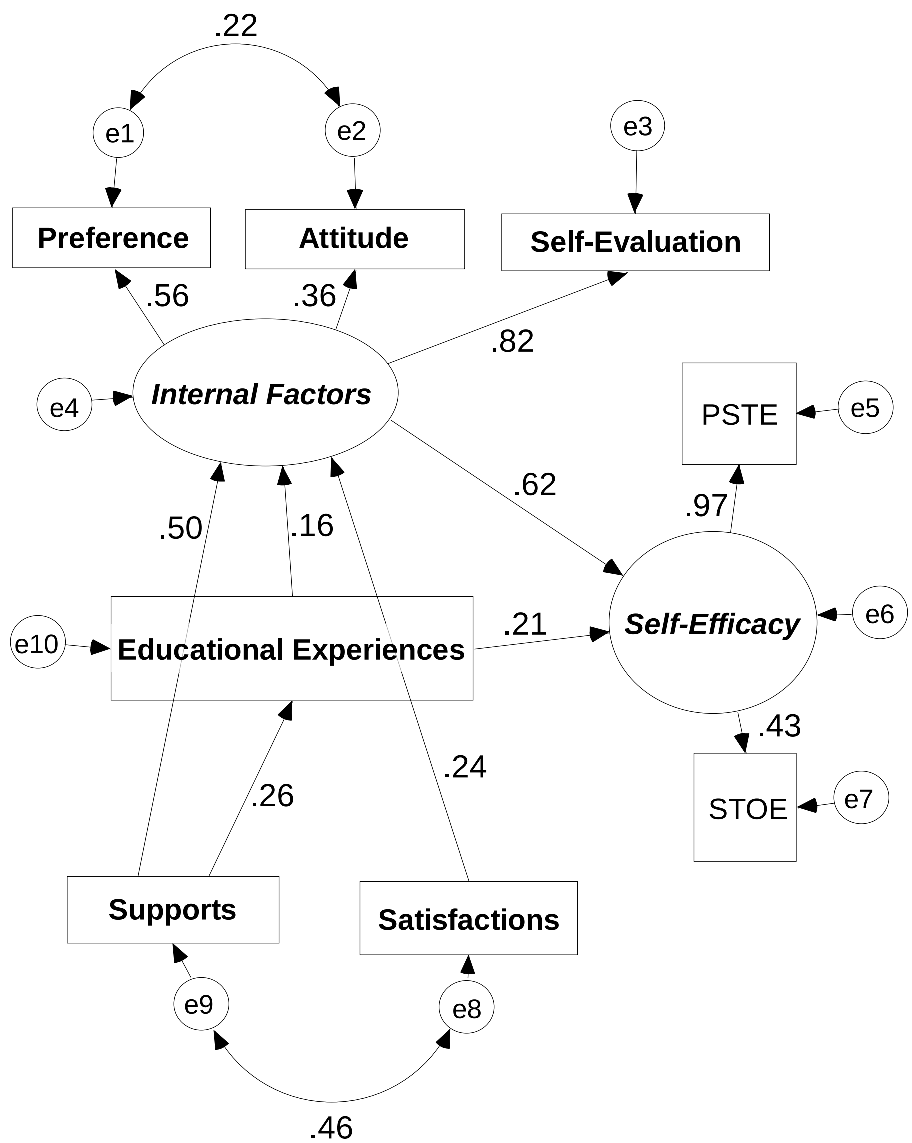
The suggested criterion levels (Table 4.9) identify the best fit model. The fit indices for initial and revised path models appear in Table 4.9.

Table 4.9: Fit Indices for Path Model

Model	X^2	*DF*	*p*	X^2/DF	IFI	TLI	CFI	RMSEA
Criterion	N/S		> .05	< 2	Nearly l	Nearly l	Nearly l	< .06
Initial	22. 471	12	.033	1.873	.977	.926	.975	.058
Revised	23.245	15	.079	1.550	.982	.954	.981	.046 *

Note : X^2 = Chi-Square
DF = the number of degrees of freedom for testing the model
P = Probability
IFI = Incremental Fit Index
TLI = The Tucker-Lewis coefficient
CFI = Comparative Fit Index
RMSEA= Root Mean Square Error

The revised form of the model is diagramed in Figure 4.2.



Note: All coefficients are significant at *p* <.05.

Figure 4.2: Revised Model of Early Childhood Teachers' Self-Efficacy in Teaching Science with Estimated Standardized Path Coefficients

Researchers (e.g., Hancock & Mueller, 2005; Hu & Bentler, 1999; Maruyama, 1998; Mueller, 1996; Tanaka, 1993) suggested using several indices that fall into the category of model fit indices including the absolute fit indices (e.g., X^2), relative indices (e.g., IFI, TLI CFI), and noncentrality-based indices (e.g., RMSEA).

Absolute fit indices do not use an alternative model as a base for comparison. They are simply derived from the fit of the obtained and implied covariance matrices. Chi-square (X^2) is the original fit index for structural models because it is derived directly from the fit function (Mueller, 1996). However, Chi-square (X^2) is not a very good fit index in practice for many situations because it is affected by sample size, model size, the distribution of the variables, and some of lack of fit because of omitted variables (Hancock & Mueller, 2005; Tanaka, 1993; Maruyama, 1998).

The relative fit indices compare a chi-square(X^2) for the model tested to one from an independence, baseline model. The independence model tested specifies that all measured variables are uncorrelated. There are several relative fit indices including Incremental Fit Index (IFI), Tucker-Lewis coefficient (TLI), and Comparative Fit Index (CFI). Generally, the values of IFI, TLI and CFI range between approximately 0 and 1.0. In the past, these index have generally been used with a conventional cutoff in which values larger than .90 are considered good fitting models, but there seems to be consensus now that this value should be increased to .95 (Muller, 1996; Hancock & Mueller, 2005; Tanaka, 1993; Maruyama, 1998).

Noncentrality-based indices include the RMSEA. Hu and Bentler (1999) empirically examined various cutoffs for many of above measures, and their data suggest that to minimize errors under various conditions, one should use a combination of one of the above relative fit indexes and the RMSEA (Root Mean Square Error) (good models <. 06).

The criteria for fit were almost reached in the initial model (Table 4.9), suggesting that a revised form of the model may have a better fit. The revised model accrues from deleting clearly insignificant paths that appear in the initial model, until the best fitting model has no identifiable, insignificant paths. The revised model indicates that IFI, TLI and CFI increased to around 1, and the RMSEA changed significantly, suggesting some improvement in fit. In this revised model, all of the factors influence early childhood teachers' self-efficacy in teaching science by direct or indirect effect.

Comparison of Models

A Chi-square Distributions Test (CHIDIST) using Microsoft Excel program compares the fit of the initial and revised models. First is the estimated difference between the chi-square values for each model. This difference, tested as a chi-square statistic, includes degrees of freedom equal to the difference in degrees of freedom for the two models (Anderson & Gerbing, 1988, pp.418-419). As a result, although the revised model did fit better than the initial model in the values of baseline comparisons (e.g., IFI, TLI, CFI) and RMSEA (Table 4.9), the difference was not significant between the two models (p = .09) (Table 4.10). Therefore, in this study, the initial model (Figure 4.1) is retained.

Table 4.10: Chi-square Distributions Test for Model Comparison

Statistic Information	Description	Analysis Process
X	The value to the evaluate distribution, a nonnegative number	Initial model X^2 –Revised model X^2 = .0774
DF	The number of degree of freedom	Initial model DF –Revised model DF = 3
P	Probability of Chi-square distribution	= .08559

Summary

This chapter's three sections describe the results of the study. The first section reports the results from the survey, including demographic characteristics and background related to science teaching. The responses of 263 teachers in Korea early childhood education proceed the data for analyses in this study.

The second section describes the five study variables in the path analysis, and the correlation among the variables. This analysis deals with the effect of in-service teacher education experiences on early childhood science education, as measured by the sum of five categorized items (self-study. conference & workshop. teacher training program, university coursework, and other experience). Because the range of variables was 453, the variable underwent correction by two times the square-root transformation for the path analysis. Internal factors consisted of three items with a .65 (Cronbach's alpha) level of consistency. The variables of satisfaction were transformed to three items with a five-Likert scale from Tschannen-Moran and Hoy (2002)'s five items with a nine point-

Likert response scale. This variable, supported by the factor analysis (% of variance =78.29) and has high reliability (Cronbach's alpha = .86). Teachers' satisfaction with their work places measures three items which are the satisfaction with their salary, the institutions' curricula and the working environment. Cronbach's alpha of reliability is .69, and the principal components model of factor analysis and varimax indicate 62.72%.

Relationships among the predictor variables of teachers' educational experience, internal factors, institution support, and satisfaction with work places on self-efficacy in science teaching were forth coming. As a result, all of the variables are significant within two dimensions of teachers' self-efficacy, PSTE and STOE.

The third section reports the results of hypotheses analyses. Teachers' internal factors and teachers' educational experiences are the predictor variables with a significant direct effect on the criterion variable of early childhood teachers' self-efficacy in teaching science. However, the institution support and satisfaction are not significant direct effects on teachers' self-efficacy in teaching science. Three predictor variables (teachers' educational experiences, support, satisfaction) have a significant indirect effect on early childhood teachers' self-efficacy mediated by teachers' internal factors. The support from institutions could influence self-efficacy in teaching science, mediated through teachers' experience in education.

CHAPTER 5

DISCUSSIONS, RECOMMENDATIONS AND CONCUISIONS

The primary purpose of this study was to investigate early childhood teachers' self-efficacy beliefs in science teaching. Specifically, this study determined the predictors of self-efficacy of early childhood teachers in science teaching and how the predictor factors influence teachers' self-efficacy beliefs for science teaching.

The focus of this chapter is to discuss the findings and limitations based on data analysis. In addition, the recommendations for future study and conclusions of this study are suggested for early childhood science education and early childhood teacher for science teaching.

Discussion of Findings

This section presents the discussion and findings of this study obtained by the survey and these are considered in association with prior research on teachers' self-efficacy in science teaching. The findings are discussed by each hypothesis.

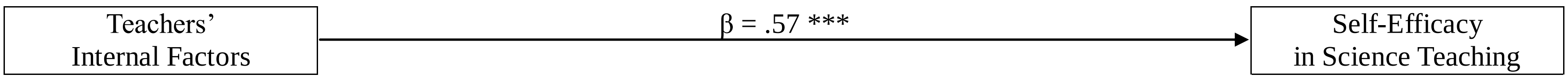
Hypothesis 1

The results of analysis for the first hypothesis show that teachers' internal factors have a direct positive effect on self-efficacy in early childhood teachers' science teaching, and therefore, the hypothesis is retained.

Teachers' internal factors are defined as three-single items such as teaching preference of early childhood science education, teaching attitude toward early childhood science education and self-evaluation of teachers in science teaching. The idea of these three items originated in the Ramey-Gassert (1996) model. These three items combine into one, "internal factors" at a time, after reliability test (Cronbach's alpha= .65). Inspection of the path model results indicates that teachers' internal factors are significant in predicting teachers' self-efficacy in science teaching to young children (β = .57, p < .001) (Figure 5.1). Therefore, the teachers' internal factors did have a direct positive effect on science teaching self-efficacy.

This result explains that teachers' internal factors are key predictor for positively impacting teachers' self-efficacy in science teaching. Therefore examining the other variables which could have positively influenced teachers' internal factors is necessary, because teachers' internal factors could act on teachers' self-efficacy as encouragement becoming a direct predictor. As could be expected, its mediating effects had support by other potential variables.

Measuring teachers' internal factor by several questions is not easy. Thus, previous research which investigated teachers' internal concepts relied on qualitative methodology through personal or group interviews and teaching observations.



β = Standardized regression weight

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

Figure 5.1: Pathway to Teachers' Self-Efficacy in Science Teaching from Teachers' Internal Factors

Several research studies investigated the correlation between teachers' internal factors and self-efficacy in science teaching. Most of research (e.g, Cho, 1997, Ramey-Gassert, 1996) used both qualitative and quantitative approaches, which provided information of teachers' internal factors through individual or group interviews, and determined the level regarding teachers' self-efficacy in science teaching by employing a measuring instrument (e.g., STEBI).

The results of previous research (Ramey-Gassert et al., 1996) suggested evidence that teachers' internal factors impact self-efficacy in science teaching. For example, teachers' attitude toward science and self-rated effectiveness for teaching science positively correlate with teachers' personal science teaching efficacy (PSTE), and teachers' choosing to teach science significantly associates with both personal science teaching efficacy (PSTE) and science teaching outcome expectancy (STOE).

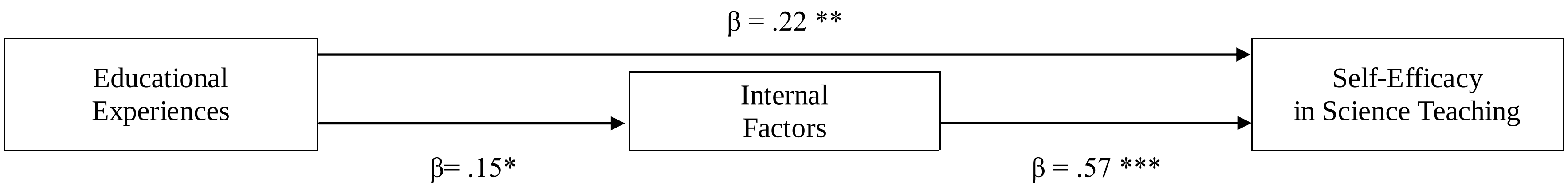
Hypothesis 2

In this study, analysis results of the second hypothesis shows that teachers' educational experiences in early childhood science education has direct and indirect positive effects on self-efficacy in science teaching.

Teachers' educational experiences for early childhood science education teaching were measured in five areas: self-study, conferences and workshops, teacher education programs, university coursework, and other experiences. The participants responded to questions regarding these five items according to hours per one year and relied on the average hours within a period of the most recent five years' experiences. The range of responses of teachers' educational experiences has extremely positive skew, because teachers' responses included from 0 to 454 hours experience (*M*=28.71, *SD*=46.79). Therefore, correction for the skew occurred by transforming the variable using two increments of the square-root (*M*=2.00, *SD*=.68, Table 4.4).

In the examination of the model, direct and indirect effects of teachers' educational experiences on teachers' self-efficacy in science teaching indicates that teachers' educational experiences are significant predictors which directly contribute to teachers' self-efficacy (β =. 22, $p < .01$) (Figure 5.2). In addition, the indirect effect of teachers' educational experiences mediated though teachers' internal factors was also significant (β = .15, $p < .05$) (Figure 5.2). This means that the teachers' educational experiences act as a direct factor to influence teachers' self-efficacy improvement, as do teachers' internal factors which positively influence teachers' self-efficacy in science teaching. Therefore, this hypothesis, teachers' educational experiences in early childhood science education having direct and indirect positive effects on self-efficacy in science teaching, is retained for this study.

The results of findings support the view of previous researchers that teachers' educational experiences for science teaching would more likely cause teachers to feel confident about influencing their students' achievement. Therefore, teachers' greater experience in attending in-service education for science teaching has a positive effect on teachers' confidence in their students' achievement (outcome expectancy) than teachers with less experience. Desouza (2004) had suggested similar findings: since self-efficacy



β = Standardized regression weight

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

Figure 5.2: Pathways to Teachers' Self-Efficacy in Science Teaching from Teachers' Educational Experiences

is related to motivational and attitudinal measures, their educational experiences may promote self-efficacy of teachers as they progress through teacher education programs for science teaching. That is to say, self-efficacy of teachers through professional development may provide some insight into how teachers develop a sense of confidence to teach science to young children.

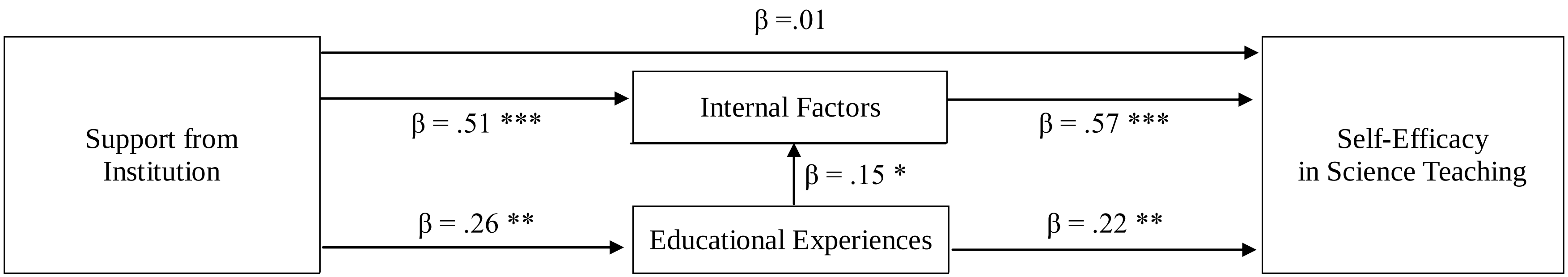
Hypothesis 3

This study tested the support teachers received from their institutions has a direct and indirect positive effects on self-efficacy in early childhood teachers' science teaching.

To analyze this hypothesis, the support from teachers' institutions were defined by teachers as administration support, colleagues' support and teaching resources support, all for science teaching. The resources, named as these three items, came from the Tschannen-Moran & Hoy (2002) scale for rating the quality of support received in five areas: teaching resources, interpersonal support provided by the administration of schools, interpersonal support provided by colleagues, parental support and involvement in classrooms, and community support provided for classrooms. In this research, since this study did not examine any variable related to children's parents and community, two of five items in the original scale (Tschannen-Moran & Hoy, 2002) related to parental support and involvement in classrooms, and community support provided for teachers' classrooms were eliminated. The variable of support from teachers' institutions was defined by the sum of three items after factor analysis (% of variance =78.30) and reliability test (Cronbach's alpha= .86).

The result using path analysis test shows that the direct effect of the support from teachers' institutions did not indicate to be significant ($\beta = .01$) (Figure 5.3). This result was not consistent with previous research which supported the importance of teachers' external support from their institutions to encourage teachers' self-efficacy in science teaching. To analyze the indirect effects of support from teachers' institutions on teachers' self-efficacy in science teaching, teachers' internal factors and educational experience were employed as mediating factors. As a result, both of the indirect effects mediated are significant (internal factors $\beta = .51$, $p<.001$; educational experiences $\beta = .26$, $p <.01$) (Figure 5.3).

In the sum, the support from teachers' institutions had no direct positive effect on teachers' self-efficacy in teaching science, but had indirect positive effects when mediated by teachers' internal factors and teachers' educational experiences. This means, that, although the support from teachers' institutions could not influence teachers' self-efficacy directly, the variable is still an important predictor which encourages teachers' self-efficacy in science teaching due to indirect action. Because the variable of support from teachers' institution had a positive relationship with teachers' internal factors and teachers' educational experiences, teachers' institutional support has the probability to improve teachers' self-efficacy in science teaching. Teachers' internal factors and educational experiences are encouraged by institutions' support of teachers, and, as a result, the increase to teachers' internal factors and educational experiences would positively influence teachers' self-efficacy beliefs in science teaching.



β = Standardized regression weight

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

Figure 5.3: Pathways to Teachers' Self-Efficacy in Science Teaching from Emotional and Material Support of Teachers' Institutions

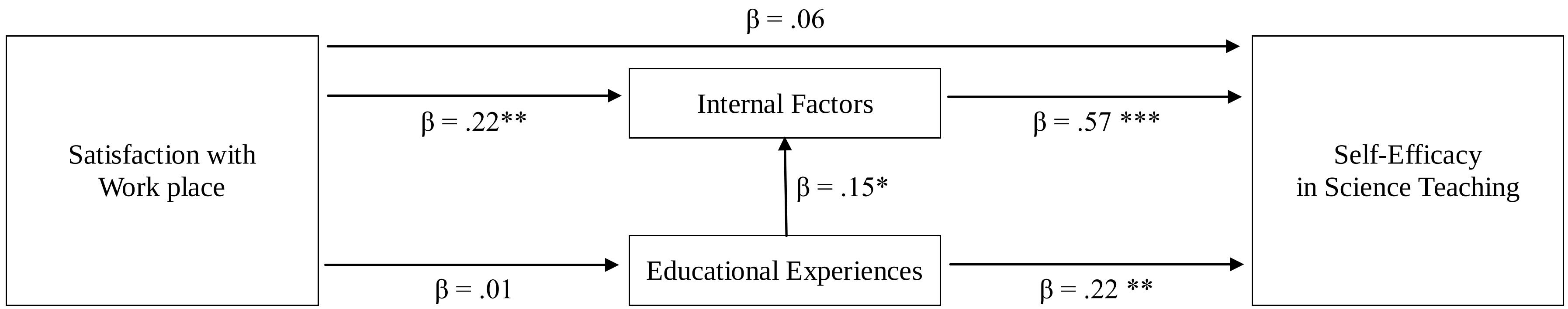
Several studies had evidence that emotional and material support from teachers' administration and colleagues affected teachers' self-efficacy for inspiration. Riggs (1994) investigated potential factors for increasing science self-efficacy for in-service teachers. Teachers were grouped by school and in-service by teams of educators and scientists in the FOSS elementary science program. Among many variables, which were found to affect science self-efficacy positively, Riggs described the value of in-service teacher interacting with each other as they planned for teaching their group lessons. Riggs reported that "teachers were able to share ideas, experiences, and competencies as they reaped verbal encouragement" (p 10). In a similar study of in-service teachers and science self-efficacy, Ramey-Gassert (1994) concluded that personal science teaching efficacy can be positively influenced through collegial support. Also concluded by Ginns and Watters (1999), experienced peer teachers, school principals, and teacher educators must provide continuous and positive feedback to reinforce in-service teachers' beliefs about their abilities to teach science. One common thread, which binds these studies together, is the opportunity for teachers to talk with, and offer support to, each other. The importance is not only the effect of administrators' and colleagues' support, but also material support for teaching science on teachers' self-efficacy beliefs. Several researchers found that inadequate facilities and lack of resources for science education in school were other causes of teachers' poor self-efficacy in science teaching and teaching practices (Cho, 1997; Munby, 1983; Mechling, 1984).

Hypothesis 4

The tests for direct and indirect effects of teachers' satisfaction with their work places on self-efficacy in early childhood teachers' science teaching indicates an indirect effect by the mediated model had statistical significance (Figure 5.4).

In this study, teachers' satisfaction with their work places had measurement through the sum of three requested items of information related to salary, curriculum and working environment satisfactions. This variable, as a predictor factor, influencing teachers' science teaching was created by research based on Ramey-Gassert's (1996) model of factors influencing science teaching self-efficacy. Justification for these items could be a representative variable of teachers' satisfaction with their work places, used the principal components model of factor analysis and varimax rotations. In addition, Cronbach alpha of reliability was the test for relationships among the items. The result of factor analysis and varimax indicates that 62.72% of the variance is explained, and the Cronbach's alpha of reliability was .69.

The result of the direct effect of teachers' satisfaction with their work places on self-efficacy in early childhood educators' science teaching was not significant ($\beta = .06$) (see Figure 5.4). To examine the indirect effects by mediation factors, teachers' internal factors and educational experiences were employed for this model. The results of the indirect effects analyses suggest that teachers' satisfactions, mediated though teachers' internal factors reported a significant effect ($\beta = .22$, $p < .01$), but educational experiences did not ($\beta = .01$) (see Figure 5.4).



β = Standardized regression weight

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

Figure 5.4: Pathways to Teachers' Self-Efficacy in Science Teaching from Satisfaction with Teachers' Work Places

In the sum, the test results of teachers' satisfaction with their work places having a direct or indirect effect on teachers' self-efficacy in science teaching found just one significant, indirect effect by a mediated model when teachers' internal factors were employed. Although the variable of satisfaction with teachers' work places could not directly contribute teachers' self-efficacy in science teaching, this variable is still an important predictor which has the probability of affecting teachers' self-efficacy enhancement as an indirect action. Because teachers' satisfaction with their work places could have a positive effect on teachers' internal factors toward early childhood science education, it would, therefore, enhance teachers' self-efficacy in science teaching.

Several studies found that workplace environments were associated with teachers' perceptions of science teaching. Dembo and Gibson (1985) strongly supported a positive relationship among high teaching efficacy and schools' supportive workplace characteristics. Similar to this finding, Ajzen (1998) inferred that professional teachers' self-efficacy in science teaching may vary in different social and physical school environments. Teachers with satisfactory school environments, physically as well as socially, showed high-levels of teaching confidence and expectancy for students' learning, which lead to students' achievement in science education. Desouza's (2004) research indicated support for teachers, in the contexts of their working environments, could lead to more hands-on and interactive classroom teaching. Hands–on and interactive teaching are representative behaviors of teachers who have high self-efficacy in science teaching (Chwalisz et al., 1992; Enchos et al.,1995).

Limitations

This study provides some significant findings about early childhood teachers' self-efficacy in science teaching, but it also has several limitations. These limitations could impact future research in early childhood science education.

The first limitation in this research is the self-selected sample of teachers who volunteered to participate. Because the population of in-service teachers working at one of five typical early childhood education centers in Korea is widely dispersed, a web-based survey was designed to reach them easily. However, the web-based survey has a limitation which is that a teacher who can not connect to the web-survey through the Internet could not participate in this study. Thus, a sampling of potential participants for this study did not have an equal chance of being selected. For this reason, the sample of early childhood teachers used in this study may not be representative of the total population of early childhood teachers in Korea.

Second, the results of this study have a limitation according to the reliability and validity of measurement of teachers' internal factors. The sub-items of teachers' internal factors came from Ramey-Gassert's (1996) model which was of non-experimental design. Applying the path model created the factor from three items (e.g, teaching preference, attitude toward early childhood science education and self-evaluation in science teaching). Although, these single-items underwent classification into research factors after reliability testing, justifying a factor which could represent a generalized concept is difficult when measurement occurs through analysis of several individual items.

Third, STEBI has limitations. Although the instrument was found to be reliable

(PSTE alpha = .78, STOE alpha= .69), the alpha did not increase or was lower than that found in previous studies. Participants commenting on a lack of clarity related to some items on the questionnaire may have contributed to the questionnaire's reliability. In addition, this questionnaire was designed for elementary school teachers. Even though, a panel of experts in early childhood science education was involved in the modification of the instrument to make it appropriate for the early childhood teaching level, it may not accurately represent the attributes which depict perceptions of early childhood teachers' self-efficacy in science teaching.

Fourth, this study was limited to investigation by path analysis of the created model. In this study model, just several selected variables were tested. Other variables, (e.g., pre-service teacher experiences) which were not studied, could influence the dependent variable. The path model for this study is based on probabilities in early childhood teachers' science teaching. Other path analysis models, involving how predictors influence teachers' self-efficacy in science teaching, could also be useful.

Recommendations for Future Study

Even though almost 30 years of research has been devoted to this area, questions regarding how to measure self-efficacy and what interventions are likely to affect self-efficacy still remain. Further more, central to further research is a need to determine how efficacy influences teaching practice and subsequent student achievement. Possible research topics for future study include:

Early Childhood Science Education

The ultimate purpose of development of teachers' self-efficacy is to positively contribute to children's learning. Therefore, studies of teachers' self-efficacy in science teaching beliefs and their impact on the quality of the children's learning are necessary.

Early Childhood Teacher Education for Science Teaching

The studies of appropriate teacher education programs, to apply classroom teaching directly to raise teachers' sense of efficacy during professional experience activities, are necessary. Based on those studies, the teacher educator should be made aware of the nature of self-efficacy, how belief can be identified, and how positive beliefs can be nurtured in early childhood teachers.

Early Childhood Science Education and Early childhood Science Teaching Research

Performing a longitudinal study to provide greater insight into the actual growth of teachers' self-efficacy in science teaching is needed.

Conclusions

Teaching efficacy is broadly defined as a situation specific expectation that teachers can influence student learning (Ashton & Webb, 1986; Bandura, 1997; Cantrell, 2003). Efficacy expectations influence teachers' thoughts and feelings, their choices for classroom learning activities, the amount of effort they are willing to expend, and their persistence in the face of obstacles. Over the past two decades, researchers have found important correlations with teacher efficacy. Teachers with high efficacy are more effective, their students perform at higher levels on standadized tests, and their students have more postive attitudes toward the content areas taught by these teachers (Anderson, Greene, & Loewen, 1988; Ashton &Webb, 1986; Cantrell, 2003; Moore & Esselman, 1992; Tschannen-Moran, Hoy& Hoy, 1998).

The work of several resesarchers (Ashton &Webb, 1986; Enochs & Riggs, 1990; Gibson &Dembo, 1984; Guskey &Passaro, 1994; Woolfork &Hoy, 1990) supports the existence of two relationships to Bandura's two dimensions of self-efficacy, which are personal efficacy and outcome expectacny. An effective instrument used to measure the constuct of science teaching is the Science Teaching Efficacy Belief Instrument (STEBI) (Encochs &Riggs, 1990). The STEBI measures the two factors of science teaching efficacy: personal science teaching efficacy (PSTE) and science teaching outcome expectacny (STOE).

Even though early childhood curricula vary among different elementary schools in many respects, most research focuses on elementary level, pre-service teachers, and rarely on early childhood in-service teachers. Approaching science education for young children from an early childhood perspective rather than from simply modifying elementary science curricula is important. Early childhood level research, especially in-service focus is necessary because many studies have shown that early childhood teachers have low teaching confidence in science education when compared to other subjects Cho, 1998; Lee, 2000; Pedersen & McCurdy, 1992; Wylo, 1993). This result leads to avioding teaching science, and science education becomes an isolated subject. This has a negative effect on childrens' learning.

Some teachers teach science to students more often and effectively than others.

Statistics show that which predicts influence teachers' self-efficacy in science teaching, but it has not been systematically analyzed as to how. Therefore, this study investigates the pathway to influencing teachers' self-efficacy in science teaching, that is, how the predictor factors encourage teachers' self-efficacy beliefs in science teaching.

The model of predictors influencing early childhood teachers' self-efficacy in this study is presented in Figure 5.5.

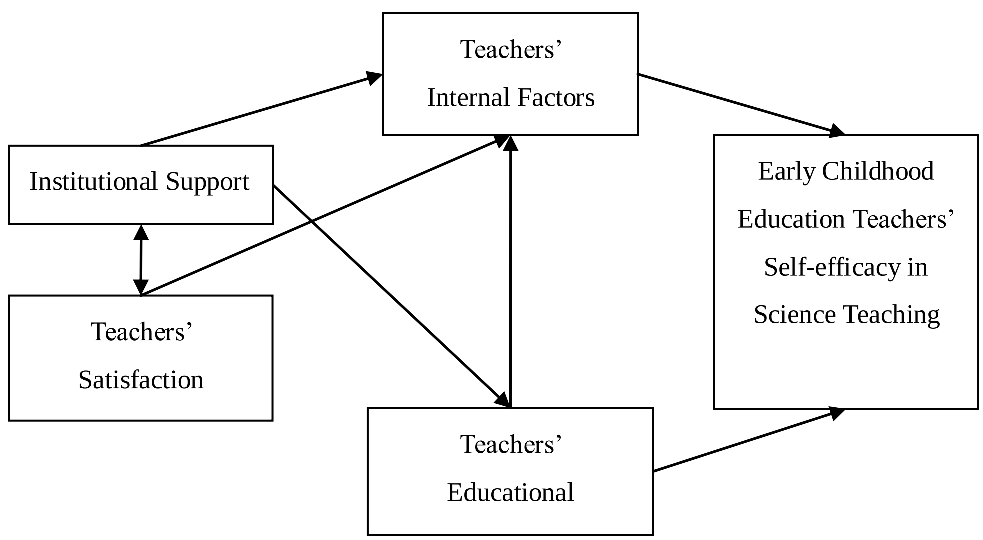


Figure 5.5: Pathways of Predictors Influencing Teachers' Self-Efficacy in Science Teaching in This Study

There are several derived conclusions from the findings of this study. These conclusions follow:

First, teachers' internal factors, teachers' characteristics, preferences in teaching, teaching attitude toward early childhood science education, self-evaluation in science teaching, are critical predictors which could impact teachers' self-efficacy in science teaching. Especially, teachers' internal factors are key predictor in this study to impact positively teachers' self-efficacy in science teaching, because teachers' internal factors could be act on teachers' self-efficacy encouragement as a direct predictor as well as could be expected its mediated effects supported by other potential variables. Therefore, examining the other variables which could positively influence teachers' internal factors is continuously necessary.

Second, general knowledge and personal teaching philosophy attribute to many educational classes completed at the College of Education, but also from a lifetime of interactions with children, parents, peer teachers, work environment, and societal influences. These supply experiences which should contribute to change, either positive or negative, in the teachers' self-efficacy beliefs in science teaching. Therefore, early childhood teacher educators need to be concerned with teacher education programs to encourage positive self-efficacy beliefs in early childhood teachers in science teaching. Further illumination can arise from the systematic study of individuals as they move through teacher preparation into professional practice.

Third, support from administrators and colleagues, and teaching resources are also important reinforcements for good practices and acknowledge, explicitly effective for instruction of science to teachers. This support is welcomed, and all early childhood teachers acknowledge the impact of this support for maintaining their overall confidence as teachers.

Fourth, satisfaction with teachers' work place stimulates teachers' internal factors which influence teachers' self-efficacy in science teaching. In addition, teachers' satisfaction has a correlation with their institutional support. Therefore, teachers' satisfaction with work places is also an important predictor which has the probability of impacting teachers' self-efficacy inspiration.

Summary

Because teaching self-efficacy has been shown to be correlated to teaching behavior, research on this topic should be continues. The purpose of this study is to examine early childhood teachers' self-efficacy in science teaching and the related factors that may contribute to these beliefs. Specifically, this study is to determine the predictors of the self-efficacy of early childhood teachers in science teaching and how the predictor factors influence teachers' self-efficacy beliefs in science teaching. The participants of this study are drawn from early childhood teachers who have taught in private and public kindergartens, and private, public, and cooperative daycare centers in Korea. The instrument used in the study are the Science Teaching Efficacy Belief Instrument (STEBI-A), Scale of Emotional and Material Support from Teachers' Institutions and a demographic questionnaire which was designed by web-based survey form.

The results of the study have lead to recommendations and conclusions in the preceding section. This study offers critical evidence as to how early childhood teachers improve their self-efficacy in science teaching. The paths of predictors' positive affect on teachers' self-efficacy is helpful to experts to plan early childhood teacher education by encouraging the productive path.

REFERENCE

Afifi, A., Clark, V. A., & May, S. (2004). *Computer-Aided Multivariate Analysis* (4th ed.). Chapman & Hall/CRC.

Amos (Version 6.0) [Computer software and brief guid]. (2006). Chicago, IL: LEAD: Technologies Inc.

Arbuckle, J. L. (2005). *Amos 6.0 User's Guide*. Chicago, IL: SPSS Inc.

Anderson, J. & Gerbing, D. (1988). Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach, *Psychological Bulletin*, 103, 411-423.

Anderson, R., Greene, M., & Loewen, P. (1988). Relationships among teachers' and students' thinking skills, sense of efficacy, and student achievement. *Alberta Journal of Educational Research,* 34, 148-165.

Armor, D., Conroy-Osefuera, P., Cox, M., King, N., McDonnell, L., Pascal, A., Pauly, E., & Zellman, G. (1976). *Analysis of the school preferred reading programs in selected Los Angeles minority schools* (Report No. R-2007-LAUSD). Santa Monica, CA: Rand (Eric Document reproduction service no: ED 130 243).

Ashton, P. T., Webb, R. B., & Doda, C. (1983). *A study of teachers' sense of efficacy* (final report, Executive Summary). Gainsville: University of Florida.

Ashton, P. (1984). Teacher efficacy: A motivational paradigm for effective teacher education. *Journal of Teacher Education,* 35 (5), p28-32.

Ashton, P. (1985). Motivation and the Teacher's Sense of Efficacy. p. 141–171 in *Research on Motivation in Education,* C.Ames and R.Ames, Eds. Orlando, FL: Academic Press.

Ashton, P., & Webb, R. (1986). *Making a difference: Teacher's sense of efficacy and student achievement.* New York: Longman.

Ajzen, I. (1998). Models of human socal behaviour and their application to health psychology. *Psychology and Health,* 13, p735-740.

Bandura, A.(1977). Self-Efficacy: Toward a unifying theory of Behavioral change. *Psychological Review, 84* (2), p191-215.

Bandura, A.(1981). Self-referent thought: A developmental analysis of Self-efficacy. In Flavell, J. H., and Ross, L. (Eds.), *Social Cognitive Development Frontier and Possible Future*, p200–239. Cambridge, England: Cambridge University Press.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), p 122-147.

Bandura, A. (1986). *Social foundations of though and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1995). *Self-efficacy in changing societies.* Melbourne, Australia: Cambridge University Press.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.

Bandura, A. (2000). Self-efficacy: Foundation of agency. In W. Perrig & A. Gorb (Eds.), *Control of human behavior, mental processes, and consciousness*, p 17-33. Mahwah, NJ: Lawrence Erlbaum.

Berman, P., & McLaughlin, M.(1977). *Federal programs supporting educational change ,Vol.7, Factors affecting implementation and continuation* (Report No.

1589/7-HEW). Santa Monica, CA: Rand.

Bleicher, R.E. (2001). *Building science teaching confidence in preservice elementary teachers.* Paper presented at the annual meeting of the National Association of Research in Science Teaching Association, St. Louis, MO.

Bleicher, R.E. (2002). *Increasing confidence in preservice elementary teachers*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Bleicher, R. E. (2004). Revisiting the STEBI-B: Measuring Self-Efficacy in Preservice Elementary Teachers. *School Science and Mathematics, 104* (8), p 383-391.

Bleicher, R.E., & Lmdgren, J. (2002). Building confidence in preservice elementary science teachers. In P. Rubba, W. DiBiase, & B. Crawford (Eds.), *Proceedings of the 2002 Annual International Conference of the Association for the Education of Teachers in Science*, p 1549-1562. ERIC Document Reproduction Service No. ED 465 602.

Cannon, J. (2001). *Influence of an extended elementary science teaching practicum experience upon preservice elementary teachers' science self-efficacy*. Retrieved 5/7/01 from http://www.ed.psu/ci/Journals/97pap8.html.

Cannon, J. R., & Scharmann, L. C. (1996). Influence of a cooperative early field experience on preservice elementary teachers' science self-efficacy. *Science Education, 80*(4), p 419-36.

Cho, H. S. (1997). *Early Childhood Teachers' Attitudes toward Science Teaching*. Doctoral dissertation, Pennsylvania State University.

Cho, H. S. (1998). Self-efficacy of kindergarten teacher. *Korea Society for Early*

Childhood Education, 18 (2), p 1-22.

Cho, B. W. (2004). The effect of a developmentally appropriate instruction model of science of on a preschoolers' scientific concepts. *The Journal of Korea Open Association for Early Childhood Education, 9* (4), p 25-55.

Choi, I. S. (2001). *Early childhood science education for problem solving with inquiry.* Seoul: Hakgisa.

Chwalisz, K. D., Altmaier, E. M., & Russell, D. W. (1992). Causal attributions, self-efficacy cognitions, and coping with stress. *Journal of Social and Clinical Psychology, 11*, p 377-400.

Cronin-Jones, L., & Shaw, E.L. Jr. (1992). The influence of methods instruction on the beliefs of preservice elementary and secondary science teachers: Preliminary comparative analysis. *School Science and Mathematics, 92*(1), p14-22.

Czerniak, C. M. (1990). A study of self-efficacy, anxiety, and science knowledge in preservice elementary teachers. Paper presented at the National Association for Research in Science Teaching, Atlanta, GA.

Dembo, M.H. & Gibson, S. (1985). Teachers' sense of efficacy: An important factor in school improvement. *Elementary School Journal, 86*, p 173-184.

Desouza, J. M. S., Boone, W. J., & Yilmaz, O. (2004). A study of science teaching self-efficacy and outcome expectancy beliefs of teachers in India. *Science Education, 88* (6), p 837-854.

Enochs, L. G., & Riggs, I. M. (1990). Further development of an elementary science teaching efficacy beliefs instrument: a preservice elementary scale. *School Science and Mathematics, 90,* p 695-706.

Enochs, L. G., Scharmann, L. C., & Riggs, I. M. (1995). The relationship of pupil control to preservice elementary science teacher self-efficacy and outcome expectancy. *Science Education*, *79,* p 63-75.

Enochs, L., Smith, P.L., & Humker, D. (2000). Establishing factorial validity of the mathematics teaching efficacy beliefs instrument. *School Science and Mathematics*, 10, p 194-202.

Finson, K.D. & Beaver, J.B. (1994). *A study of the status of science education in Illinois scientific literacy target schools, K-6*. Macomb, IL: Western Illinois University.

Finson, K. D., Riggs, I. M., & Jesunatahadas, J. (1999). *The relationship of science teaching self efficacy and outcome expectancy to the Draw-A-Science-Teacher Teaching Checklist*. Paper presented at the annual international conference of the Association of Educators of Teachers of Science, Austin, TX.

Fleer, M. (1991). Socially constructed learning in early childhood science education. *Research in Science Education 21*, p 96-103.

Gibson, S., & Dembo, M. H. (1984). Teacher efficacy: A construct validation. *Journal of Educational Psychology, 76*, p 569-582.

Ginns, I. S. & Watters, J. J. (1999). Beginning elementary school teachers and the effective teaching of science. *Journal of Science Teacher Education, 10*(4), p 287-313.

Han, Y. M. (2004). Teacher's awareness toward educational goals and teaching strategies for early childhood science education. *Journal of Future Early Childhood Education, 11* (2), p 121-138.

Henson, R.K. (2001). *Teaching self-efficacy: Substantive implications and measurement dilemmas*. Paper presented at the annual meeting of the Educational Research Exchange. College Station, TX.

Hsu, C. H. (2002). *Early childhood educators' professional development in Taiwan.* Doctoral dissertation, Pennsylvania State University.

Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling,* 6, p 1-55.

Jarrett, O. S. (1999). Science interest and confidence among preservice elementary teachers. *Journal of Elementary Science Education, 11*(1), p49-59.

Kim, J. J, & Kim, Y. S. (2004). A survey of early childhood teachers' science education and their need for educational support. *The journal of Early Childhood Education, 8* (2), p 157-181.

Kwon, E. (1990). Beyond teaching for "understanding" in early science: A Deweyan criticism. *The journal of Early Childhood Education, 8* (3), p 205-228.

Lawal, O. (2003) *Strategic Reforms of the Nigerian Education System To Meet the Future Challenges Ahead of the Nigerian Child*. Annual Research Network Meeting and Conference of Children in Agriculture Programme (CIAP), Adeniran Ogunsanya College of Education, Ijanikin. .

Lee, K. M. (2000).*Discovery science :Exploration for the early years*. Doctoral dissertation, Jung Ang University: Korea

Lumpe, A.T., Haney, J.J., & Czerniak, C.M. (2000). Assessing teachers' beliefs about their science teaching context. *Journal of Research in Science Teaching*, p 37, 275-292.

Markle, G. C. (1978). Assessing the validity and reliability of the subject preference inventory with preservice elementary teachers. *Journal of Research in Science Teaching*, *15*(6), p 519-522.

Martin, D. J. (2001). *Constructing early childhood science-Includes national science education standards.* NY: Delmar Thompson Learning.

Moore, W., & Esselman, M. (1992). *Teacher efficacy, power, school climate and achievement: A desegregating district's experience*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco.

Morrell, P. D., & Carroll, J.B. (2003). An extended examination of preservice elementary teachers' science teaching self-efficacy, *School Science and Mathematics, v. 103,* p. 246-251.

Muller, W. K(1996). High Gravity Brewing, *MBAA Tech. Quart. 33*(1), p 16-19.

Munby, H. (1983). Thirty studies involving the "scientific attitude inventory": What confidence can we have in this instrument? *Journal of Research in Science Teaching, 20*, p 141-162.

Pajares, M. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*, p 301-332.

Pajares, F. (1996). Self-efficacy belief in academic settings. *Review of Educational Research, 66* (4), p 543-578.

Pedersen, J. E., & McCurdy, D. W. (1992). The effect of hands-on, minds-on teaching experiences on attitudes of preservice elementary teachers. *Science Education, 76*(2), p 141-146.

Plourde Lee A., (2002). The influence of student teaching on preservice elementary teachers' science self-efficacy and outcome expectancy beliefs. *Journal of Instructional Psychology*, 29, p 245-253.

Ramey-Gassert, L., Shroyer, M. G., & Staver, J. R (1996). A qualitative study of factors influencing science teaching self-efficacy of elementary level teachers. *Science Education, 80* (3), p 283-315.

Riggs, LM. (1988). *The development of an elementary teachers ' science teaching efficacy belief instrument*. Unpublished doctoral dissertation, Kansas State University, Manhattan, KS.

Riggs, I. R. & Enochs, L.,G (1990). Toward the development of an elementary teacher's science teaching efficacy belief instrument. *Science Education, 74* (6), p 625-637.

Riggs, A. (1994). Gender and technology Education, in Banks, F *Teaching Technology*, Open University Press.

Ritter, J.M., Boone, W.J., & Rubba, P.A. (2002). *Extension of the self-efficacy beliefs about equitable science teaching and learning instruments to include learning support and gifted and talented students*. Paper presented at the annual meeting of the Association for the Education of Teachers in Science, Charlotte, NC.

Rivkin (1992). *Science Is a Way of Life. Young Children*, 47 (4). NAEYC. Washington, DC.

Rubeck, M. L., & Enochs, L. G. (1991). *A path analytical model of variables that influence science and chemistry teaching self-efficacy and outcome expectancy in middle school science teachers*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Anaheim, CA.

Rubeck, M.E., & Enochs, E.G. (1991). *A path analytical model of variables that influence science and chemistry teaching self-efficacy and outcome expectancy in middle school science teachers*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Fontana, WI.

Schoon, K.J., & Boone, W.J. (1998). Self-efficacy and alternative conceptions of science of preservice elementary teachers. *Science Education*, 82, p 553-568.

Schwandt, T., A. (2001). *Dictionary of qualitative inquiry* (2^{nd}ed.). Thousand Oaks, CA: Sage.

Settlage, J. (2000). Understanding the learning cycle: Influences on abilities to embrace the approach by preservice elementary school teachers. *Science Education*, 84, p 43-50.

Simons, J. A., & Simons, F. A. (1986). Montessori and regular preschools : A comparison, In Katz, L. G. (ed.), *Current Topics in Early Childhood education, 1*(6), p 195-223.

Soodak, L., & Podell, D. (1993). Teacher efficacy and student problems as factors in special education referral. *Journal of Special Education, 12,* p 66-81.

Spodek, B., Saracho, O., & Peters, D. (1988). Professionalism, semiprofessionalism, and craftsmanship. In B. Spodek, O. Saracho & D. Peters (Eds.), *Professionalism and the early childhood practitioner,* p 3-9. New York: Teachers College Press.

Satiatical Package for Social Science (Version 14.0) [Computer sortware and brief guide] (2006). Chicago, IL: LEAD Technologies Inc.

Stevens, C., & Wenner, G. (1996). Elementary preservice teachers' knowledge and beliefs regarding science and mathematics. *School Science and Mathematics*, 96, p 2-9.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics (4th ed.*). MA : Allyn and Bacon.

Tosun, T. (2000). The impact of prior science course experience and achievement on the science teaching self-efficacy of preservice elementary teachers. *Journal of Elementary Science Education,* 72, p 21-31.

Tschannen-Moran, M., Woolfolk Hoy, A., & Hoy, W. K. (1998). Teacher efficacy: Its meaning and measure. *Review of Education Research, 68* (2), p202-48.

Tschannen-Moran, M., & Hoy, A. W.(2002, April). *The influence of resources and support on teachers' efficacy beliefs.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA

Urdan, T., C. (2001). *Statistics in Plain English*. Lawrence Erlbaum Association, Mahwah, NJ.

Wassermann, S., & Ivany, J. W. (1988). *Teaching elementary science*. New York: Harper & Row.

Weiss, I., Nelson, B., Boyd, S., & Hudson, W. S. (1993). *The effect of the student teaching experience upon preservice elementary teachers' attitude and anxiety involving science and science teaching.* ERIC Document Reproduction Service No. 365542.

Wigfield, A., & Harold, R.D. (1992). Teacher beliefs and children's achievement self-perceptions: A developmental perspective. In Schunk, D. H., & Meese, J. E. (Eds). *Student perceptions in the classroom.* Hillsdale, NJ: Earbaum.

Wingfield, M.E., & Ramsey, J. (1999, January). *Improving science teaching self-efficacy of elementary preservice teachers.* Paper presented at the annual meeting of the Association for the Education of Teachers of Science, Austin, Texas

Wilson, J. D., & Scharmann, L. C. (1994). *An evaluation of field experiences for the preparation of elementary teachers for science, mathematics, and technology*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Anaheim, CA.

Wylo, B. L. (1993). *Effect of a science program for preservice elementary teachers on attitudes toward science and teaching science.* Doctoral Dissertation, The University of Michigan.

<Appendix A-1>

Recruitment Letter

Dear Teacher,

Hello, I am Yang Eun Kim a doctoral candidate in the Childhood Education Education Program at Pennsylvania State University in the United States. This email is to invite you to participate in my research project. The purpose of the study is to determine in-service teacher's self-efficacy with regard to teaching science in early childhood education centers. To complete my research, I need to collect data based on a survey to be completed by early childhood education centers teachers in Korean. I would be grateful if you would agree to participate. If you are willing to consider becoming a responding subject, please open the attached file.

Thank you very much for your consideration.

Sincerely yours,

Yang Eun Kim

The Pennsylvania State University

Ph.D Candidate

Email: yuk120@psu.edu

Telephone: 814-880-6799

<Appendix A-2>

Recruitment Letter

선생님께

안녕하십니까?

저는 미국 펜실베니아 주립대학교 박사과정에 재학중인 김양은입니다.

연구의 참여자를 모집하기 위해 편지를 보내게 되었습니다. 제 연구의 목적은 유아교육기관에 근무하시는 선생님들의 과학 수업 시 갖는 교수 효능감에 영향을 주는 여러 변인들의 경로를 분석하고자 계획되었습니다.

이 연구를 위해서 선생님들의 설문응답이 필요하오니, 많은 협조를 부탁드립니다. 이 연구에 참여하시길 동의하신다면, 보내드린 웹주소를 클릭하거나 첨부파일을 열어주시기 바랍니다.

선생님의 협조에 감사드립니다.

김 양 은

펜실베니아 주립대학교 박사과정

Email: yuk120@psu.edu

전화:1- 814-880-6799

Page 1 of 1

<Appendix B-1>

Informed Consent Form

INFORMED CONSENT FORM FOR INTERNET-BASED RESEARCH

The Pennsylvania State University

Title of Project: Self-Efficacy with Regard to the Teaching of Science of Early Childhood Teachers in Korea

Principal Investigator: Yang Eun Kim
425Waupelani Dr. #320
State College, PA16801
Email: yuk120@psu.edu
Phone: 814-880-6799

Faculty Advisor: Dr. Thomas D. Yawkey
165 Chambers Building, University Park, PA16802
Email: tdy1@psu.edu
Phone: 814-863-2937

1. Purpose of the Study:

The overall purpose of this study is to examine the self-efficacy of early childhood educators regarding their instruction of science to young children in Korea. In order to achieve the purpose of the investigation, this study focuses on examining what factors influence teachers' self-efficacy.

2. Procedure to be Followed:

1) If you, as an in-service teacher of kindergarten in Korea, volunteer to participate in this study, you are agreeing to respond to the questionnaire listed on a web-site established specifically for this purpose.

2) When you agree to be involved in this study and after reviewing this consent form, you simply click on the “I agree” button, below. If you do not want to participate, you can choose the “I do not agree” button.

3) If you click the “I agree” button, you can connect to the survey for this study, and all you need to do is click the “Send” button after completing the survey.

3a: Benefits to the Teachers:

Participating in this study may allow teachers to become more aware of their self-efficacy regarding teaching science to kindergarten children. Also, teachers will gain a better understanding of teaching strategies to improve self-efficacy in early childhood, science education.

3b: Potential Benefits to Society in General:

<Benefits to pedagogical settings>

The results of this study should indicate what factors which influence teachers’ self-efficacy with regard to teaching science in kindergarten. The results of this study should benefit educators and policy makers with respect to preparing teachers during their educations by inspiring and improving their self-efficacy with respect to instructing science subjects in kindergartens in Korea and around the world.

4. Duration of the Procedures and Study:

The actual time necessary to respond to the survey questions is estimated to be less than 20 minutes.

5. Statement of Confidentiality:

- The survey doesn't ask for any information that could identify you.

- Confidentiality will be maintained to the degree permitted by the technology used. Specifically, no guarantees can be made regarding the interception of data sent via the Internet by any third parties.

- The participants' responses will be sent to the principal investigator only via Penn State webmail. In addition, the principal investigator will change the password of Penn State webmail twice a week for security.

6. Right to Ask Questions:

If you have any questions about this research and /or your participation in it, please contact: Yang Eun Kim.

7. Voluntary Participation:

The participants of this study must be 18 years of age or older.

Your participation in this study is voluntary. You may withdraw from this project at any time by ceasing to answer the questions in the web survey. You may refuse to answer the questions on the web survey at anytime. If you do not click the "Send" button, those questions already answered will not be recorded.

- If you consent to participate in this research study and to the terms above, please click the "I agree" button, below.

- Please keep this form for your records.

I agree **I don't agree**

<Appendix B-2>

Informed Consent Form

연구참가 동의서

펜실베니아 주립대학

연구주제: 유아교육 기관 교사의 과학교수 효능감에 관한 연구

제 1 연구자: 김양은

425Waupelani Dr. #320
State College, PA 16801
Email: yuk120@psu.edu
Phone: 814-880-6799

지도교수: Dr. Thomas D. Yawkey

165 Chambers Building,
University Park, PA 16802
Email: tdy1@psu.edu
Phone: 814-863-2937

1. 연구의 목적:

이 연구의 목적은 유아교육기관에 근무하는 교사들의 과학교수 효능감에 어떤 내외적 요소가 영향을 미치는지 알아보고자 하는 연구입니다.

2. 연구절차:

i. 귀하께서 유치원 교사 자격으로 이 연구참가에 동의하시면 본 질문지에 응답하시는 것에 동의하게 됩니다.

ii. 귀하께서 본 연구의 취지를 이해하고, 연구에 참여하시기를 동의하신다면, 아래에 있는 "동의합니다" 버튼을 눌러주십시오. 만약 이 연구에 참여하시길 원하지 않으신다면 "동의하지 않습니다" 버튼을 누르시면 됩니다.

iii. "동의합니다" 버튼을 누르시면, 질문지 화면으로 연결됩니다. 질문지를 작성하신 후에는 "보내기" 버튼을 누르시면 됩니다.

3a. 귀하께 해당하는 유익함:

이 연구를 통해 현재 유아교육 기관 교사들의 과학교수 효능감에 관해 더 많은 지식을 가질 수 있을 것입니다. 또한, 유아과학교육 시 자기효능감을 향상시키기 위한 교수 전략에 관한 이해를 기대하실 수 있습니다.

3b. 사회에 공헌되는 유익함:

이 연구를 통해 유아교육 기관 현장에 있는 교사들의 과학교수 효능감에 영향을 미치는 요소를 파악해, 교사의 자기효능감을 고취시키기 위한 교사교육 프로그램을 발달시키는데 도움을 줄 것입니다.

4. 연구절차에 걸리는 시간:

이 질문지를 마치시는데 20 분 미만이 소요될 것입니다.

5. 신뢰성 진술:

- 이 질문지는 귀하의 신상에 관한 질문을 포함하고 있지 않습니다.
- 귀하의 연구에 관한 기밀은 테크날리지 이용에 의해 허용된 수준으로 유지될 것입니다. 특별히, 인터넷을 통해 이뤄지므로 데이터 전송에 관해 장애가 있을 수도 있습니다.
- 참가자의 응답내용은 연구자의 펜스테잇 메일로만 전송될 것이며, 연구자는 보안을 위해 일주일에 2 번 펜스테잇 메일의 암호를 교체할 것입니다.

6. 문의에 관한 참가자의 권리:

이 연구 또는 연구참가에 관한 질문이 있으시면 제 1 연구자, 김양은에게 연락하시면 됩니다.

7. 자원 참가:

이 연구는 18 세 이상의 성인이 자발적인 참여에 의해 이루어지는 것입니다. 만약 귀하께서 이 연구참가를 거부하시고자 한다면, 언제든지 질문지 작성을 중단하셔도 됩니다. 또한, 질문지 작성 이후에 "보내기" 버튼을 누르시지 않는다면, 귀하께서 작성하신 모든 질문 내용은 저장되지 않습니다.

- 위의 약관에 동의하시며, 이 연구의 참가를 동의하시면 "동의합니다" 버튼을 눌러주십시오.

- 연구 참가를 증명하기 위해 본 동의서를 간직하시기 바랍니다.

동의합니다　　　　　　　동의하지 않습니다

<Appendix C-1>

Survey Context

Part I

1. Do you have a degree in Early Childhood Education (ECE) or related program?

   Yes ______ No ______

2. Please indicate all your current certifications as a teacher of 3-5 years old children.

   ① 1st degree kindergarten teacher

   ② 2nd degree kindergarten teacher

   ③ public kindergarten teacher

   ④ 1st degree daycare center teacher

   ⑤ 2nd degree daycare center teacher

   ⑥ President of kindergarten

   ⑦ President of daycare center

3. Please indicate your current responsibilities as a early childhood education center teacher:

   1) I teach only a specific subject at a given time and date.
      (e.g. Physical exercise, English, Music, etc.)

   2) I teach all subjects including science as a full time teacher.

4. Please indicate your current position in a early childhood education center :

   1) I am a full time in-service teacher working at least 5 days per week and for one or more years.

   2) I am a full time in-service teacher working at least 5 days per week for less than one year.

   3) I am a part-time in-service teacher and have worked for one or more years.

   4) I am a part-time in-service teacher and have worked less than one year.

Part II

Directions: Please check or write out the appropriate response to items 1 through 26.

1. Years of teaching experience:____________years ___________month_____________

2. Grade target of teaching: ① Age 3 ② Age 4 ③ Age 5 ④ Other

3. Type of kindergarten:

① Private kindergarten
② Public kindergarten
③ University lab kindergarten
④ Private daycare center
⑤ Public daycare center
⑥ Corporation daycare center
⑦ Other

4. Location of kindergarten:

① Rural area ② Suburban area ③ Urban area ④ Capital city

5. How much is your salary? :____________ won

Are you satisfied with your salary?

① Strongly unsatisfied
② Unsatisfied
③ Moderate
④ Satisfied
⑤ Strongly satisfied

6. Mark in order which subject is the most importance in your opinion, and the longest time you taught in your real class.

Education Area	Importance in Early Childhood Education	Teaching portion in Your Early Childhood Education Center
Language		
Mathematic		
Drawing/ Making		
Social Life		
Music		
Physical Exercise		
Science Activity		
Etc.		

7 .How much time do you prepare to teach science in a day?

:____________Minute

8. How much time do you teach science in your class?

:____________Minute

9. Evaluate Early Childhood Science Education Program or Curriculum in your early childhood education center.

①Strongly unsatisfied with the current curriculum of Early Childhood Science Education

②Unsatisfied with the current curriculum of Early Childhood Science Education

③Satisfied with the current curriculum of Early Childhood Science Education.

④Strongly Satisfied with the current curriculum of Early Childhood Science Education.

⑤Uncertain

10. Experience with in-service teacher education for early childhood science education within past 5 years.

For the answer of question #10, these categories are defined as follows;

Self Study (e.g. study by self, group study, discussion or meeting with other teachers, study through books, internet, multimedia sources)
Conference and Workshop (e.g. program is held by scientific association of early childhood education)
Teacher Education Program (e.g. the program is held by educational institutions including educational toy company or teaching material company.)
University Coursework (e.g. taking a course for early childhood science education at university. If you are a student taking a class related to early childhood science education, it will be applicable to here.)

Self-study : ___________ hours per 1 year (the average within 5 years)
Conferences & Workshop: __________hours per 1 year (the average within 5 years)
Teacher training programs:_____________hours per 1 year (the average within 5 years)
University Coursework:____________ hours per 1 year (the average within 5 years)
Other (Specify):___________hours per 1 year (the average within 5 years)

11. The level of satisfaction with in-service teacher education program which you completed for Early Childhood Science Education.

① Strongly unsatisfied
② Unsatisfied
③ Moderate
④ Satisfied
⑤ Strongly satisfied

12. The cycle of change in Science Section in your class.

① once per semester

② once per month

③ once per week

④ once per year

⑤ depends on teacher's need

⑥ depends on children's interests

13. Do you have a science related hobby?

① Yes (specify:)

② No

14. How many books did you buy within past 3 years?

: __________________

15. Experience in pre-service teacher education for early childhood science education

: ___________________ Number of class

16. Class size: __________________ Ratio of teachers to students

17. Parents' attitude toward Early Childhood Science Education

① Science is never taught in my class.

② Science is not a very important subject in Early Childhood Education.

③ Science is a moderately important subject in Early Childhood Education.

④ Science is a more or less important subject in Early Childhood Education

⑤ Science is the most important subject in Early Childhood Education

18. Teachers' attitude toward teaching science:

①Strongly dislike teaching science as compared to other subjects

②Dislike teaching science as compared to other subjects

③Moderately dislike teaching science as compared to other subjects

④Like teaching science as compared to other subjects

⑤Strongly like teaching science as compared to other subjects

19. Children's interests in science.

① Strongly dislike learning science as compared to other subjects

② Dislike learning science as compared to other subjects

③ Moderately learning science as compared to other subjects

④ Like learning science as compared to other subjects

⑤ Strongly like learning science as compared to other subjects

20. Importance of Early Childhood Science Education

① Strongly dislike their children's learning science as compared to other subjects

② Dislike their children's learning science as compared to other subjects

③ Moderately dislike their children's learning science as compared to other subjects

④ Like their children's learning science as compared to other subjects

⑤ Strongly like their children's learning science as compared to other subjects

21. You are qualified to teach Early Childhood Science Education?

① Strongly disagree

② Disagree

③ Moderate

④ Agree

⑤ Strongly agree

22. Please indicate the degree to which you agree or disagree with each question below.

1=Strongly Disagree

2=Disagree

3=Moderate

4=Agree

5=Strongly Agree

22-1 Your current kindergarten/daycare center gives opportunities to attend in service teacher education programs for Early Childhood Science Education?

22-2 Your current kindergarten/daycare center gives opportunities to interact and cooperate with other teachers for Early Childhood Science Education?

22-3 Your current kindergarten/daycare center provides support materials and gives full preparation time to teachers for Early Childhood Science Education?

23. Please evaluate the degree to which you agree or disagree with the effectiveness of each item for better teaching science.

1=Strongly disagree

2=Disagree

3=Moderate

4=Agree

5=Strongly Agree

23-1 Pre service teacher education

23-2 Internship program of pre service teacher

23-3 In service teacher education

23-4 Observation of other teachers' teaching

23-5 Understanding of teaching subject

23-6 Experience of teaching subject

23-7 Advice or evaluation about my teaching

23-8 Emotional and material supports for teaching from kindergarten/daycare center

24. Evaluate the educational quality of your kindergarten or daycare center.

① seriously low compared to other kindergartens/daycare centers

② low compared to other kindergartens/daycare centers

③ Moderate

④ high compared to other kindergartens/daycare centers

⑤ very high compared to other kindergartens/daycare centers

25. Evaluate your satisfaction with your working environment.

① Strongly unsatisfied

② Unsatisfied

③ Moderate

④ Satisfied

⑤ Strongly satisfied

26. Teacher's highest educational level:

① Teacher Education Program for Daycare Center Teacher

② Junior College Education

③ Bachelor's Degree in ECE related program

④ Master's Degree in ECE related program

⑤Doctoral Degree

Part III STEBI-A (Used with permission from Riggs and Enchos)

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate letters to the right of each statement.

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

1. When a student does better than usual in science, it is often because the teacher exerted a little extra effort.
2. I am continually finding better ways to teach science.
3. Even when I try very hard, I don’t teach science as well as I do most subjects.
4. When the science grades of students improve, it is most often due to their teacher having found a more effectively teaching approach.
5. I know the steps necessary to teach science concepts effectively.
6. I am not very effective in monitoring science experiments.
7. If students are underachieving in science, it is most likely due to ineffective science teaching.
8. I generally teach science ineffectively.
9. The inadequacy of a student’s science background can be overcome by good teaching.
10. The low science achievement of some students cannot generally be blamed on their teachers.
11. When a low achieving child progresses in science, it is usually due to extra attention given by the teacher.
12. I understand science concepts well enough to be effective in teaching kindergarten science
13. Increased effort in science teaching produces little change in some students’ science achievement.
14. The teacher is generally responsible for the achievement of student in science.
15. Students’ achievement in science is directly related to their teacher’s effectiveness in science teaching.

16. If parents comment that their child is slowing more interest in science at school, it is probably due to the performance of the child’s teacher.
17. I find it difficult to explain to students why science experiments work.
18. I am typically able to answer students’ science questions.
19. I wonder if I have the necessary skills to teach science.
20. Effectiveness in science teaching has little influence on the achievement of students with low motivation.
21. Given a choice, I would not invite the principal to evaluate my science teaching.
22. When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better.
23. When teaching science, I usually welcome student questions.
24. I don’t know what to do to turn students on to science.
25. Even teachers with good science teaching abilities cannot help some kids learn science.

Send

<Appendix C[-2]>

Survey Context

본 질문지는 응답자의 내외적 환경요소를 알기위한 질문들(Part I, II)과 과학교수 효능감에 관한 질문들(Part III) 로 구성되어있습니다.

Part I.

1. 대학(원)에서 유아교육 및 이에 관련된 학과의 교육과정을 이수하였습니까?

   ○ 예　　○ 아니오

2. 선생님께서 소지하고 계신 모든 자격(증)을 표기해 주십시오. 이 문항은 **중복 응답이 가능합니다.**

   □ 1급 유치원 정교사 자격증　　□ 2급 유치원 정교사 자격증

   □ 초등학교 부설 병설 유치원 교사 자격

   □ 1급 보육교사 자격증　　□ 2급 보육교사 자격증

   □ 유치원 시설장 자격　　□ 어린이집 시설장 자격

3. 다음에 해당되는 한 곳에 표기해 주십시오.

   ○ 나는 유아교육 기관에 근무하는 교사로서 정해진 시간이나 요일에 특정과목만을 가르치는 교사이다.
   (예> 영어, 체육, 피아노, 바이올린, 미술 등 특정 교과목만 담당)

   ○ 나는 같은 유아교육 기관에서 주 5일 이상 근무하며, 유아교육 교과 대부분을 가르치는 교사이다.

4. 다음에 해당되는 한 곳에 표기해 주십시오.

- ◯ 유아교육 기관에서 주 5일 이상 근무하는 full-time 교사로서, 1년 이상의 교사 경험이 있다.
- ◯ 유아교육 기관에서 주 5일 이상 근무하는 full-time 교사로서, 1년 미만 교사 경험이 있다.
- ◯ 1년 이상의 유아교육 기관 교사 경험은 있으나, 특정 시간만 근무하는 part-time 교사이다.
- ◯ 1년 미만의 유아교육 기관 현장경험이 있으나, 특정 시간만 근무하는 part-time 교사이다.

Part II.

1. 교사 경력을 기재해 주십시오.

   [ ]년 [ ]개월

2. 현재 가르치고 있는 유아의 연령을 표기해 주십시오.

   ◯ 만 3세 ◯ 만 4세 ◯ 만 5세 ◯ 기타

3. 현재 근무하고 있는 유아교육 기관은 어디에 해당되는지 표기해 주십시오.

   ◯ 사립유치원 ◯ 국.공립 유치원

   ◯ 대학부설 및 대학원 산하의 유치원

   ◯ 사립(민간) 어린이집 ◯ 국.공립 어린이집

   ◯ 직장 및 법인시설에서 운영하는 어린이집 ◯ 기타

4. 현재 근무하고 있는 유아교육 기관은 어느곳에 위치하고 있는지 표기해 주십시오.

○ 소 도시 (군, 읍 포함) ○ 수도권 소재 중,소도시

○ 광역시 ○ 특별시

5. 현재 선생님의 월급과 그 월급수준에 대한 만족도를 표기해 주십시오.

[ ] 만원

○ 매우 불만 ○ 대체로 불만 ○ 보통 ○ 대체로 만족 ○ 매우 만족

6. 유아교육 교과 과정 중 가장 중요하다고 생각하는 영역과 현재 교육현장에서의 비중을 1, 2, 3..순서대로 표기해주십시오.

영역	아교육 과정에서 중요하다고 생각하는 순서	하루 일과 중 차지하는 비중
언어(읽기, 쓰기, 말하기)	[ ]	[ ]
산수	[ ]	[ ]
그리기/꾸미기	[ ]	[ ]
사회생활	[ ]	[ ]
음악	[ ]	[ ]
체육/율동	[ ]	[ ]
발표/표현하기	[ ]	[ ]
과학 (관찰, 야외학습)	[ ]	[ ]
기타	[ ]	[ ]

7. 선생님께서 하루에 유아과학 수업을 위해 준비하는 시간은 어느 정도

입니까? [　　　]분

8. 현재 선생님이 근무하시는 교육기관의 하루일과 중 유아과학 수업은 어느

정도 입니까? [　　　]분

9. 현재 선생님의 교육기관에서 운영되고 있는 유아 과학교육 커리큘럼 및 과학 교과운영수준을 평가해 주십시오.

○ 과학 교과운영 및 커리큘럼이 현 유아의 수준에 맞지 않으므로, 전반적인 개선이 필요하다고 생각한다. (구체적으로 [　　　])

○ 현재의 과학 교과운영 및 커리큘럼에 대해 어느정도 보안해야 할 필요성을 느낀다. (구체적으로 [　　　])

○ 현재 운영되고 있는 과학 교과운영과 커리큘럼에 다소 만족한다.

○ 현재 운영되고 있는 과학 교과운영과 커리큘럼에 매우 만족한다.

○ 잘 모르겠다.

10. 과학과목을 가르치기 위해 교사가 받은 교사교육 경험에 관한 질문입니다. 아래에 있는 참고표를 이용하여, 최근 5 년동안의 경험을 바탕으로 응답해 주십시오. **이 문항은 복수 응답이 가능합니다. 해당되는 모든곳에 표기해 주시기 바랍니다.**

☐ 유아과학 교육을 위해 **자가 학습**을 1 년에 [　　　]시간 정도 하고 있다.

☐ 유아과학 교육을 위해 관련 학술단체에서 시행하는 **학술대회**를 1 년에 1 년에 [　　　]시간 정도 참여하고 있다.

☐ 유아과학 교육을 위해 **교사교육 프로그램**에 1 년에 1 년에 ____시간 정도 참여하고 있다.

☐ 유아과학 교육을 위해 **대학(원)에서 개설하는 교과과정**을 1 년에

교과과정을 1 년에 ____시간 정도 참여하고 있다.

☐ 그 외에 유아과학 교육 교수를 위해서 하고 있는 활동이 있다면 기재해

주시기 바랍니다. ____(1 년에 ____시간 정도)

참고

<u>과학 수업을 위한 자가학습</u>: 유아과학 수업을 위해 자유시간에 스스로 수업 준비 및 공부를 하는 것. 그룹을 만들어 토론활동을 하거나, 과학수업을 위한 교사회의, 책, 각종매체, 인터넷 등을 이용해 과학수업을 위한 지식을 쌓는것을 포함함.

<u>과학 수업을 위한 학술대회</u>: 유아과학 수업을 위해 학술단체(예: 유아교육학회, 아동학회.) 등에서 개최하는 단기 학술대회에 참석하는것.

<u>과학 수업을 위한 교사교육 프로그램</u>: 유아과학 수업을 위해 시, 도, 교육청에서 개최하는 교사교육 프로그램을 비롯하여, 교재 및 교구를 판매하는 회사에서 개최하는 각종 교사교육 프로그램에 참석하는 것.

<u>과학 수업을 위한 교육기관(대학 및 대학원) 부설 프로그램</u>: 대학(원)에서 개설하는 과학교육 관련 강좌를 신청하여 수강하는 것. 현재 학생 신분으로 유아과학 관련 수업을 듣고 있는 경우에도 해당함.

11. 유아과학 교육에 관련된 연수 프로그램을 이수한 후, 유치원 현장에서 그 내용을 적용할 때 만족수준을 표기해주십시오.

○ 매우 불만족 ○ 대체로 불만 ○ 보통 ○ 대체로 만족 ○ 매우 만족

12. 과학코너의 교재, 교구 변화 주기는 어느정도 인지 표기해 주십시오.

- 매학기마다 변화
- 월별로 변화
- 주별로 변화
- 필요에 따라 수시 변화
- 아동의 흥미에 따라 수시 변화
- 학기초에 준비된 재료를 1년 동안 계속 전시

13. 취미활동 중 과학관련 활동이 있으면 기재해 주십시오.

- 있다 ( )
- 없다

14. 최근 3년내 과학관련 도서 구입 정도를 기재해 주십시오. 권

15. 교사가 되기전, 유아과학 교육에 해당하는 과목을 수강한 과목수를 기재해 주십시오. 과목

16. 현재 가르치고 있는 교실의 유아 수와 교사 수를 기재해 주십시오.

유아 명, 교사 명

17. 유아교육에서 과학교육은 어느 정도 중요하다고 생각하시는지 표기해 주십시오.

- 전혀 다루지 않는다
- 별로 중요하지 않다
- 보통이다
- 중요하다
- 가장 중요하다

18. 유아 교육기관 현장에서 다른 과목에 비해 과학을 가르치는 것을 어느정도 선호하시는지 표기해 주십시오.

- 다른과목에 비해 전혀 선호하지 않는 편
- 다른과목에 비해 별로 선호하지 않는 편
- 보통
- 다른 과목에 비해 대체로 선호하는 편
- 다른 과목에 비해 매우 선호하는 편

19. 유아가 느끼는 과학에 대한 흥미도는 어느 정도라고 생각하십니까?

- 다른과목에 비해 전혀 선호하지 않는 편
- 다른과목에 비해 별로 선호하지 않는 편
- 보통
- 다른 과목에 비해 대체로 선호하는 편
- 다른 과목에 비해 매우 선호하는 편

20. 부모가 느끼는 유아과학에 대한 중요도는 어느 정도라고 생각하십니까?

- 다른과목에 비해 전혀 중요하게 생각하지 않는 편
- 다른과목에 비해 별로 중요하게 생각하지 않는 편
- 보통
- 다른과목에 비해 대체로 중요하게 생각하는 편
- 다른과목에 비해 매우 중요하게 생각하는 편

21. 본인이 유아 과학을 가르치는데 있어 잘 준비되어 있는 교사라고 생각하십니까?

- 전혀 그렇지 않다
- 그렇지 않은 편이다
- 보통이다
- 그런 편이다
- 매우 그렇다

22. 선생님의 유아과학 수업을 위해, 현 교육기관에서 어느정도 지원을 받고 있는지 알고자 하는 문항입니다. 아래 내용을 참고하셔서, 해당되는 한 곳에 표기해 주십시오.

A. **전혀 그렇지 않다**
B. **그렇지 않은 편이다**
C. **보통이다**
D. **그런 편이다**
E. **매우 그렇다**

		1	2	3	4	5
1	현 기관에서 유아과학 수업을 위해 교사교육에 참여할 기회를 충분히 주고 있다고 생각하십니까?	○	○	○	○	○
2	현 기관에서 유아과학 수업을 위해 교사간 상호 교류가 충분히 이뤄지고 있다고 생각하십니까?	○	○	○	○	○
3	현 기관에서 유아과학수업을 위해 자료 준비에 필요한 물질적, 시간적 투자가 충분히 이뤄지고 있다고 생각하십니까?	○	○	○	○	○

23. 보다 좋은 유아과학 수업을 계획함에 있어서, 다음 항목이 어느정도 유용할 것이라 생각하는지 평가해 주십시오.

F. **전혀 유용하지 않다**
G. **유용하지 않은 편이다**
H. **보통이다**
I. **유용한 편이다**
J. **매우 유용하다**

	항목	1	2	3	4	5
1	교사가 되기 전 교육기관(대학, 대학원, 보육교사 교육원)에서의 학습경험	○	○	○	○	○
2	예비 교사 인턴쉽 (교육실습)	○	○	○	○	○
3	교사 교육 프로그램 참가	○	○	○	○	○
4	동료 교사나 선배 교사의 수업 현장 참관을 통한 간접 경험	○	○	○	○	○
5	교과 내용 및 교수 전략에 대한 이해	○	○	○	○	○
6	교과 내용을 가르쳐본 경험	○	○	○	○	○
7	본인의 수업에 대한 동료나 선배교사의 평가 및 조언	○	○	○	○	○
8	교사의 수업에 대한 기관 및 학부모의 정서적, 물질적 지지	○	○	○	○	○

24. 선생님의 현재 근무환경에 대한 질적 수준은 어느 정도인지 표기해 주십시오.

- 타 유아교육 기관에 비해 질적 수준이 매우 낮음
- 타 유아교육 기관에 비해 질적 수준이 대체로 낮은 편
- 보통
- 타 유아교육 기관에 비해 질적 수준이 대체로 높음
- 타 유아교육 기관에 비해 질적 수준이 매우 높음

25. 선생님의 현재 근무환경에 대한 만족도를 표기해 주십시오.

- 매우 불만족
- 대체로 불만족
- 보통
- 대체로 만족
- 매우 만족

26. 귀하의 최종 학력을 표기해 주십시오.

- 보육교사 교육원
- 전문대학
- 4 년제 대학
- 석사 재학 중이거나 석사학위 소지
- 박사 재학중이거나 박사학위 소지

Part III. **유아과학 수업 시 교수 효능감 측정 척도**

아래의 각 문항을 읽고 어느정도 수준으로 동의, 혹은 동의하지 않으시는지 응답해 주시기 바랍니다. 각 문항에 대한 동의의 수준은 다음과 같이 규정합니다.

A. 전혀 동의하지 않음
B. 동의하지 않는 편
C. 보통
D. 동의하는 편
E. 매우 동의

	내가 유치원 현장에서 유아에게 과학을 가르칠 때,	1	2	3	4	5
1	유아가 평소보다 더 나은 과학활동을 한다면, 그것은 내가 그 수업을 위해 더 노력을 했기 때문이다.	○	○	○	○	○
2	나는 지속적으로 보다 더 나은 과학 교수 방법을 찾고 있다.	○	○	○	○	○
3	내가 열심히 노력하고 있음에도 불구하고, 다른 과목들을 가르치는 것만큼 과학과목을 잘 가르치고 있지 않다.	○	○	○	○	○
4	유아의 과학적 수준이 향상되었다면, 대개 교사가 보다 더 효과적인 과학 수업 접근 방법을 발견했기 때문이다.	○	○	○	○	○
5	나는 과학 개념들을 효율적으로 가르치는데 필요한 과정을 알고 있다.	○	○	○	○	○
6	나는 과학 실험을 조절하고 감시하는 모니터링 능력이 부족하다.	○	○	○	○	○
7	만약 유아들이 과학수업에서 기대 이하의 성과를 나타낸다면, 그것은 교사가 과학을 효과적으로 가르치고 있지 못해서이다.	○	○	○	○	○
8	나는 일반적으로 과학을 비효율적으로 가르치고 있다.	○	○	○	○	○
9	유아의 기초적 과학지식 부족은 현재 그 유아를 담당하고 있는 교사의 좋은 가르침에 의해 극복될 수 있다.	○	○	○	○	○
10	일부 유아들이 과학수업에서 낮은 성취결과를 보였을때, 그 책임이 교사에게 있는 것은 아니다.	○	○	○	○	○
11	학습에 있어 또래에 비해 낮은 수준의 성취정도를 보이는 유아과 과학수업에 진전을 보인다면, 이것은 교사가 그 아이에게 특별한 주의를 기울였기 때문이다.	○	○	○	○	○

12	나는 유아 과학을 효율적으로 가르칠 수 있을 만큼 과학적 개념들을 충분히 잘 이해하고 있다.	○	○	○	○	○
13	교사가 과학수업을 위해 더 많은 노력을 함에도 불구하고, 일부 유아들의 과학 수준 향상에 전혀 변화를 일의키지 못하기도 한다.	○	○	○	○	○
14	교사는 일반적으로 유아의 과학 학습에 관한 학업성취 및 그 결과에 대해 책임이 있다.	○	○	○	○	○
15	유아의 과학에 대한 성취정도는 교사의 과학 교수의 효율성과 직접적으로 관련이 있다.	○	○	○	○	○
16	만약 유아의 부모들이 그들의 자녀가 유치원 과학수업에 점점 더 많은 흥미를 보이고 있다고 얘기한다면, 그것은 아마도 그 유아를 담당하고 있는 교사의 수행 및 성취에 의한것이다.	○	○	○	○	○
17	나는 유아들에게 과학 실험이 왜 그렇게 진행되는지에 관해 설명하는 것이 어렵다.	○	○	○	○	○
18	나는 유아가 묻는 대부분의 과학적 질문에 대답할 수 있다.	○	○	○	○	○
19	나는 내가 과학을 가르치는데 필수적인 기술을 충분히 가지고 있는지 고민하곤 한다.	○	○	○	○	○
20	교사가 과학수업을 효율적으로 잘 가르치는 것이 과학수업에 열의가 낮은 유아의 과학성취에는 거의 그 영향을 미치지 않는다.	○	○	○	○	○
21	선택할 수 있다면, 나는 유치원 원장님이 나의 과학수업을 평가하는데 초대하고 싶지 않다.	○	○	○	○	○
22	어떤 유아가 과학 개념을 이해하는데 어려움을 겪고 있을때, 나는 대개 그 유아가 그 개념을 보다 잘 이해하도록 돕는데 있어 어찌할 바를 몰라 당황한다.	○	○	○	○	○
23	과학수업시, 나는 유아들이 질문을 하는 것을 좋아한다.	○	○	○	○	○
24	나는 유아가 과학에 흥미를 가지게 하기 위해 무엇을 해야하는지 모른다.	○	○	○	○	○
25	훌륭한 과학교수 능력을 가진 교사라 할지라도, 몇몇의 일부 유아들의 과학학습에 도움을 줄 수 없기도 한다.	○	○	○	○	○

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Publications

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Kim, Yeon Ha, Jung, Min Ja, & Kim, Yang Eun (2004). A study on the Formation of Parental Beliefs of the Unmarried: Focus on the Internal Representation of Childhood and Communication of One's Parents. *Journal of the Korean Living Science Association, 13*(4), Korean Living Science Association.

Kim, Yang Eun, & Cho, Bok Hee (2002). A Study of the Self-awareness of Infants. *Journal of Korean Association of Child Studies, 23* (2). Korean Association of Child Studies.

Presentations

Kim, Yeon Ha, Jung, Min Ja, & Kim, Yang Eun (2007). *Yong Unmarried Adults' Experiences in the Family of Origin and Preferred Adult-Child Interaction Style*. Poster Presented at Society Research of Child Development.

Kim, Yang Eun (2005). *Teacher Preparation of ECE Teachers for Science Competencies in Korea*. Paper Presented at in Mid-Western Educational Research.

Kim, Yang Eun (2005). *The Effect of Science Context Based Curriculum in Language Development of K-graders*. Paper Presented at Mid-Western Educational Research.

Liu, Wen-Ren, Yawkey, D. T., Lai, Ting-Ling, Tseng, Hsia-Yen, & Kim, Yang Eun (2004).
Teachers Perceptions of ESL Programs: The Effects of In-Service Teacher Training Programs. Paper Presented at Mid-Western Educational Research.